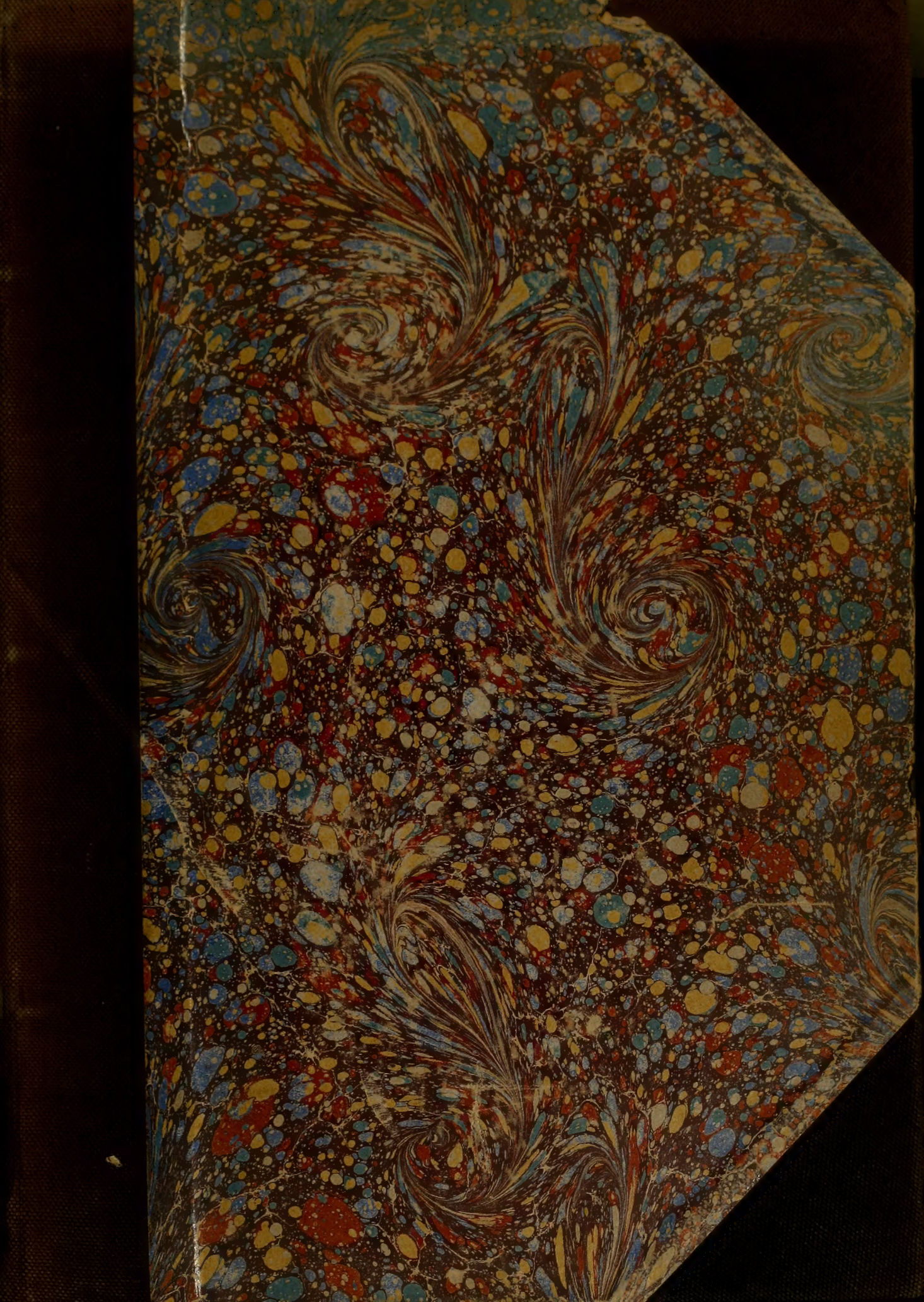

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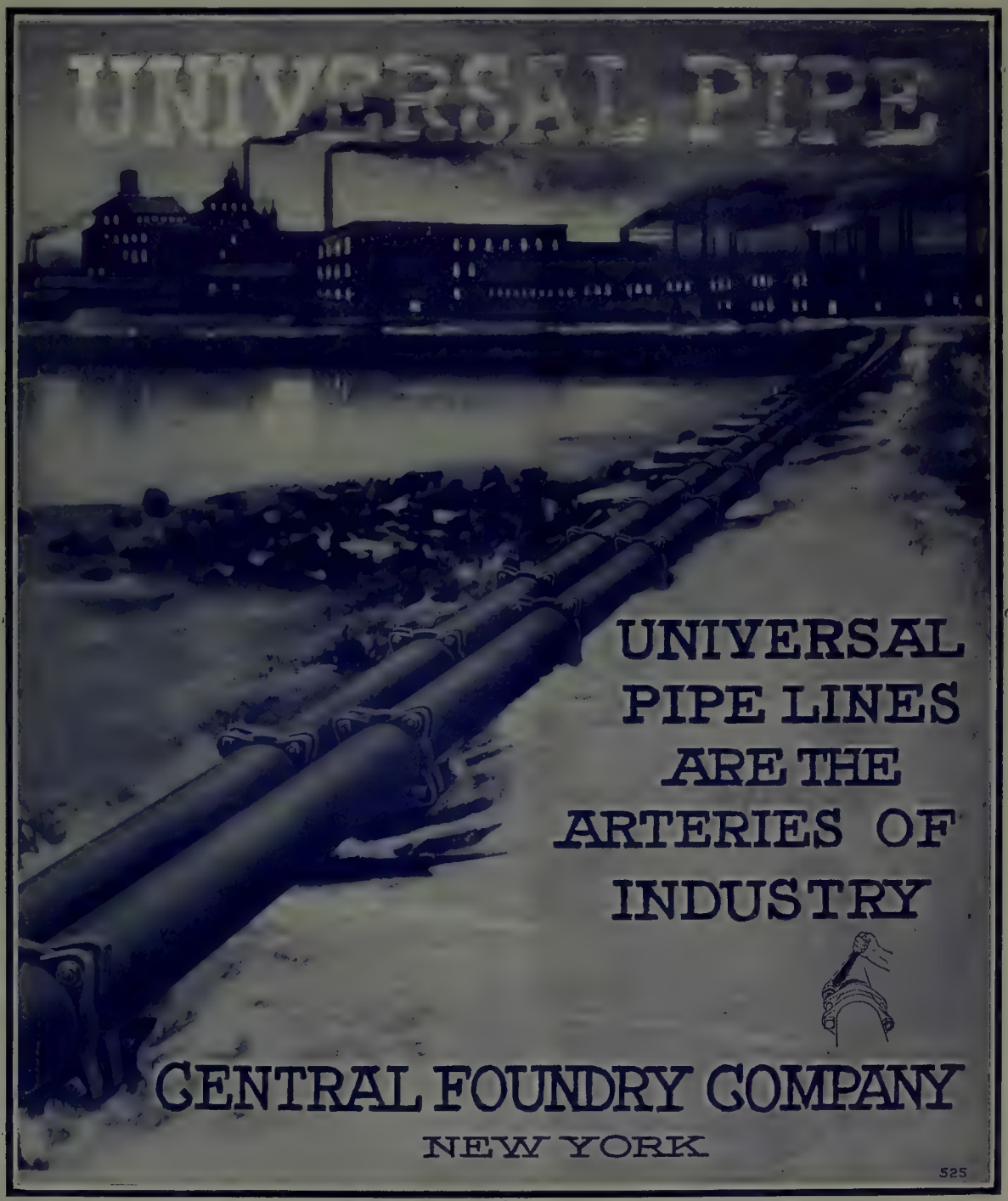

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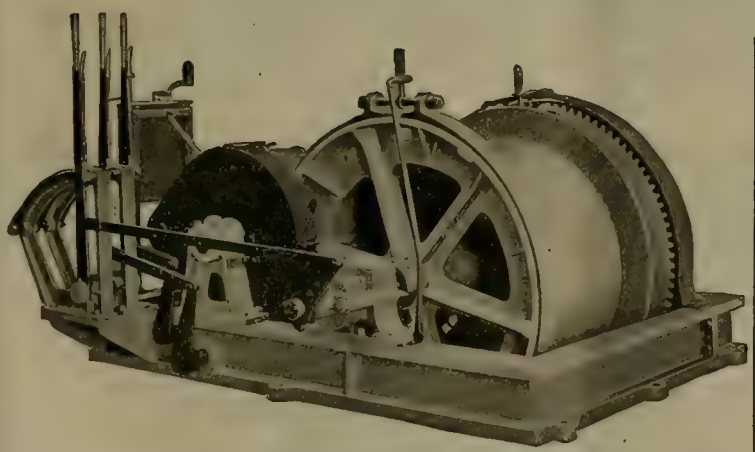

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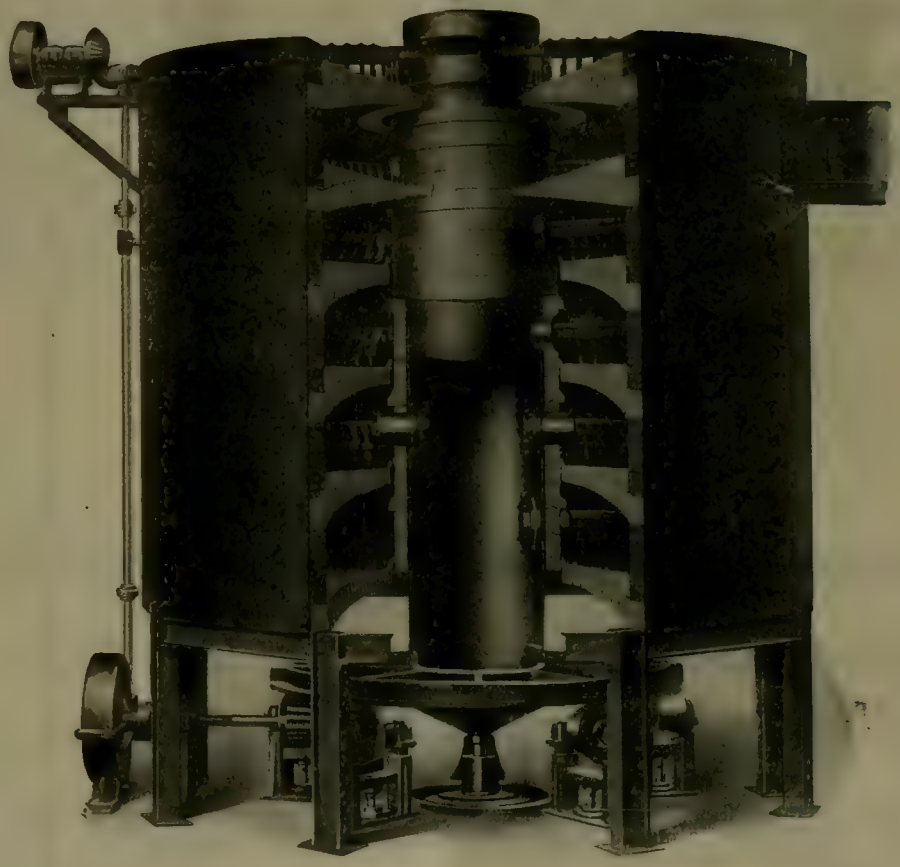

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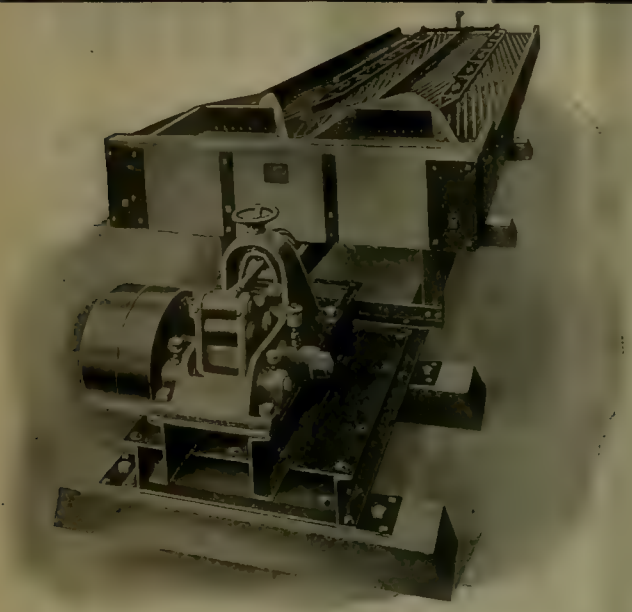

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THREADING "NATIONAL" PIPE

Advantages of Uniformity

¶ Uniformity of any material contributes largely to successful manipulation. For instance: cross-grained, gnarled or knotty wood cannot be properly carved, for it will split or ravel on a sharp edge. This is analogous to steel or other metal. If metal is not uniform, it may be either too brittle or too soft in places, and thus make a poor thread.

¶ It will be conceded that the first requirement to make the result of any process successful is good material, therefore to obtain a good thread the metal must be in the first place uniform. Next, and equally important, the tools must be competent to do the work.

Good Threads Essential

¶ A great deal of difficulty has been experienced in threading pipe, and it is certain that the dies in use are frequently inadequate in construction and ineffectual in results. Practically all pipe must be threaded, therefore dies which produce clean, smoothly cut threads will interest every user of pipe. With the improved form of die (see Fig. 1A), steel is threaded (either by machinery or hand stocks), just as rapidly as iron.

Constituents of a Proper Die

¶ A good die consists of a frame or holder and a set of chasers, all arranged with consideration for the following points.

Lip—Chip Space—Clearance—Lead—Number of Chasers

Lip

¶ **LIP**, also known as hook or rake, is the inclination of the cutting edge of the chaser to the surface of the pipe. Fig. 1A illustrates the chaser of the properly made die. The chips curl off clean and leave a smooth thread. Fig. 1B shows the chaser of an improperly shaped die.

Chip Space

¶ **CHIP SPACE** is the space required in the holder in front of the chaser to allow room for the accumulation of chips. A lack of chip space will cause the chips to clog and tear the threads.

Clearance

¶ **CLEARANCE** is the angle between the threads of the chasers and the threads of the pipe.

Correct Form of Chaser

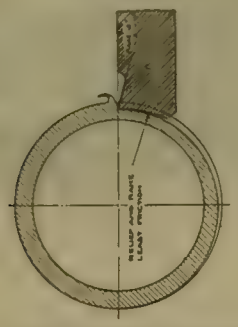

Fig. 1A—Thread Cut with Properly Made Die

Incorrect Form of Chaser

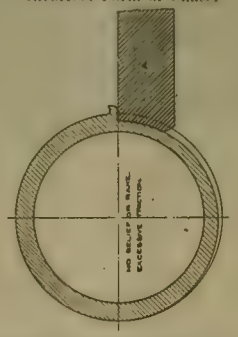

Fig. 1B—Same with Improperly Shaped and Commonly Used Die

Lead

¶ **LEAD** is the angle which is machined or ground on the front of each chaser to enable the die to start on the pipe, and also to distribute the work of making the first cut over a number of threads.

Chasers

¶ **NUMBER OF CHASERS.**—To get good results at one cut, the die should have a suitable number of chasers; the approximate number is determined by the size of the die.

Results of Using Proper Die

¶ A die made with regard to these points by an experienced tool maker will thread both wrought iron and steel pipe with equally good results. Applying these principles to hand dies, it is possible for one man to do the work of two.

¶ In a paper by T. N. Thomson read before the American Society of Heating and Ventilating Engineers in 1906, the author says:

> **"The power required to thread mild steel pipe with the new die is not much more than that required to thread wrought iron with the same die, and much less than the power required to thread wrought iron pipe with the common die."**

¶ This subject is covered more fully in N. T. C. Bulletin No. 6, and we will be glad to send anyone who is interested a copy.

MARKING

¶ To readily identify "NATIONAL" material, and as protection to manufacturer and consumer alike, the practice of National Tube Company is to roll in raised letters of good size on each few feet of every length of welded pipe the name "NATIONAL" (except on the smaller butt-weld sizes, on which this is not mechanically feasible).

Name Rolled in Raised Letters on National Tube Co. Pipe

¶ In addition, all sizes of "NATIONAL" welded pipe below four or five inches are subjected to a roll-knobbling process known as "Spellerizing" to lessen the tendency to corrosion, especially in the form of pitting. This "Spellerizing" process is peculiar to "NATIONAL" Pipe, to which process National Tube Company has exclusive rights.

¶ We have recently issued a booklet, "MODERN WELDED PIPE," which treats of the manufacture, uses and characteristics of tubular products. While this book was not issued for general distribution, we will gladly send a copy to any person whose letterhead or activities would indicate a legitimate use. We will also send on request list No. 5, showing sizes, dimensions, trade customs and specifications.

NATIONAL TUBE COMPANY, PITTSBURGH, PA., U.S.A.

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When establishing designs for our standard light locomotives care was taken to secure efficiency and durability.

They are proportioned so that the severest strains and shocks are met with proper resistance.

No effort is spared in their construction. Every piece must be so accurately made as to fit not only the locomotive of which it is a part, but must fit every other locomotive of the same size and design.

All parts are made in fixtures or to templates, compelling accuracy of manufacture. They are made to go into place without a machine shop.

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"Empire" Gold Dredges

Many of the superiorities of the "Empire" Gold Dredge are evident on even cursory examination, where superiorities of even more vital importance do not appear on the surface.

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These external and internal features of superiority are combined in the "Empire" Gold Dredge in a high-grade, high-duty, gold-saving machine of utmost capacity, utmost endurance, and utmost economy, assuring the realization of maximum profits from any placer property that is "Empire" dredged.

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THE COPPER SMELTER

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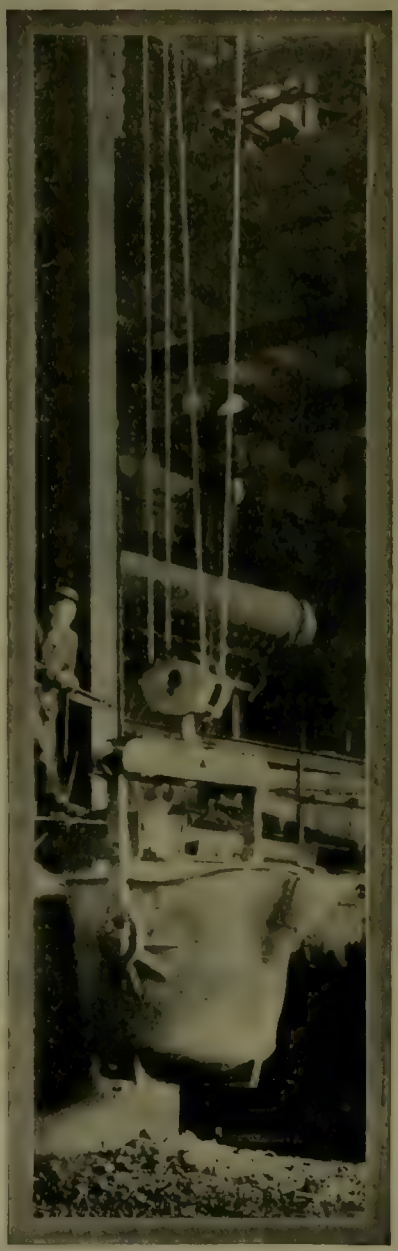
No industrial operation requires greater assurance of continuity of service than copper smelting, none requires more substantial equipment, or more accessible and easily renewable parts; in no plant is faulty equipment so utterly useless.

Long experience and intimate connection with the advances made in copper smelting in the past has given Allis-Chalmers equipment its well deserved reputation for reliability.

Almost every smelter of note contains some Allis-Chalmers equipment: The sampling plant with its crushers, rolls, samplers, screens and accessories, the roasting plant with its McDougall furnaces, the smelting plant with its special water jacket furnaces, the converter plant with the best types of acid- and basic-lined converters, the power plant with its steam, electric or gas actuated blowing engines and complete electrical equipment; all designed and built for the special service required.



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Economy

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Meeting the Requirements of Unusual Conditions in Mining Service

WHILE the "Independence" split wood pulley is primarily a standard stock article, manufactured for ordinary service, there is nothing whatever to prevent its being made to meet the requirements of unusual conditions in mining service.

Some months ago we delivered a number of special split wood pulleys to the United States Reduction and Refining Company, Colorado Springs, Colo., for use on crushing rolls, the iron pulleys originally bought with the machines crystalizing from the vibration and jar on the rolls when large ore went through. The company's superintendent in writing us on the service of these pulleys said:

"We do not believe that there is a better split wood pulley made than the Dodge 'Independence' in meeting the requirements of extra heavy duty."

In the manufacture of special split wood pulleys no sacrifice whatever is made of the advantages of standard construction, nor is there any attempt made to improve upon the standard construction to meet the stresses of extra heavy demands. The rim always remains a structure of wood and glue, made as much thicker than the standard as the service may require. The arms and hubs are made up in the usual "Independence" way, with merely the necessary reinforcement and extra thickness called for by the large bore or other special matters. The arms are dove-tailed and wedged into the rim, as is customary, with standard anchor bolts. The hub and arm bolts which clamp the pulley halves together onto the shaft are suitably increased in size and number.

"Independence" pulleys for service such as that required by reduction and refining companies are special in proportions, yet absolutely standard in their conformity to the well-proved essential details of Dodge wood pulley construction.

If you are looking for a pulley for heavy work it will be well for you to get in touch with us. We are quite sure that we can please you with our "Independence" brand. A snappy little book, "From Log to Line-Shaft," gives a history of the pulley and its use. Perhaps you'd like it. Nothing would please us better than to respond to your request.

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"ADAMANTINE" is our registered Trade Mark. To avoid substitution order by that name.

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EDITORIAL

FOLLOWING the articles on the 'Organization of Smelting Enterprises' printed in April, we publish this week one on 'Building a Reduction Plant,' by Mr. Herbert Lang, who speaks from an experience that lends much weight to his words. This will be followed in turn by some account of the pitfalls that have been met in actual construction by Mr. A. Sydney Additon, with especial reference to the building of plants of moderate size in remote and difficult situations.

BRADEN Copper Company figures attract keen interest in the United States where this great undertaking in Chile is considered the probable forerunner of many profitable enterprises. We print this week the substance of a new report upon the property by Mr. Pope Yeatman, whose general account of the deposit we published December 16, 1911. Mr. Yeatman's revised figures of ore reserves show 44,000,000 tons containing 2.65 per cent copper, as against a previous estimate of 23,000,000 tons at 2.50 per cent. A broker's circular in New York says that this "shows the ease with which tonnage is added at the mine," which just raises the question whether *Life* is to have a rival.

ADVERTISING the results of company meetings is common in England, but is sufficiently unusual in the United States to warrant calling attention to the announcement of the Minerals Separation American Syndicate, Limited, appearing in this issue. In these days when company success depends upon public support, expenditure for publicity is as legitimate as for raw materials. The danger to be guarded against is the placing of paid matter in the reading pages, the disguising of advertisements. That has been a common practice in the United States, though not, we are glad to say, one adopted by technical journals. The day for such misbranding is rapidly passing. The great public service corporations find it better to take paid space and fill it with plain statements of fact, even in newspapers that editorially oppose their policies, than surreptitiously to own weak journals. The public is quick to detect and to discount tainted news. And a reputation for printing it kills the influence and therefore the income of a paper more swiftly than most violent, but evidently honest, partisanship. The advertising pages of a good technical journal afford a medium for reaching an especially thoughtful and influential audience, but to do so effectively the advertiser must have a message of real import and must tell it plainly. To those who have such a message, we extend a welcome.

The Hall Sulphur Process

Copper metallurgists everywhere, but especially in California, will be keenly interested in the Hall process for dealing with the sulphur in smelter fume, with which the First National Copper Company is about to undertake experiments upon a working scale at its smelter at Coram, California. Mr. William A. Hall, who has devised the process, is a graduate of the Massachusetts Institute of Technology, and a chemist of distinction who has made notable successes in the field of industrial chemistry, being a cousin of the chemist of the same name who devised the process for the production of aluminum by electrolysis of bauxite in a fused bath of cryolite. The Hall sulphur process is essentially a controlled oxidation; the sulphide ore being roasted in a specially-constructed furnace in an atmosphere of reducing gases and steam at a temperature between 700 and 900°C. As a result, the metallic bases are oxidized, but the sulphur, owing to the dissociation of the steam, escapes without becoming oxidized and, passing off in the fume in the form of 'flowers of sulphur,' is easily collected. Careful tests made under the direction of Messrs. C. F. Chandler and A. L. Walker, indicate that the chemistry of the new process is sound, Mr. Walker finding that ore containing nearly 40 per cent of sulphur was roasted to a sulphur content of 3 to 5 per cent at a rate which indicates that approximately the same tonnage per square foot of hearth area can be handled in this way as is done in current practice with the ordinary type of McDougall furnace. No data have been made public as to the fuel consumption to maintain this roasting speed, exact information as to this critical point being one of the objects of the large-scale experiments about to be started at Coram. The collection of the sulphur will be done by the aid of the Feld washer, though the possibilities of collection by means of the Cottrell electric precipitation process are also to be tested. The process will at first be applied to the McDougall roasters.

The large question involved is, of course, the disposal of the sulphur to be produced. Application of the process to all the ore and operation at the rate maintained at Balaklala in 1910 will involve the production of about 250 tons of sulphur per day, or somewhat in excess of the present visible market, assuming that the sulphur can be laid down at points of consumption at a price which would enable it to supplant the pyrite now in use, as well as the rather limited amount of Japanese and Louisiana sulphur now being used in California. The estimated cost of sulphur production is placed at $5 per ton at a maximum, at which rate the sulphur would easily be able to dominate the market and perhaps increase consumption, as a lower selling price commonly does. In any case, any financial loss, not to exceed ½ cent per pound of copper produced, for example, incurred in the production of sulphur may properly be charged to the cost of smelting under the conditions obtaining in Shasta county. Under previous conditions of operating at Balaklala, a production cost of 10 cents per pound of copper produced was estimated, though operating difficulties caused it to be somewhat exceeded in practice. The new process, if it proves feasible, will meet fully legislative restrictions, and if the cost of operation proves sufficiently low, will solve the smelter-fume situation as far as the First National is concerned. It is proposed to spend considerable sums on the experimental work, under the direction of Mr. H. F. Wierum, who has had extensive experience with the Tennessee Copper Company, and the prospect of success seems decidedly favorable. But, like the manufacture of sulphuric acid from smelter fume, the process is not one which is of universal application, as its general adoption would at once swamp the market on which dependence is placed for meeting the cost of operation. The foreign rights to the Hall patents have been acquired by the Sulphur Company, Ltd., and the American rights are controlled by the Federal Sulphur Company, Ltd. We wish both companies the fullest measure of success in their efforts to meet a situation trying in the extreme to copper metallurgists throughout the world.

Fourth of July

Once more the 'Glorious Fourth' is with us, and from the great cities of the United States to the borderlands of civilization, bunting is being hung on the outer wall and the American people are joining in the celebration of the Nation's birthday. Other holidays may come and go, but the one red-letter day of the year, the one from which time is dated in the mining camps, is the Fourth of July. It stands out as the oasis in the summer months when the miner can forget for 24 hours the stopes and can devote his entire energies to celebrating. Probably in no other type of community is Independence day more thoroughly celebrated than in the mining camp. Here the festivities are as various as the changes of the kaleidoscope, and the miner gives himself up to recreation which ranges all the way from an over-indulgence in "the cup that clears today of past regrets and future fears," to general picnics with the accompanying liberal garnishing of patriotic sentiment by the camp spellbinder. The nipper and the general manager, united by the ties of patriotism, rub elbows in 'setting-off' fireworks, and on common ground decide questions of superiority in matters of marksmanship and athletics. Outside of the possible barbecue, the features of the day around which the greatest attention centres are the athletic games, which are planned to afford such a variety that everyone may participate regardless of their past performances on the athletic field or prowess in the recognized sports, for near-sports are given a prominent place in the order of the day, and the three-leg race and greased-pig events attract more attention than the 100-yard dash and the hurdles. Then there is the rope-climb, the shot-put, turkey shooting, and many another opportunity for each to shine. And always the band plays its sprightliest.

The feature of the day's program, however, is the drilling contest, as it is this contest that carries with it, if not an olive wreath, at least a purse and a reputation. This is the one contest to which the mining

industry makes claim as its own, and the winning of the drilling contest is to the miner what the Marathon is to the runner, or the roping contest to the cowboy. No one knows how old the hand-drilling contest is, but every miner has watched with strained interest as the drill ate its way into granite while the umpire announces the passing minutes. We believe the best record is that of the Amalgamated 3-hand team, 59½ inches in 15 minutes, made at Calumet, Michigan, in 1911. How widespread is the interest in such contests is suggested by the picture below of a Fourth of July celebration at one of the Oriental Consolidated mines in Korea. While the dress of the onlookers is unusual, the rest of the scene is natural enough, even to the five-gallon kerosene can converted into a water bucket. These Korean drillers, by the way, make good records, cutting their 30 inches and over in 15 minutes and contesting as stoutly as any 'Peerless' man or 'Shad.' As hand-drilling is giving way to machine work, so are hand-drilling contests being displaced by competitions between machine drills. The first of these we believe was held on the Fourth of July 1902 at Idaho Springs, Colorado. The machine contests are longer but less dramatic. One misses the play of muscle and the display of brand new undershirts usually worn by contestants on such occasions.

CELEBRATING THE FOURTH OF JULY IN KOREA.

But we have lingered over-long perhaps at the drilling. There are still the hose-cart races to be run, the ladder-climbing contests, and the picnic dinner. After that is the inevitable baseball game, between rival camps, where distances are not too great, and between mine and mill where geography must be considered. Today, we doubt not, from the Davis pyrites mine of Massachusetts, to Masbate there will be 'three baggers' and close decisions that will provoke hot contention. Whether the Constitution follows the flag is open to debate; but there is no question that close behind 'Old Glory' comes the baseball score. Wherever nine North Americans are gathered together there is a pitcher, a catcher, and a full complement of basemen and fielders. Japan's management of battleships was not more convincing of her Westernization than her enthusiasm for baseball, and whether Stanford wins or loses at Tokyo today, sound friendships will be formed.

It is always hard to leave a ball game, but we really must go to supper (never dinner at the mine), and besides there is the dance in the evening. If we are not ready and dressed in our best, who knows but that Katie, the black-eyed waitress, may tire of delay and go on with Mike the 'mucker.' It will never do to be late. For those who do not dance, and even in a mining camp there are such, or perhaps as the sole attraction, there is that friendly glove contest between foundry and saw-mill. Seated expectant by the ringside there is a good evening's fun to be enjoyed, with many a pretty give and take. Always there is the half thought that a new 'white man's hope' may shine forth at the end. Tired and sleepy, we at last reluctantly go to bed, happily if with no head that hangs over on the morrow and makes food look repellant while the throat notes anew the dryness of the desert. The old custom of dedicating the Nation's birthday to drunkenness is gradually giving way to one of making it a day of healthy sport; and in the turning away from routine thoughts and work, we trust that each will find time for a quiet bit of thankfulness to our forefathers whose sacrifice made possible our Country.

Building a Reduction Plant

By Herbert Lang

When the plans and details of a proposed works are sufficiently advanced, the engineer sets about the preparation of drawings and specifications of the different articles required, with the view of obtaining bids for supplying them. By far the greater number of such articles, being of ordinary manufacture, do not require to be designed, while their specification may consist of the merest framework of words. Things of special manufacture, which should be as few as possible, require very exact drawings and specifications, and herein lies a great deal of work for the designer, all of which must be completed before the plans are submitted to the builders. It is not well to ask bids from many firms. Scarcely ever is it advisable to call upon more than two or three, for reasons which will be more apparent to the experienced than to the casual reader. In such business undertakings as the erection of a large metallurgical works, it is policy to avoid publicity as far as possible. The engineer himself, whose drawings may represent the fruit, perhaps, of years of study, feeling that they mark a distinct advance in the art, has a natural wish to withhold them from the sight of manufacturers who, like many that might be named, make a practice of copying (in effect stealing) all original drawings that come to their shops. Again, there is much time lost when a large number of firms are taken into the competition, owing to the number of explanations that are required to be given, and to other causes.

Choice of Contractors

It is common for the inexperienced individual or company to express a preference for the work of some particular builder, especially some much advertised concern with whose name they have become familiar, but of whose work they may know absolutely nothing. Not infrequently they may propose to put the whole matter of constructing the machinery, and even of setting up the plant, in the hands of some favorite iron works. This is a situation that calls for extreme tact on the part of the engineer, who may feel the impolicy of employing the firm in question, without being able to communicate his views to his own employers. The policy of certain large builders in the United States is often quite unfavorable to the interests of engineers and employers alike. Their practice frequently is to suggest and bring about changes in the plans, to urge heavier and more costly machinery, to pooh-pooh the ideas and work of rival concerns, and finally to cast discredit on the original designer of the plant under consideration, provided that by injuring his standing with his employers they may advance their own interests. All this has its effect upon tyros, already awestricken by the fame of the bidding firm, and it not infrequently happens that the plans upon which the engineer spent anxious months are discarded, and the manufacturing concern is practically given *carte blanche* to construct the works. It can easily be seen that such proceedings are as little to the advantage of metallurgy at large as they are to the true interests of the machinery buyers. Aside from this, there is the natural and less reprehensible tendency on the part of all builders to increase the magnitude of the orders (and consequently their profits) at the expense of the purchaser, whom it is the duty of the engineer to protect. The firms most difficult to deal with are those which pose at once as builders of machinery and as original designers of plants. Such concerns produce only designs which embrace their own machinery as constituent parts, and as a rule will assume no responsibility as to the appropriateness of their designs, while at the same time they declare that they will not be responsible for the success even of their own machinery unless their designs also are accepted. This illogical stand cannot deceive the engineer, but appears sufficient to take in many of the more credulous sort of buyers, to the extent of giving a single order, never repeated, for machinery and plans.

Making the Plans

During the preparation of the plans and the construction of the works, there are times when it becomes advisable for the engineer to call for outside assistance, especially in matters of mechanical engineering, in which he may not be sufficiently versed. At such times the resources in skill and apparatus, which well conducted and equipped iron works possess, become of great use. When such a course becomes necessary, it is well to use great discrimination in the selection of a suitable house. With some an application leads simply to the handing over of every detail of construction to people who are not in every way fitted for it. As a general thing, the large machinery houses are acquainted with only the mechanical engineering side of the questions, there being rarely any real metallurgical skill within the concern, and it often happens that the quality of brains which such concerns place at their customers' disposal is of the most ordinary sort. It is far better to avoid such biased and incapable aid. The experience in this matter is that the smaller iron works, especially those making no pretense to extraordinary skill and ability in designing and building plants, are of far more assistance, chiefly because the problems are taken up by the principal officers of such works, who are apt to be men of high attainments in general engineering, and who, having no specialties of their own to uphold, have with more ability far less bias than the mediocre and prejudiced salesmen, draughtsmen, and whatnot who perform that kind of task for the larger makers. No one but a metallurgist can ever know how the progress of the art has been hampered and delayed by the disposition of the larger makers to hang to their antiquated drawings and patterns; or by their employment of solicitors and clerks in the place of skilled engineers; or by their boundless

and absurd claims of improvement. Making the largest allowance for the credulousness and gullibility of the mining public, it is difficult to understand how such claims can bring business.

Purchase of Machinery

Speaking generally, then, it would seem that the preferable way to proceed in the construction of the reduction plant would be, after the plans are advanced sufficiently, to ask tenders from two, or at most three, iron works of fair repute and of known skill and versatility, and select as the maker of the desired apparatus that one which combines the advantages of a low, but not too low, price with a location not so far from the proposed works that repair parts for the machinery cannot be had quickly. By no means should the successful bidder be required or even asked to erect the works, for this can always be done better and cheaper by the purchasers, with the added advantage that the men who are to run the plant can generally be had to set it up, whereby they become acquainted with its peculiarities, much to the betterment of the running. Let the greater part of the machinery be bought in the open market, and let it be set up as soon as it arrives, without waiting for other parts. By no means put off the purchase of portions that are certain to be required, but arrange the arrival on the ground of the different portions so that there will be no rush at any time, but that a crew of a certain number of men, working steadily and without hurry, may perform the whole of the work. To 'rush things' is a favorite phrase with some builders, but rushing is expensive when metallurgical works are to be set up.

As a general thing, the time required for planning and building the reduction works is much underrated. It frequently happens that companies who have pursued a leisurely course of mining development, occupying perhaps years in work that could have been performed in as many months, suddenly resolve upon the erection of reduction works, and demand that they be built and put in operation hurriedly. The effect of haste in this work is invariably bad. Not only do the plans suffer, but the mechanical work is poorer and the expense far greater. I repeat with emphasis the first rule of construction, which is, *take plenty of time.* To this the reader who has read and appreciated the foregoing will add for himself the second rule, namely, *take plenty of money.*

Value of Guarantees

The ordinary guarantees by makers of machinery relate to the quality of material and workmanship furnished, and are quite conventional in words and form. There is never any difficulty in enforcing agreements of this sort, and buyers may rest secure in the quality if not in the design of whatever they may buy in the way of metallurgical apparatus. In addition to materials, some of the larger machinery houses profess to furnish advice upon metallurgical topics, especially in cases where their apparatus is about to be installed. This implies a responsibility not only as to the character of the machinery furnished, but also as to the process or method of treatment to be adopted. Hence it may properly be nominated in the bond that the process and the arrangement of plant are to remain on trial until proved to be correct and advisable, and that before the dealers are paid for their wares. Otherwise their position, it is easy to see, is better than that of the professional engineer who prepares plans and gives advice for which he in the nature of things is held to strict accountability. If the machinery dealers were also held responsible for the advice they give, we should hear less unfounded boasting from them, and the condition of metallurgy would be much improved.

Value of Professional Services

The information upon which the engineer depends is furnished by maps, analyses, assays, and reports, but chiefly by personal inspection, of which nothing can take the place. No one, no matter what his qualifications may be, is justified in prescribing or planning without first having seen with his own eyes the ground of the future operations, and inspected thoroughly every part of it. This he owes both to himself and his employers. Nor can this inspection be slurred or hurried over. Time spent in such a careful reconnaissance bears excellent fruit in avoidance of mistakes, and in the improved character of the engineering. It is rare indeed that the engineer does not, with his trained vision, notice something, perhaps of great import, whose bearing on the problems in hand had not been brought to the notice of the company. Such a fact, unexpectedly developed, may result in an entire change of process; and whereas the company at first thought of putting in, let us say, a cyanidation plant, the light thrown upon the subject by the investigations of the engineer may result in the decision to use chlorination instead. Again, the original resolve may have been to use a concentrating process, in which case the recognition, on the part of the engineer, of large amounts of accessible fluxing ores previously unnoted by the projectors, has turned the scales and rendered smelting vastly more feasible.

Selection of Millsite

One of the most important duties which can fall to the lot of the engineer is the selection of the site upon which the works are destined to be built, and into the choice of which go a great deal of the experience and skill which he should possess. Chief among the considerations which govern the choice are those relating to the transportation of the ore from the mine to the works. The perpetual problem is how most cheaply to get the ore and other materials to the works, and how to get the products away. As a rule, the question deals with the relative merits of railways, overhead trams, and wagon-roads, according to circumstances. By no means can one solve these questions off-hand; but the engineer must prepare himself with such aids as contour maps, drawings, and estimates of cost, which embrace facts that cannot otherwise be taken into account. In order to know accurately the ground upon which he stands, the surveyor's aid must be in-

voked, and a thoroughly reliable contour map made, embracing all the debatable ground. The 5-ft. contours should be used, and the scale must not be cramped. On this map proceed to lay out, first, the transportation lines, particularly if railways are to be a part of the plan, and next, the actual location of the works themselves. Notice that it is important to begin with the railway. Almost all such works nowadays are connected with them, and it needs no argument to prove the desirability of so arranging matters with reference to the different departments of the works that the handling of freight of all kinds will be facilitated to the utmost. This requires that the tracks be put down first. Herein may be noted the additional advantage that they may be used both in the erection and for the repair of the works themselves. In case that wagon-roads or overhead tramways be used for the means of transport, the necessity of their prior location is less obvious, but even then it will be found profitable to lay them out in advance of other constructions.

Handling Material

The ideal method of handling materials about the works is by means of railways of the standard gage of 4 ft. 8½ in. By the exercise of skill and judgment on the part of the designer, all the requirements of freighting may be met by lines of this sort, penetrating to all parts of the establishment, whatever be its extent, and delivering all the materials wheresoever they may be required. A narrower gage may answer, but not if connecting lines are of the standard gage. Good engineering demands that such lines should be laid out with extreme care in order to obtain the utmost benefit. The sharpest curve should not be of less than 200 ft. radius, and there should be no grades whatever within the works, while if such are deemed advisable on the outside, they must slope away from and not toward the works, thus preventing damage by runaway cars and engines. Metallurgists should take care to follow the practice of the railway engineers in all this, not only as to the construction of the line itself, but also as to the character of the rolling stock which may be intended for use. Given a broad-gage road, it would be quite inadvisable to introduce miniature cars or locomotives, because by so doing would be forfeited the numerous advantages that flow from full-sized apparatus. The extreme advantages of the full-sized railway equipment are not appreciated or understood except by the regular transportation companies, who, as is well known, are always seeking to increase the size and weight of their engines and cars. This touches a principle that is universal throughout the whole domain of metallurgy. The superior economy of large furnaces, heavy stamps, powerful engines, and, generally, of the most powerful and heavy apparatus of all kinds, within the limits of practicability, are undeniable. What the extreme limits in size of practicable apparatus may ultimately be found to be is not material to the question. For the present the tendency is toward increased sizes of machinery in every branch of metallurgy. This tendency is accompanied by another not less strongly marked tendency toward increased speed of driving. Whereas, in times not remote, and within the memory of persons still in active practice, stamps, for instance, weighed 700 lb. and fell 80 times per minute; they now have reached double the weight and drop 100 times per minute. Instances might easily be multiplied. The case of the reverberatory smelting furnaces, which have increased from 16 to 100 ft. in length of hearth, may be cited; the iron furnaces of Pittsburgh, whose internal capacity is ten times what it once was; the matting furnaces of Butte, whose capacity has increased twentyfold in 20 years, are further illustrations. In all this the principle is the same; that is to say, the economy of metallurgical devices depends, among other things, upon the size of those devices.

The designer should take plenty of room. The works, however limited in capacity, should not be cramped. Compactness, upon which many builders pride themselves, is not a merit in metallurgical plans, but, on the contrary, is a chief cause of blundering. The likelihood of future enlargements must always be faced, and the question of fire insurance is generally a live one. It might be supposed that the matter of cheap and rapid transit through the works would be favored by compactness of plant; but this is not always the case, inasmuch as it debars the engineer from the employment of the most rapid and economical means of transit when the different parts of the plant are huddled into a mass. Experience shows that the separation of large or moderate-sized plants into departments has an excellent effect upon the success of the establishment as a whole, and should always be practised in laying out new works. All necessary study should be bestowed upon the plans while they are forming, there being no economy in hurrying this part of the work. The general drawings of the works should be finished and blueprinted before a single article is ordered, or a single shovelful of earth excavated. The site must be selected, and the location of all parts of the plant, including the corners of the buildings, staked out, if the fullest measure of economy in construction and running is to be achieved. It is well known that where these indispensable preliminaries are neglected the plant costs much more, especially in the two items of grading and excavating.

Arrangement of the Plant

Little is gained in general by extensive excavation, especially if it be in hard ground, since the improved methods of elevating and transporting render it in a measure unnecessary. The ideal metallurgical works should be so arranged that all parts may be accessible by the broad-gage railway line. This necessitates laying out the plant alongside of the tracks, which must have been previously staked, with the longer axis of the buildings parallel to the rails, and not transverse, whereby the greatest convenience in the matter of dumping room is secured. The plant, if at all extensive or complicated, should be divided into departments or sections, so as to have good ventilation with freedom of each section from the smoke, gases, and flying particles

from the others. By this disposition, the cost of buildings, and particularly of grading and of retaining walls, may be much diminished. Where, on the contrary, the different parts of a plant are huddled together, not only is the cost of working greater, but that of subsequent additions to the works will also be greater. Further, the very compactness of a plant, which is so much valued by some designers, will invariably prevent the orderly and logical additions of parts that may be subsequently found necessary.

Most metallurgical works are built upon side-hills in order to get the benefit of gravitation, by which the substances undergoing treatment are assisted on their way. The practice of so building the works has become fixed by the habit of generations and centuries, and with some builders has become almost second nature. But with the improvement in machinery, by which a wealth of appliances for hoisting, transferring, and lowering the heavy and bulky materials of metallurgy now available, the arguments and reasons that formerly led to the side-hill have in good part lost their force, and a rival school, advocates of the so-called level site, has appeared. Their arguments relate chiefly to smelting, but have an important bearing upon other metallurgical processes.

Sidehill v. Single-Level Sites

A sloping or side-hill site is made up virtually of a number of terraces, upon each of which some part of the plant is placed; there may be two, three, or more of these terraces, the result of excavation into the side-hill. The single level site, which ostensibly is composed of but one level, virtually has quite as many, if by level is meant the elevation on which work is performed. For there must be, first, a lower dumping ground (called dump for short) on which the waste is deposited, and also several floors of greater or less extent, upon which the men stand to work at their tasks. Each of these floors may be entitled 'levels' with as much propriety as if they were the generally more extensive areas embraced in the side-hill site. Thus there must be a space about the head as well as the base of cupola furnaces for their proper working; the use of ore-bins implies at least two levels; and so for the usual arrangements of metallurgical works of all kinds. The conflict of opinion as regards one-level versus terraced sites was largely based upon a misapprehension, and there is really not such a great difference between the two opposed plans of construction as has been generally imagined. The greater differences arise from the method of supporting the levels (floors) and their relative positions about the works. In the side-hill plan they are laid out in an orderly sequence from top to bottom; while in the one-level plan they are scattered about the terrace according to convenience or the views of the designer. In the former they rest upon the solid or filled ground; in the other they are supported, for the most part, on framework of wood or metal. The question, therefore, is narrowed down to a consideration of the relative advantages of floors or levels supported by posts, or by earth or stonework. It is necessary to consider the matter of installing and using the different classes of elevating and transferring machinery made advisable by the one or the other plan, together with the possibility of future enlargements and alterations—a matter that should always be kept in mind.

One-Level Site

There is no question but that the one-level site, with buildings somewhat widely separated, is the most favorable to enlargements; and while the question of convenience and economy of working is to be settled by the engineer on the spot, I am firmly convinced of the superior advantages of the one-level plant in those respects also. Doubtless, most builders will agree that ventilation is better, and that as a general thing the danger from the spread of fire is less. As a rule, there is greater economy of space in the one-level plan, as the room directly beneath the upper floors is not wholly occupied by the supports, and because the stowage spaces can be better utilized. Ore, for example, which it would be out of the question to transfer for storage from one level to another, may be moved on the same level to wherever convenience may dictate. Thus any given space on the terrace may be used successively for several purposes, while on the side-hill plan the engineer is rigidly held to one use for one space.

In the case of stamp-milling, where the course of the ore is constantly downward, and where there are no materials of any moment that require to be returned from lower to higher levels, there is little opportunity to argue against the side-hill construction. But in processes like cyanidation, where the reëlevation of the liquids forms an important part of the process, and which cannot be obviated, there is less reason for seeking a site upon sloping ground, as the pumping of the liquids from tank to tank cannot be much forwarded by differences of levels between the tanks.

Modern Iron and Steel Works

In the larger iron and steel works, where the quantity of material to be handled reaches its maximum, and the metallurgical engineering has advanced to a perfect appreciation of the conditions, the works are invariably, of late years, placed on level ground, with abundant room for expansion and for the application of those approved means of transport that have attained such perfection in that work. There is no question there as to the proper site to be selected, other than as influenced by the favorable conjunction of lines of transportation, and the practicable nature of the foundations, which is vastly important to their ponderous apparatus. Thus at the Phoenixhutte in Germany, and the Lackawanna works in our own country, millions were spent in the preparation of the unfortunately situated ground upon which the designers were seemingly forced to build. Fault may not be found with the selection of these sites, but it is unfortunately true that an undue amount of money is almost always put into such constructions as piling, filling, grading, and draining unsuitable ground; an expense which the merest change in transporta-

tion lines frequently renders wholly useless. If one-half the perspicuity that is devoted to the subject of metallurgical processes could be occasionally given to the study of railway or water transport, one-half the reduction plants would never be built where they are.

Necessity of Several Levels

Although the huge steel and iron plants of the day are regarded as the best exponents of the one-level plan of construction, the curious visitor will notice about them ample evidence of the universality of the many-level idea. He will observe a strict adherence to the custom of erecting the big furnaces on a platform of masonry, elevated some eight or ten feet above the general level of the works, designed very properly as the railway level. This is in order to admit of the use of the large slag and metal pots and ladles, which often have a capacity of 20 or more tons, and being mounted on wheels, and drawn by a small locomotive, transport their contents wherever required. This mode of transport renders it a matter of small moment that the slag dump may be at a distance, often of several miles. But although the dump may be so far away, it must still be a dump; that is to say, the slag must eventually be brought to repose on a lower level than the tracks. Since work is performed upon the top of the masonry platform, that also constitutes another level. Again, the top of the furnace, being the scene of more or less labor, forms a fourth level; and so on. In taking the pig iron to the bessemer vessels, a locomotive is sometimes used, which with its train of several ladles is hoisted bodily from the railway level to a position so elevated that the contents of the ladles may be poured directly into the converters. This, then, involves another level still. It can be seen after some reflection that the terrace or side-hill system of laying out these works would not answer in such instances.

Concentrating Works

In the case of concentrating works, I have always considered it doubtful if the advantages of gravity were not more than counterbalanced by the costs and inconveniences inherent in the form of construction which is now uniformly adopted. It would seem important to do away with the heavy and oftentimes costly retaining walls which this type usually requires; with the expensive and sometimes unsatisfactory wooden piers upon which rock-breakers and other heavy machinery is generally supported far above solid ground; and with the massive buildings whose frames support the shafting by which power is transmitted to the various mechanisms of such a works. Since the elevating and reëlevating of the crushed material, often to considerable heights, is an unavoidable feature of this form of ore reduction, may it not prove to be the part of economy to extend the elevating system to such an extent as to allow the crushing apparatus, the shafting, and such other parts as require exceptionally firm foundations, to rest upon the ground? Were this done, much money could be saved, particularly in the cost of the buildings, which might be made much lighter, with large incidental reductions in the danger from fire, the cost of insurance, and in replacements and repairs.

The design and location of smelting works especially have been much modified by the improvements in hoisting and carrying machinery during recent years. Formerly, when the muscular strength of man was depended on for the transportation of the ore to the furnaces, and the removal of slag and metal, and when the daily tonnage treated did not make such a grand figure, it was almost a matter of course that the work was arranged so that the slag dump was close to one side of the furnaces, while the ore dumps were as near to the other. The hauling of slag in two-wheeled hand pots is still practised in some works, even of comparatively modern build, while the wheeling of ore from the heaps to the feeding-floors is also common. The excursion of the hand-pushed slag-pot with its 300 or 400 lb. of slag between furnace and slag dump is being replaced by the locomotive with its huge tipping basin of fifty or one hundred times that capacity; or by the granulating stream, whose capacity has never been measured.

Effects of Gravity

The effects of gravity are many and indispensable in all metallurgical operations; yet it is easy to go too far in soliciting its aid. Under an exaggerated idea of its usefulness, designers have been known to seek sites on distant hills, and to lay railway tracks for many miles in order to obtain the advantages of a drop of some few feet. These advantages are measurable, if at all, in terms of the cost of elevating the same materials an equal distance by mechanical means. If the cost of doing this by such means commonly used be considered, an approximate idea of what such a drop is worth in dollars and cents will be gained, and many would doubtless be surprised at its small value. The actual cost of the power for raising weights is but a trifle. The power of one horse, as is well known, is sufficient to raise 33,000 lb. one foot per minute, at which rate he could in 24 hours elevate the whole of the material consumed in a thousand-ton smelter a distance of 22 ft., which is not far from the average height of a copper or lead blast-furnace. If an allowance of 50% be made for losses from the inefficiency of elevating and hoisting machinery, and assume that the horse be replaced by electrical or steam power at an expense of $50 per year, the daily cost of the power for elevating the above amount works out to 28c. Other elements which enter into such an estimate, such as the cost of attendance, repairs, and in particular the loss by interruption of the work, modify it considerably, although the result will always show the impolicy of going far to secure the assumed advantages of gravity. Further, the engineer should not lose sight of the fact that some means are always necessary to raise the ore and other materials to the summit of whatever eminence is to be chosen, this possibly involving the use of an extended line of railway, whose use would not commonly be thought of as pertaining to the reduction plant and process.

Stoping Methods in Michigan Mines

By P. B. McDonald

The choice of a mining method for an undeveloped property is a matter which should receive careful attention, as it involves a problem of prime importance in the economic working of the property. As the supply of cheap timber has decreased during the past 20 years, making the square-set method of mining expensive, a wide variety of new methods has been advanced, each particularly suited to certain local conditions. The object of the new methods has been to do away with the use of so much timber and to make mining safer, thus reducing the loss of life. The notable increase in the mining of large, irregular shaped, low-grade orebodies has been a favorable factor for the development of new methods, mainly because an efficient mining method is a necessity in the mining of low-grade ore. In most of the recent methods, shoveling of ore in the stopes is avoided as much as possible, on account of the high cost of this work. There are several mines paying dividends today that were failures before a system of mining was evolved which suited the local conditions at each property.

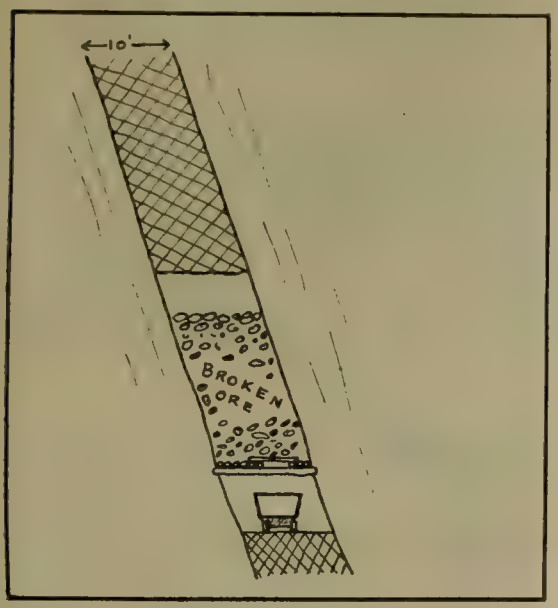


Fig. 1. BACK-STOPING.

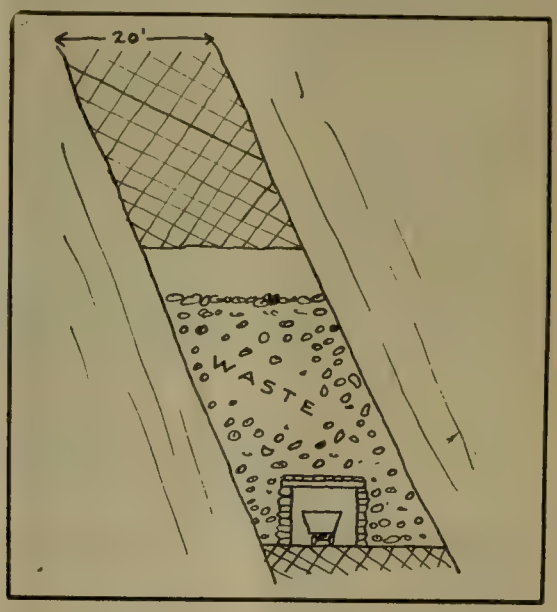


Fig. 2. DRY-WALL METHOD.

Classification of Mining Methods

Mining methods are usually classified as to whether the stoping is overhand or underhand or a combination of the two, but there is a better classification having to do with the condition of the stope itself. The stope may be open, as in relatively narrow veins of hard ore, with very little or no timber used in the process; the stope may be kept filled with broken ore or waste rock on which the miners stand to drill; or the caving principle may be employed in which a block of ore is undercut and part of it removed, the balance being allowed to settle due to the force of gravity.

The caving system is usually not suitable to a small or medium width orebody, but is a cheap mining method for a large massive deposit. At the Tobin iron mine of Corrigan, McKinney & Co. at Crystal Falls, Michigan, block caving is employed. A sub-level is opened 25 ft. above the main level, and a checkerboard of drifts and cross-cuts is driven on this sub-level, making a number of short vertical pillars in the ore, which are reduced to suitable size and then all blasted at once, thus undercutting a great block of ore 100 ft. high. As the ore slowly caves it racks and grinds itself into small pieces convenient for loading into tram cars and is subsequently discharged through chute-raises to the main haulage level and trammed to the shaft. The ore at this property is a medium hard, red hematite.

Pewabic Mine

In the Pewabic mine at Iron mountain no sub-level is driven, but blocks of ore 250 by 200 by 100 ft. high are caved into the main level where pillars 8 ft. square have been shot out. The block of ore is first undercut along the foot-wall and one end. When the pillars have been withdrawn the ore gradually settles to the floor, and in spite of the fact that it is rather hard ore, it is crushed so that 80% of it can be put through a 3-in. opening. This caving process takes from 6 to 8 months. Timbered drifts and cross-cuts are then driven through the crushed ore, and the trammers shovel the ore into cars, beginning at the more remote headings, and pull down the timber sets as they retreat. The cost of mining by this method at the Pewabic is about 50c. per ton. It will be noted that the cost of explosives and timber are naturally low. It need scarcely be stated that caving methods of mining

render the overlying surface unfit for buildings, railroads, and the like.

On the Mesabi range in Minnesota caving methods suitable to soft ores are extensively used for mining large flat lenses of iron ore. On the Mesabi, and in some parts of Michigan, caving is accomplished in sub-levels by drawing horizontal slices 8 to 20 ft. high and extracting these successively from the top downward. The overlying rock or sand caves and is kept separated from the ore by a mat of timber and lagging; this overlying material furnishes weight which helps cave the few feet of ore over the 'room,' which is 8 ft. high, and is excavated by the miners underneath the block to be caved. Caving in horizontal slices by means of timbered sub-levels is a more careful method than the block-caving methods used at the Tobin and Pewabic, but is also more expensive in labor and timber and is better fitted for a high-grade ore. It is necessary to shovel practically all of the broken ore, and nearly all the drifts and 'rooms' have to be carefully timbered. The 'caving' is not caused by removing the pillars, but by widening the timbered room 8 ft. high and caving the few feet of ore overhead. In some cases the slices are only 8 ft. thick altogether, so that practically none of the ore is caved. The term caving applies principally to the overlying rock and sand.

Back Stoping

Fig. 1 illustrates back stoping. By this method the stope is kept nearly full of broken ore upon which the miners stand when drilling into the back. The broken ore is removed by trammers on the haulage level by prying apart the cross-lagging over their heads and letting the ore drop into the tram cars. The cross-lagging rests upon timbers laid lengthwise of the drift, which in turn are supported by heavy timbers placed at intervals across the drift with their ends securely recessed in the walls. The miners climb to the back through ladder-ways or raises which are left at intervals. The level of the broken ore may be kept on a slope lengthwise of the orebody so that flat stope holes may be drilled and the ore broken in benches; or the broken ore may be kept horizontal and 'uppers' drilled into the back. The levels are usually 100 ft. apart; when the stope is within about 20 ft. of the level above, the unbroken material is left as a floor pillar as long as it is desired to maintain the level above, after which this floor pillar is drawn retracting toward the shaft. This method of mining is especially suitable for a steeply dipping vein from 8 to 12 ft. wide. It has been successfully used in the hard ore mines of the Michigan iron regions. Some operators object to mining on broken ore, because of the capital represented in the large amount of broken ore which is necessary for keeping the stopes filled.

Dry-Wall Method

Fig. 2 shows the main features of the 'dry-wall' method used in some of the South Range copper mines of Michigan where the dip is sufficiently steep. The main haulage drift is driven lengthwise of the lode and is widened out to the full width of the ore-body, perhaps 20 ft., by 'breast-stoping.' The broken material is carefully sorted and the waste rock is built into 'dry-walls' (so called because no mortar is used) on each side of the track, perhaps 8 ft. apart. The miners are very skillful at building these dry-falls, and the finished walls, which are 7 ft. high, are surprisingly straight and solid. The balance of the waste-rock is thrown behind the dry-walls. Heavy timbers are now laid across the drift, the ends resting on top of the dry-walls; these timbers are spaced at about 2-ft. intervals and planks or timber are laid on them lengthwise of the drift, thus making a tight roof to the haulage way. Overhand stoping is now started, the miners standing on this platform and using it as a floor. As the stoping progresses, the broken material is sorted and the waste rock is kept to stand on, while the ore is thrown down chutes to the haulage levels. The chutes are built in the waste rock by the dry-wall method of stone laying, and are about 65 ft. from centre to centre. If there is not enough waste rock to make sufficient fill to stand on, a raise is driven to the level above or to the surface, and broken filling is run into the stope until the men can stand on the waste and reach the back for drilling. The top of the fill is usually kept level and small cars may be used on it for handling the ore. If it is desired

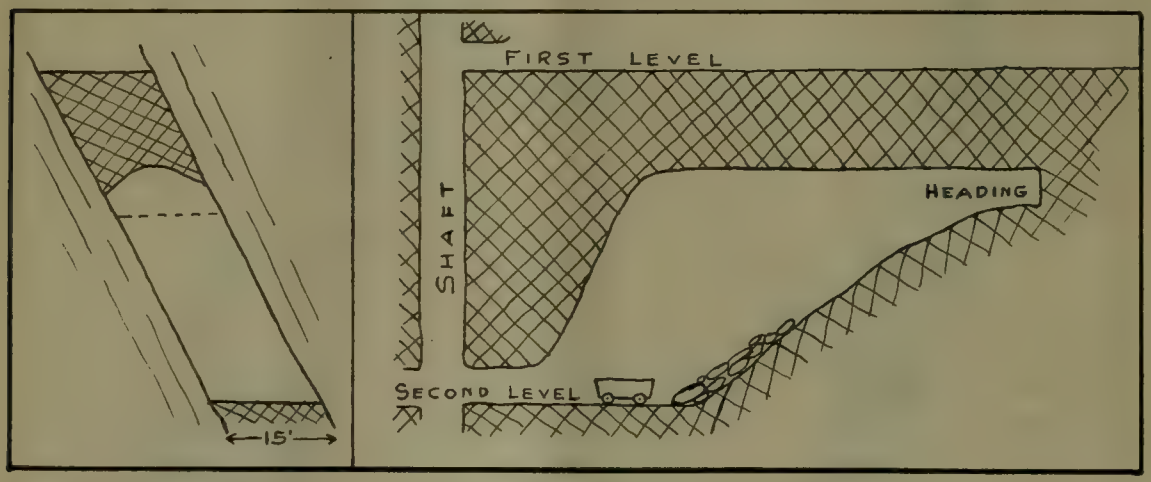


FIG. 3. OPEN-STOPE METHOD.

to use horizontal holes to break the ore, a portion of the fill may be kept at an angle of about 40°, upon which the miners can stand and drill and thus break the ore in benches; otherwise 'uppers' are used. This method of mining is obviously suited for ore that requires considerable sorting, and gives better results than going to the expense of hoisting all the broken material to the surface before sorting it. Native copper rock is easy to sort, especially when the surfaces are fresh, as is the case immediately after blasting. This method of mining is also safe, because the miners can watch the roof over their heads and see in advance any signs of caving. The cost of mining is usually over $1 per ton, but this refers of course to the sorted product which is the result of careful underground sorting, and should not be directly compared to a method which hoists both ore and waste before sorting.

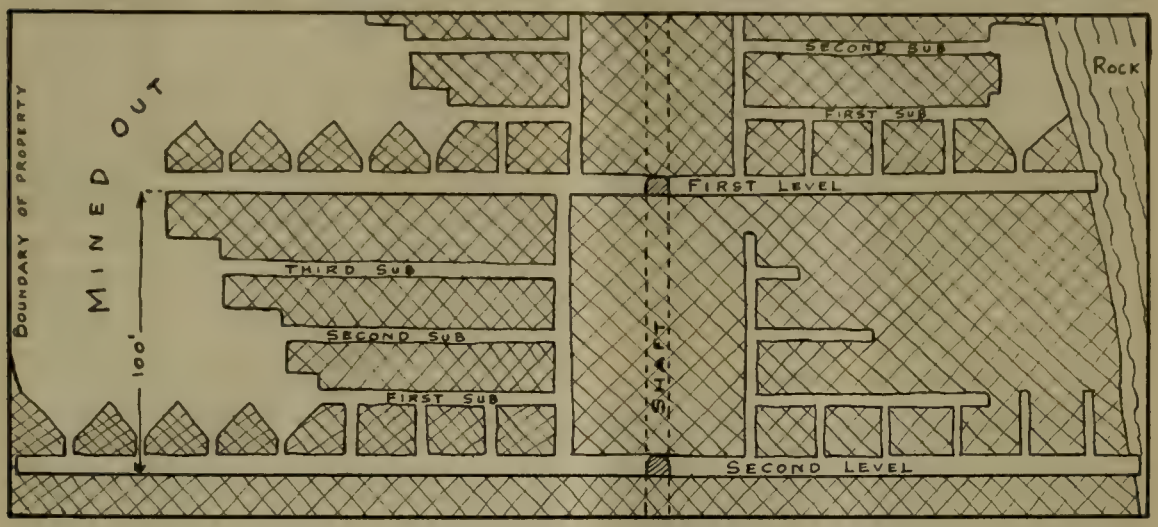


FIG. 4. SUB-LEVEL STOPING METHOD.

Open-Stope Method

Fig. 3 shows an open stope method of mining which is used in various parts of the country with orebodies up to 30 ft. in width. This method is simple, makes little 'dead' work and permits ore being stoped almost as soon as the shaft is sunk. It has the disadvantage of a high roof over the trammers' heads, which is dangerous in mining soft ores. The shaft may be sunk in the ore following the dip of the vein (as in sketch), or it may be a few feet back in the foot-wall and maintain a constant dip. Levels are usually 50 ft. apart measured along the dip. The drifts are kept small near the shaft, but, after leaving a suitable shaft pillar, a stope is opened about 30 ft. high. When the system is well started, driving along the vein takes place near the roof of the stope in what is called the 'heading,' this drift being later widened to the full width of the orebody. Stope holes are put in on the slope leading from the haulage level up to the heading; both down-holes and 'lifters' can be used, and when blasted they break the ore in large masses and chunks that may need sledging to handle conveniently. The roof is kept well trimmed or 'scaled,' ladders being used to occasionally inspect the older workings. As in other mining methods, the floor pillar can be drawn, retreating toward the shaft, when desired. Workings left for a long time are apt to get dangerous. This method of mining is suitable to mines where a small daily tonnage is hoisted and where it is desired to obviate dead work and tying up capital. Where the ore is variable and pockety, this method is especially suitable, as the poor material can be readily left as pillars in the mine. Some mines leave 40% of the vein material unbroken because of its poor showing; incidentally these pillars tend to make the workings safer. The cost of mining by this method is usually less than $1 per ton.

Sub-Level Methods

Fig. 4 shows the comparatively new sub-level stoping method in use in many of the smaller Michigan iron mines with ore of medium hardness in steeply pitching, tabular orebodies up to 100 ft. in width. A vertical shaft is sunk in the foot-wall and a cross-cut is driven on each 100-ft. level to the ore, where a main haulage drift is driven in each direction, lengthwise of the deposit. If the orebody is wide, two parallel haulage drifts are sometimes driven and connected at intervals, making a convenient track system for motor haulage. Chute raises are then driven 25 ft. above the floor and spaced 25 ft. centre to centre, being put in the cross-cuts if necessary. Main haulage levels are usually 100 ft. apart; and three sub-levels are driven, spaced about 25 ft. from floor to floor. The first sub-level (consisting usually of a single drift) intercepts the tops of the chute-raises. The sub-level drifts are hastily driven and do not resemble the carefully trimmed haulage drifts. Stoping is started on the first sub-level by putting in down-holes around the end chute-raise for blasting out a funnel shaped top, 'uppers' being blasted next. The right-hand portion of the first level shown in Fig. 4 illustrates the starting of a stope, and below on the second level is shown an earlier stage of development with sub-levels partly driven. The second level on the left-hand side shows a stope well started, while above on the first level the stope is well advanced and the

floor pillar is being mined and is falling into the second-level chute-raises (thus connecting the first-level stope with the second-level stope). As the sub-levels are drawn back toward the shaft or toward the ladderway, both 'down' and 'upper' holes are used, as well as horizontal holes for widening to the walls. The walls should be firm so as not to cave and mix with the broken ore. The miners take care to keep the bottom sub-level back under the middle sub, and the middle sub-level farther back than the upper sub-level so they are protected by the unbroken ore over their heads from falls of ground in the stopes. The open stopes are of course dangerous places to enter, and no one is allowed in them. The sub-level stoping method of mining is notably a safe one, as the miners attack the ore in the stopes taken from the sub-levels where they are practically as safe as in the main haulage ways. The chute-raises are equipped on the haulage levels with ordinary wooden lip chutes for loading tram cars; by raising the planks from the mouth of a chute the ore runs out, but occasionally blocks itself from some large chunk becoming wedged, in which case a stick of dynamite may be necessary to loosen the ore.

Mining Wide Orebodies

When the orebody is wider, the mining of the ore in the sub-levels is accomplished by maintaining a bench to the wall on each side which gives the miners a place to stand; the middle portion of the ore (where the sub-level drift is) is kept drawn back ahead of the sides, giving a semi-circular effect to the edge of the stope. In some cases where the sub-levels are rather far apart vertically, all the ore between cannot be reached either by the uppers from below or by one set of down holes from above; it is then necessary to climb down from the upper sub-level to the bench remaining, when the first set of down holes was blasted, and drill another set of down holes. Should the ore be too soft to permit this bench to hold a man and a rock-drill, it would be necessary to space the subs nearer together and have more of them. The expense of driving the sub-levels is one of the disadvantages of the method. Where the orebody is long, it is customary to make the stopes about 250 ft. in length, separating them by ladder-ways protected by vertical pillars. It will be noted that this method of mining is an open stope method, in that the stopes are not filled with broken ore, waste, or caved material. The method has been adopted by mines that in the old days would probably have used the square-set timber method, and is sometimes preferred to the method of back stoping on broken ore.

The four methods of mining just described are applicable to steeply dipping orebodies. When the vein has a shallow dip, say 20 to 40°, it is usually much easier to devise a cheap mining method, because the miners can then stand on the foot-wall as they work up from one level to the next. It is possible to drive the main haulage drifts to the property boundaries and commence stoping in a retreating system, holding the hanging wall by pillars or timbers so long as mining is in progress on that level. The Wolverine copper mine in Michigan has had a notably low mining cost, partly because of the shallow dip of the lode, which makes mining comparatively simple. In early days in the Lake Superior district miners tried to hold up the hanging wall indefinitely by timber stulls, which was impossible below very shallow depths. In some of the older stopes of the Calumet & Hecla mines, timbers once 10 or 15 ft. high can be seen which have been crushed down to 2 or 3 ft. by the slowly sinking hanging wall. It has been recognized that, since the hanging wall cannot be held up, it is better to devise methods which allow the hanging wall to come down, timber being used only for local purposes to prevent falls of ground.

Imports of Potash Salts

The importation of potash salts for consumption in the United States during 1912 amounted to 622,179,164 lb., valued at $10,692,285, according to W. C. Phalen, of the U. S. Geological Survey. This importation is only a part, however, of the potash salts entering the United States. To it should be added the importation of kainite and manure salts, including double manure salts. The imports of potash salts of these classes amounted to nearly 700,000 long tons, valued at more than $4,000,000. The imports for consumption of materials entering largely into the fertilizing industry, plus the domestic phosphate rock, reached the total valuation of over $46,000,000. These statistics in detail, together with others showing the condition of the German potash and salt industry, are given in the Survey's report on potash just issued as an advance chapter of the volume 'Mineral Resources of the United States for 1912.'

The investigations of the Geological Survey in 1912 into sources of potash salts in the United States included a continuation of deep drilling in Nevada, begun in 1911; a continuation of the collection of samples of rock-salt brines and bitterns, and of the study of the salt industry of the United States; the examination of various dried or partly dried lakes, *playas*, flats, or marshes in several of the Western states, both within and without the Great Basin, including Arizona, California, Nevada, New Mexico, and Nebraska; the investigation of deposits of potassium nitrate in California and Montana; and the investigation of occurrences of alunite in Arizona, Colorado, and Nevada. Information on all these investigations has either been published or is in process of publication by the Survey.

Mr. Phalen's report contains abstracts of papers on sources of potash published by the Bureau of Soils and by private individuals during 1912, as well as sections on potash salts as a by-product in the manufacture of portland cement, and on the utilization of kelp at Cardiff and Terminal Island, California.

Anthracite production of Pennsylvania in 1912 totaled 75,322,855 tons, valued at $177,622,626, against 80,771,488 tons, and $174,952,415 in 1911. There were 174,030 men employed, who worked an average of 231 days during the past year.

Equipment at the Crown Mines

*The paper on 'Centralized Organization at the Crown Mines,' which was read by R. C. Warriner, the general manager, before a recent meeting of the South African Association of Engineers, is the most complete that has ever been prepared to describe and illustrate the main features of the ore-handling operations of a mine upon the Rand. The following extracts are of special interest.

Sorting and Crushing Station

At No. 5 shaft the ore is delivered from the skips to the grizzlies at the head-frame which consist of two sets; the upper set is spaced 3¾ in. and 8 in. apart, and lies at an angle of 22°. This upper set was put in, firstly to take the shock of the falling rock from the 'fines' grizzly, and secondly to retard the flow and so obtain better grading. The second set or 'fines' grizzly is spaced 2 in. apart, and lies at an angle of 45°. The grizzlies are placed immediately above the 'fines' bin, and the 'fines' accumulated in this bin are loaded direct into the 50-ton hopper trucks for transport to the mills. The oversize from both sets of grizzlies is delivered into a coarse-rock bin, whence it is fed to the sorting belts. The ore is washed as it is fed to the sorting belts in a chute fitted with sprays, and having a bottom fitted with grizzlies of fire-bar section to remove the coarse particles, slime, and water. The washing water for these sprays is delivered from a 5-in. Enke high-lift centrifugal pump, which is supplied from the mine pump column. The washing water is run by launder to a revolving separating screen which removes all particles over ¼-in. size. It then runs to an 8-in. Robeson-Davidson sand pump, which delivers it to a conical separator at 'C' mill, the overflow going direct to the slime-collecting tanks and the underflow to tailing pumps, and then to tube-mills. The oversize from the separating screen is delivered into a small concrete bin from which it is raised periodically by means of a small air winch and skip, and tipped into the 'fines' bin at the head-frame. By this method clean water is used for washing, the labor usually employed for cleaning settling sumps is saved, and other difficulties common to this portion of a sorting station are overcome.

Sorting Belts

The sorting belts, four in number, are 36 in. wide, have an inclination of 14°, and are run at a speed of 150 ft. per minute. Each belt is driven by a 25-hp. motor, running at 500 r.p.m. through a 60-to-1 reduction gear, fixed between the head pulley of the sorting belt and the pulley driven from the motor. To this pulley is attached a 'Benn' friction clutch running in oil, and by this means the belts are stopped and started at will. This system is to provide for the thorough sorting of each portion of the belt. For example, a belt loaded with rock from the bin is run out and stopped. It is then the duty of each boy to pick the belt clean of waste immediately in front of him. As soon as the overseer in charge is satisfied that all the waste has been removed, he places a chalk mark at the bottom end of the belt, which is then set in motion and stopped again when the above-mentioned chalk mark is opposite the foremost sorting-boy. The waste sorted is placed on the under side of the belt and is delivered into a waste-rock bin of large capacity. One boy is employed on each waste-rock belt sorting out any 'reef' which may have been accidentally discarded. The waste is loaded from the bin into 20-cu. ft. side-tipping cars, and these cars are elevated to the level of the top of the waste dump by a creeper chain-gear, the capacity of which is 6 tons per minute. This chain ascends an incline of 20° at a speed of 60 ft. per minute. The system has proved most satisfactory, a considerable saving of labor being effected when compared with other types of elevators, and this is the first plant at which it has been installed on these fields. At the head of the creeper chain-gear, the cars are attached to a mechanical haulage which conveys them to the dumping point.

*Abstract from *South African Mining Journal.*

Tube-Mill Pebbles

During the sorting operations, tube-mill pebbles are also picked and deposited on a conveyor belt running diagonally across and under the sorting-floor in such a manner that the pebbles can be picked from either of the four sorting belts. The pebble conveyor delivers into a partitioned-off portion of the main bin under the crushers, from which the pebbles are loaded into the 50-ton hopper-shaped cars for transport to the tube-mill pebble bins at the various mills. The sorted ore is delivered at the upper end of the sorting belts into a distribution box or bin, which feeds three 12 by 30-in. Hadfield & Jack reciprocating jaw crushers, for reduction to 1½-in. diameter. The crushed ore falls directly into the main ore-bin and is loaded from there by pneumatically operated doors into the 50-ton hopper trucks. The whole of the plant is electrically driven by separate motors for each piece of machinery, the crusher motors being 60 hp. each. The crusher station and bins are built of ferro-concrete, and the sorting station of steel. The plant was laid out for a crushing capacity of 6000 tons in 10 hours, but for individual hours the output has been as high as 750 tons. The following table showing units of power consumed and cost of same for crushing and sorting should prove of interest:

Month.	Tons hoisted	Crushing. Total units consumed	Crushing. Units per ton	Crushing. Cost per ton, pence.	Sorting. Total units consumed	Sorting. Units per ton	Sorting. Cost per ton, pence.
October	105,836	26,195	0.25	0.13	13,500	0.13	0.07
November ..	101,896	35,431	0.35	0.18	17,500	0.17	0.09
December ..	109,430	29,444	0.27	0.14	23,500	0.22	0.12
January	135,940	27,675	0.20	0.11	29,500	0.22	0.12

Between 400 and 500 miles of 6, 8, and 10-in. pipe is being made by the National Tube Co., of Pittsburgh, for oilfields in Rumania, Europe.

The Mineral Resources of Virginia—III

By Thomas Leonard Watson

Virginia has more known deposits of manganese and has produced more manganese than any other state in the Union. Manganese ores occur in each of the three major geologic provinces of the state, namely, the Coastal Plain, the Piedmont province, and the Appalachian Mountains province. Of these, the Mountain province has yielded the principal production, with extensive operations and a large total production from the Piedmont province. Only a small production has come from the eastern or Coastal Plain province. The beginning of manganese mining in Virginia and perhaps in the United States was in 1857, when 100 tons of ore was reported taken from the lands of Joshua Robertson about five miles from Waynesboro, Augusta county. The principal productive manganese deposits in the state are: (1) those of the Piedmont region occurring chiefly in Campbell and Nelson counties, south and northeast of Lynchburg; and (2) those of the Valley region occurring along the west slope of the Blue Ridge.

Only the oxides of manganese are of commercial importance in Virginia. Of these, pyrolusite and psilomelame greatly predominate with, in places, much of the earthy oxide, wad. These oxides often occur admixed in varying proportions. The ore is often partly or entirely crystalline, of a dark steel-blue color, and the nodular (kidney) type, which usually prevails, often displays a complete or partly layered structure.

Ores of Manganese

The manganese ores are usually found imbedded in the residual clays which overlie the rocks, from which the clays have been derived by the usual processes of decay. The underlying rock yielding the ore-bearing clays may be of sedimentary or igneous origin. The ore is distributed in clays in an irregular manner in the form of pockets or lenticular masses, rarely as distinct beds; as veinlets and stringers cutting the clays in all directions; as single nodules and masses, ranging in weight up to 500 pounds, assembled in the clays; as small disseminated grains scattered through the clays; as breccia ore in large masses; and as probable replacement and cavity fillings in sandstone or sandy clay. In places, both in the Piedmont and Valley regions, the ore distribution conforms in a general way to the bedding of the inclosing clays; frequently, however, this is obscured and the orebodies indiscriminately cut the clays in all directions.

The nature of the manganese ores mined in Virginia is one of irregular distribution, in the form of nodules and pockets, through residual clays, which range in thickness from a few feet up to several hundred feet. The method of mining depends largely upon the situation of the deposits and their depth below the surface. Open-pit and underground methods are both employed. These methods are often used to advantage in combination. Underground timbering is necessary on account of the liability of caving of the clays.

Tin

Though not a producer of tin, the existence of tin ore in Virginia, in the Irish creek area of Rockbridge county, has been known for many years, and in 1883 and later the deposits were opened in several places. The Irish creek area is about four miles long in a northeast-southwest direction, and three miles wide. The tin ore (cassiterite) occurs principally in greisen veins, which traverse the granite in all directions and have steep though varying dips. The Irish creek tin area was carefully examined in 1885 by the late Jed. Hotchkiss, who concluded his report on the area as follows: "In conclusion, this report is emphasized by the opinion that this Irish creek tin-bearing district, as above described, will prove abundantly productive in tin."

Nickel and Cobalt

The existence of nickel in Virginia has been reported from a number of localities in the Piedmont region, especially in association with extensive pyrrhotite bodies of the Floyd-Carroll-Grayson counties plateau in southwest Virginia, and in Amherst county east of Lynchburg. More recently nickel has been reported from near Broad Run station in Fauquier county. In addition to the above occurrences, cobalt is found in association with some of the impure earthy manganese deposits of the Valley region, especially along the western base of the Blue Ridge. Probably the most encouraging locality from which nickel has been reported is in the northern part of Floyd county, where the Virginia Nickel Corporation has done considerable exploratory work on Flat Run and Lick Fork. The ore is chiefly pyrrhotite, with some chalcopyrite.

The rocks immediately associated with the ore are, without exception, of igneous origin, and comprise pyroxene syenite, diabase, and gabbro. These are intruded into the country schists and gneisses. The gabbro and diabase penetrate the pyroxene syenite in dike-like forms and are accordingly younger in age. The mica-gabbro is the ore-bearing rock. In some parts of the gabbro, the sulphides are sparingly present, in others they make up 50% and more of the total rock mass, with all gradations between.

Arsenic

In 1903 the United States Arsenic Mines Co., of Pittsburgh, Pennsylvania, began the mining of arsenopyrite (mispickel) at Rewald, in Floyd county. An extensive plant, erected for refining the product, was started in 1904, with a monthly capacity, after January 1905, of 90 tons of pure white arsenic. Operations were temporarily abandoned several years ago, but were resumed in 1911.

The mines are 17 miles from Christiansburg, at Rewald, Floyd county. The ore is arsenopyrite, a

double sulphide of arsenic and iron, and occurs in 'veins' (lenses) in quartz-sericite schist, which is closely associated with biotite gneiss, but the relations of the two rock types to each other, and of the gneiss to the orebodies, are unknown. The principal orebody is reported to be 3 ft. thick at the surface and widens to a thickness of 14 ft. at a depth of 120.

Rutile (Titanium)

The Virginia rutile deposits are only known rutile deposits of commercial importance in the United States. Rutile is mined in the Tye River-Hat Creek area of Nelson county. The area is a large one, situated in the foothills region of the Blue Ridge, and is about seven miles northwest of the main line of the Southern Railway. Recent detailed field studies of this area by the Virginia Geological Survey indicate practically an unlimited supply of rutile, which can be concentrated to yield a high-grade product, much of it containing more than 99% of TiO_2. Since 1902 the Virginia deposits have supplied all the rutile used in this country, and much of the product has been shipped abroad. With the development of new uses of titanium—the two most important being in the manufacture of ferrotitanium for the production of special grades of steel, and in the manufacture of arc-lamp electrodes—and the consequent increasing demands for rutile, the prospect for the future of rutile mining in Virginia seems decidedly encouraging.

Two distinct types of rutile occur in the district, and each has been mined. In the first type, designated syenite (formerly pegmatite) rutile, the rutile occurs as disseminated grains of various sizes and as wavy lines in a coarse-grained feldspar-quartz-hornblende rock. In the second type, designated nelsonite rutile, the rutile occurs in an even-granular rock, having dikelike characters, and composed normally of ilmenite and apatite. The American Rutile Co. began mining the syenite (pegmatite) rutile in 1901 on the east side of Tye river near Roseland, and in 1902 a milling plant was built for concentrating the ore. In 1907 the General Electric Co. exploited the nelsonite dikes, near Rose's Mill, for rutile.

A second area of rutile has recently been discovered in Goochland and Hanover counties, Virginia. The area is an encouraging one, and some prospecting work has been done near Peers in Goochland county, and near Waldelock and Gouldin in Hanover county. The rutile is found as an original constituent in acid pegmatite dikes which penetrate gneisses derived from granites by metamorphism. Masses of nearly pure metal weighing many pounds are found in places on the surface admixed with the residual rock decay produced by the processes of weathering.

Mica and Minor Minerals

Pegmatites containing commercial mica have been abundantly developed in many parts of the Virginia Piedmont counties, and many excellent surface indications occur. Up to the present time, however, prospecting and the mining of mica has been confined to only a few of the known deposits. Dikes of pegmatite containing feldspar as an important constituent are quite widely distributed throughout the Virginia Piedmont region. Feldspar, with the associated mica of the pegmatites, has been mined in a number of counties. In the years previous to 1907, Virginia was a producer of asbestos, but since that time the mines have been inactive, although the mineral is known to occur in several counties. The mill for fiberizing the asbestos at Bedford City has been closed since 1906. The gypsum deposits occur associated with the salt deposits of Washington and Smythe counties, in the valley of the North Fork and Holston rivers. The date of the discovery of gypsum in Virginia was probably in the early part of the nineteenth century. The mines of the United States Gypsum Co. and the Southern Gypsum Co., which are situated northeast of Saltville, are the most extensive and the only producing ones at present.

Salt mining has been an important industry for a number of years. In 1771, Jefferson mentioned in his 'Notes on Virginia' the occurrence of salt brine in the Holston valley, but it was not until 1840 that rock salt was discovered. A large number of wells have been bored, ranging in depth from 300 to 1400 ft., the greatest depth being 2380 ft. At the present time there are about 24 producing wells. The mining of rock salt has not as yet been attempted, the entire salt product being derived from the salt brines of the wells. Of recent years the brines have been utilized exclusively for the manufacture of sodium carbonate and caustic soda. The product has been of superior merit from the start, and because of this fact a large and growing trade has been acquired.

Virginia is entitled to take rank among the chief coal-producing states. Many of the reserves have been made accessible recently through the construction of new lines of railroads. The area of the southwest Virginia coalfield is estimated to be 1550 square miles, with the original supply of coal placed at 22,500,000,000 tons, of which total but a small percentage has been mined to date.

Sulphur Industry of Sicily

There was nothing noteworthy in the trade of the year 1912, differences in exchange rates excepted, prices remained practically stationary. Shipments to Greece and Turkey showed a decline because of the Balkan and Italo-Turkish wars.

The total exports of crude and refined sulphur from the island of Sicily in 1912 amounted to 447,590 metric tons, which was a slight decline from 1911. The chief purchasers of Sicilian sulphur were as follows: France, 104,109 tons; Italy, 77,396 tons; Austria, 38,359 tons; Norway and Sweden, 34,850 tons; Germany, 32,286 tons; Russia, 25,562 tons; England and Malta, 19,833 tons; Australia, 11,285 tons; and United States and Canada, 2894 tons. Prices averaged, refined, $20.94 per ton; refined-ground, $23.16; refined-rolled, $21.80; and sublimed, $26.63 per ton. The production was 357,547 metric tons; and stocks at the end of 1912 were 450,917 tons.—*Consular Report.*

St. Joseph Lead Company

By Dwight A. Jones

*The production of lead from the smelter during the past year has been 66,847 tons. Of this amount, 32,109 tons was from purchased ores, 31,296 tons was produced from our own mines, and 3442 tons was from stock at Herculaneum. The average price received for lead at East St. Louis was 4.35, or approximately $87 per ton, there being some increase in the average price for the year. The net income from all sources, after the payment of all expenses and income charges, and after setting aside $75,626 for depreciation, was $637,910.37 in comparison with $598,082.52 in 1912. Dividends amounting to $597,300 were paid during the year, being 6% on the outstanding capital stock.

Influence of Industrial Situation

In order that the stockholders may appreciate the situation that has existed with reference to the work and earnings of the Company during the last few years, it is desirable to recall the great change in the general industrial situation which occurred during and after the year 1907, as the lead industry was seriously affected by this change. In 1906 the net income was $1,256,545.68, and in 1907 it was $2,038,820.32. For the year 1906 the price of lead at East St. Louis was over $100 per ton, and for the year 1907 it was over $114 per ton. In the following year, 1908, the price dropped to $88, and the net income fell to $657,446.89. While the Company had, during the years preceding 1908, taken many steps to increase its output and to improve its plants, which for the most part were built many years previous, it was suddenly confronted with a situation that demanded drastic action in all its widely separated departments.

As the most essential and most beneficial possession it could have was a strong and adequate lead reserve, much time had been devoted and much money had been expended in drilling adjacent lands, so that all the deposits that were available at low cost could be secured and so that other companies would not crowd upon its territory. In doing this it was realized that only a portion of the work had been accomplished which was necessary for broad development into a thoroughly equipped mining concern with a modern power-plant, modern mills, and a modern smelter. A new mill, then equal to the capacity of any mill in the district, had been built in a new territory and was first in complete operation in the year that ended on April 30, 1905. Notwithstanding the improvements in the mining plants which had been made, it was realized each year, with the continuance of the low price of lead that has prevailed since 1908, that mining must be done on a large scale to make the work profitable under new conditions, and must be confined to as few mines as practicable, and that mills to be profitable in the district must also be capable of handling a very large tonnage with a minimum of loss, and that modern smelting plants must be equipped with every known method of saving lead to accomplish work economically and efficiently. On these accounts, it has been necessary for the Company to discard old power-plants, old mill methods and equipment, old roasting, smelting, and refining furnaces, and as rapidly as large mines could be found, to abandon mining from scattered shafts, which had been the necessary practice for many years.

Improvements

During this period also various improvements in mining, milling, and smelting have been introduced, and even some of the later methods have been displaced by newly patented processes, especially in the smelting department, where this Company was the first in any country to use a large-size Dwight-Lloyd sintering plant. These considerations are brought to the attention of stockholders that they may understand the conditions that have prevailed since 1908 and may appreciate the necessity for a considerable expenditure of money. It has been the aim and desire to furnish all needed improvements as soon as plans could be perfected for such improvements. This policy has been necessary, and the ample and newly discovered ore reserves made this policy wise and practicable. The pig lead product from mines owned by the Company in the year that ended on April 30, 1900, was 12,196 tons, and in 1912 was 34,195 tons. The pig lead product from the Company's smelter in 1900 was 19,270 tons, and in 1912 was 62,922 tons. The net income in 1900 was $231,294.60, and after reaching its highest point in 1907, was in 1913 $637,910.37, owing mainly to the reduced price of lead. Since 1899 the Leadwood district, now the main mineral reserve district, was acquired; the Hoffman, Hunt, Day, Eaton, Angel, and Prospect Lead Co. tracts, containing 1631 acres of mineral land, having been purchased from the owners. The new mill at Leadwood and the three shafts supplying it with ore, and the power-plant and other accessory plants, have been entirely constructed. Other valuable tracts of land in the Bonne Terre district have also been acquired, and, by prospect drilling, large and valuable ore deposits have been disclosed.

Financial Standing

On April 30, 1900, the Company owed $292,319.99, after deducting its cash and bills receivable. In the period from this date until April 30, 1913, the Company expended approximately $4,400,000 in construction essential for its increasing product and operations, and it has written off for depreciation on property and plant over $2,500,000. No fixed amortization charge has been adopted because the value of the mines has been constantly increased by drilling, and it was not deemed advisable to

*From report as president for the year that ended on April 30, 1913. Details regarding the difficulties of this company were given in the *Mining and Scientific Press*, November 9, 1912, and March 24, 1913. At the latter time a summary of the balance-sheet for the year was printed.

take up this subject until a reasonable approximation to their full value could be made. Summarizing the entire indebtedness of the companies, it appears that the St. Joseph Lead Co. owes, less cash, notes, and accounts receivable, $1,982,307, that the Mississippi River & Bonne Terre railway owes, less cash, notes, and accounts receivable, including its indebtedness on its equipment notes, approximately $800,000, and that the Bonne Terre Farming & Cattle Co. owes practically nothing except its indebtedness of $244,450 to the St. Joseph Lead Co. It is, therefore, seen that the three companies, with assets conservatively valued at approximately $19,000,000, less cash, notes, and accounts receivable, have a total indebtedness of $3,000,000.

Additions to the Property

The total amount paid for lands bought by the St. Joseph Lead Co. since 1899 has been approximately $300,000. After extensive prospect drilling on properties acquired, large and valuable deposits were found. In the years 1902 and 1906 the values of the Hoffman and Hunt mines were increased on the books of the Company $5,500,000. That these mines are even now far more valuable, recent drilling has fully proved. Moreover, since 1904, lead of a gross value of over $15,000,000 has been taken from the property. Additional exploration has greatly extended the territory in the neighborhood of these mines.

In the entire period since its organization, the net income of the Company has been $15,247,022, while its total cash dividends have been $8,717,486. Many important improvements are yet under way, and it may be desirable for the Company to make still further extensions to its plant, but when the improvements now in process of completion are finished, there is likely to be a great addition to the net income, and before undertaking further expenditures it is deemed desirable to go over the whole situation with respect to the ore reserves and plants. The savings to be effected in the immediate future include those resulting from the larger stopes in the mines, the abandonment of old steam-plants, and the introduction of Hancock jigs and other modern mill machinery at Bonne Terre, and also from the mine, mill, and power improvements at Leadwood. It is also expected that from the many new and systematic methods and the recently erected large flue at Herculaneum and the new bag-house now in course of construction, material savings will be effected in the smelting department.

During the years since 1908 the price of lead recieved by the Company at East St. Louis has been for fiscal years as follows: 1909, $81 per ton; 1910, $85; 1911, $84; 1912, $83; and 1913, $87 per ton.

Future Outlook

A normal increase in the consumption of lead has taken place from year to year, and the great activity in electrical work, both in Europe and this country, indicates that the price will advance. During September 1912 lead in London and in New York sold at practically $100 per ton, but has unfortunately receded for a time. In view of these considerations and of the work that has been accomplished in securing lead reserves, and in rebuilding and reorganizing the plants and mining operations, it is believed that the stockholders will in the future find much cause for satisfaction. Such improvements as have been made on the surface lands of the company have resulted in causing an increase in the value of other real estate held by it.

Doe Run Lead Co.

The ore output of the Doe Run Lead Co. for April 1913 was over 4200 tons of lead concentrate, valued at approximately $179,000. The business of the St. Joseph Lead Co. as a lead producer and refiner, and as the owner of an industrial railroad necessary for its own purpose, is much more valuable with the large ore and concentrate product of the Doe Run Lead Co. to handle, than without it. It is of great importance that this business should be retained and that the alliance with the Doe Run Lead Co. should be continued in some shape. The smelting contract between the St. Joseph Lead Co. and the Doe Run Lead Co. was approved by the board of directors of the St. Joseph Lead Co., and is a fair contract. In Missouri it has been criticized as unfair to the Doe Run Lead Co., while in New York it is criticized as unfair to the St. Joseph Lead Co. The contract was made for a period of 3½ years, of which period one year has already expired. It provides that the concentrates of the Doe Run Lead Co. shall be purchased at the market price, with a fixed charge of $6 for smelting and a deduction of 10% for loss. It also contains a provision that an average price for the year of not less than 4c. shall be paid for the lead in the concentrate. The average price of lead has not been below 4c. at East St. Louis for over 12 years. The contract contains a provision allowing for the alteration of its terms.

If a consolidation of the St. Joseph Lead Co. and the Doe Run Lead Co. could be effected, there is no doubt but that a substantial reduction of expenses could be made, and that more freedom could be obtained in carrying on the joint operations of the companies. It is, therefore, to be hoped that such a consolidation can be brought about.

Large Driving Belts

Two large driving belts were recently made in San Francisco by the H. N. Cook Belting Co. for the American Beet Sugar Co., at Oxnard, Ventura county, California. Their dimensions are (1) 76 in. wide, 4 ply, by 105 ft. long; and (2) 65 in. wide, 3 ply, and 157 ft. long. The hides of about 1000 steers were used in their manufacture.

Gold Production of West African Mines in May

	Tons.	Value.	Profit.
Ashanti	11,018	$177,000	$58,000
Broomassie	3,214	73,400	36,900
Tarquah	4,910	67,200	12,400
Abosso	3,870	76,800	17,300

Sorting belts in the Coeur d'Alene region are protected from wear by cross-bars of flat steel riveted to them; at the Federal mines these turn up at the ends, giving the effect of a trough.

Combined Method of Analysis for Constituents of Zinc Ores

By Frank A. Bird

Decompose 5 gm. of the ore in a No. 1 beaker and cover with water. If the ore is a light sulphide or oxide, add 10 c.c. of nitric acid and potassium chlorate at short intervals to oxidize the sulphur, if necessary. If the ore is a heavy sulphide, use from 15 to 20 c.c. of nitric acid and sufficient potassium chlorate, or a saturated solution of potassium chlorate in nitric acid. The decomposition is effected as in any of the wet sulphur methods. A moderate heat will generally decompose the ore and prevent the formation of sulphur globules. Should sulphur separate out, transfer it to a No. 0 beaker and decompose it with a little nitric acid and chlorate, then add this to the main portion, which will save time. When all of the sulphur is in solution, evaporate the solution to a pasty condition and add 5 c.c. of water and 7 c.c. of hydrochloric acid, and reduce to dryness to expel the nitric acid and dehydrate the silica. Cool the residue and add 5 c.c. hydrochloric acid, heat to solution, and everything should then be decomposed. Add 20 c.c. cold water, 35 c.c. ammonia solution,[1] and a precipitant for manganese; 10 c.c. or more of hydrogen peroxide or bromine water. (Or ammonium persulphate salt, 0.1 to 0.5 gm. when the sulphur is not determined.) Boil 5 min. and filter into a No. 2 beaker, using a 9-cm. ashless paper. Label this 'Precipitate A.'

Lime.—Wash the beaker and paper alternately three times each, with hot water; reserve the beaker and place it under a funnel. Should the filtrate not smell strongly of ammonia, add a little more ammonia. Place solution on a hot-plate, and when boiling add sufficient ammonium oxalate solution[2] to precipitate the lime as oxalate. Continue the boiling about one minute and then set aside until the precipitate settles.[3] Decant the solution through an 11-cm. filter-paper, retaining the precipitate in the beaker, to which add a little ammonia after most of the solution is decanted, mix by shaking, and then pour into the filter. Wash the beaker 4 times and retain it; then wash the paper 6 times, both washings being very thorough. With the paper still in the funnel, wash the precipitate back into the retained beaker. Dissolve the calcium oxalate by adding 5 to 7 c.c. of sulphuric acid which has *just* been added to two parts water; dilute to 200 c.c. with water of from 70 to 80°C. and titrate rapidly with potassium permanganate solution. Stop at the first permanent pink and add the filter-paper to the solution, after removing it from the funnel in such a manner as to collect any precipitate that has crept above it. Stir the paper in the solution a minute, and then cautiously continue adding the permanganate to a final permanent pink; about 1 c.c. more will be required. The volumetric method for finishing is more satisfactory and accurate than igniting the precipitate, and where a series of estimations have to be made, it is more convenient and rapid.

Sulphur.—After receiving the calcium oxalate precipitate on the filter and washing the beaker in which the precipitation was made, remove the filtrate receiving the paper washings in some waste vessel. Acidify the filtrate with hydrochloric acid, add 3 to 4 c.c. excess, and boil. While the solution is boiling, precipitate the sulphur, as usual, with hot barium chloride solution,[4] filter, and wash. Label this 'Filtrate A.'

Silica.—Heat 5 c.c. hydrochloric acid with 10 c.c. water and pour this over 'Precipitate A,' to dissolve the iron, etc.; change beakers, if necessary, running the solution through a second time or until everything dissolves. Notice that everything is dissolved in the decomposition beaker, and transfer all the insoluble material from it to a filter-paper. Wash the paper, ignite, and weigh as insoluble silica.

Zinc.—To the filtrate from the silica add 35 c.c. of ammonia solution and manganese precipitant, as before, omitting the water, and repeat the operation; filter through a new paper. With this double precipitation of the iron, all zinc will be in this solution and in 'Filtrate A,' which are to be combined after acidifying the last with hydrochloric acid. Washing with an ammonium chloride-ammonia solution is not necessary with two precipitations, and this method never fails.

To the combined filtrates add granulated lead, and about 15 c.c. more of hydrochloric acid, if the titration is to be made using ammonium molybdate as an indicator. Boil 10 min. and determine the zinc as usual with potassium ferrocyanide.

By decomposing the ore in a No. 1 beaker and throughout the operation avoiding excess of wash-waters, the total bulk by the time the zinc titration is reached can be held between 250 and 300 c.c. In standardizing the ferrocyanide solution, work with an equal bulk of solution.

Iron.—Heat 5 c.c. of hydrochloric acid diluted with 5 c.c. of water and dissolve the iron precipitate, receiving it in the original decomposition beaker; boil the solution and reduce with stannous chloride. When cool, take up the excess with mercuric chloride, and transfer the solution to a No. 4 beaker, diluting to 400 c.c. with cold water; then add 10 c.c. of manganese sulphate solution[5] and

[1]Prepared by mixing together 400 gm. ammonium chloride, 800 c.c. ammonia, and 1300 c.c. water. This amount fills a 5-pint acid bottle.

[2]For this solution, 40 c.c. of a 1:24 hot ammonium oxalate solution is sufficient for pure calcium carbonate = 56% lime.

[3]To be sure sufficient ammonium oxalate solution has been used, test a few drops of the clear solution with a drop of ammonia and some 10% solution of calcium chloride, a precipitate should form.

[4]Five cubic centimetres of a hot 10% barium chloride solution precipitates 0.506 gm. $BaSO_4$, equivalent to 13.9% sulphur when working with 0.5-gm. sample.

[5]Zimmerman-Reinhardt's solution is composed of 160 gm. manganese sulphate dissolved in water to 1750 c.c., then 330 c.c. thick phosphoric acid (85%) is added, and 320 c.c. sulphuric acid. If preferred, reduction can be made in the usual way with granulated lead, zinc, or sodium sulphate; some operators only add 5 c.c. of the phosphoric acid when reduction is made with either of these three.

titrate immediately with potassium permanganate solution.

The following scheme appears to answer every requirement for the technical determination of lime in ores or limestones. It is rapid and does away entirely with ammonium sulphide for the precipitation of manganese and zinc, which when employed always entails a tedious and long-drawn-out process.

Treat 0.5 or 1 gm. of ore in a No. 1 beaker; if a sulphide, treat with 6 c.c. of hydrochloric acid, boil to about half the volume, then add 5 c.c. of nitric acid and reduce to a pasty state. If the ore is oxidized, both acids can be added together.

When a pasty condition is reached, add 40 c.c. of water, 3 c.c. hydrochloric acid, 20 c.c. ammonia, and a precipitant for manganese, as in the above combined method. Boil 5 min. and filter through an 11-cm. paper, washing well with hot water. From here on, proceed exactly as in the combined method for lime: "Should filtrate not smell strongly of ammonia," etc. For all practical purposes, this method is equally as good as the longer ones.

Braden Copper Company

By Pope Yeatman

*I have the honor to report that I have visited the Braden Copper Co.'s property in April, and the following covers, in general, the impressions of my visit:

The plant has not been entirely completed, but should be sufficiently so before the end of the summer to be able to handle at least 3000 tons of ore per day. The construction and operation of the plant has been delayed, due, first, to the abnormal weather conditions of a year ago; second, to some difficulty in obtaining labor; and third, to the installation of the Minerals Separation process for the concentration of the ores. The adoption of this process was decided upon last August, but all the machinery has not yet been delivered on the ground. Nevertheless, progress has been much greater than during previous years, and conditions are shaping in a very satisfactory manner.

Development Work

Considerable development work has been done, and especially in the Teniente section, where the main Teniente orebody has been explored for a distance of over 4000 ft., showing ore of excellent character; in fact, above the average grade. A connection was made in the shaft, extending from Teniente No. 1 to No. 2, and an ore-pass was completed, so that all ore taken out in development in the Teniente orebody can be sent to the mill. A few cross-cuts and raises have been driven, which still further prove the magnitude of the Teniente orebody. The principal work in the Fortuna has been on the No. 2 level, which is being extended so as to make connection by means of a winze with the Teniente tunnel, about 50 metres below. The faces of Fortuna No. 2 and Teniente No. 1 are now about 1000 ft. apart. The No. 2 Fortuna level has also shown considerable ore. A new level, Fortuna No. 2½, was started in order to mine ore between levels, it being found that the distance between levels No. 2 and 3 was too great to allow for carrying up the pillars safely. Improvements at the mine consisted of the erection of more dwelling houses, quarters for the Chileans, and enlargement of the plant.

Increased tonnage has been shown in the Fortuna orebody through the extensions of cross-cuts. The increase of fully-developed ore in the Teniente has not been much, for the reason that the development work was done on only one level to prove the extent of the orebody in length and breadth, rather than the actual volume, which would necessitate the driving of several more levels above the No. 1. While not actually blocked, the Teniente No. 1 development has determined an orebody of great extent.

Developed Ore (1)

Orebody.	Dry tons.	Copper, %.
Fortuna No. 2	2,123,627	2.85
" No. 3	3,983,843	2.66
" No. 3½	6,412,456	2.50
" No. 4	100,000	3.32
Teniente No. 1	4,040,834	2.75
	16,660,760	2.65

Probable Ore (2)

Orebody.	Dry tons.	Copper, %.
Fortuna No. 2	175,545	2.65
" No. 4	2,045,000	2.32
" No. 5	105,000	3.20
Teniente No. 1	2,020,417	2.75
" No. 3	4,040,834	2.75
" No. 3*	61,100	2.27
" No. 3	301,548	2.23
	8,749,444	2.63

Possible Ore (3)

Orebody.	Dry tons.	Copper, %.
Fortuna No. 2	625,500	1.84
" No. 3	175,545	2.65
" No. 3	625,500	1.84
" No. 4	1,680,000	2.28
Teniente No. 1	6,300,000	2.75
" No. 3	9,295,000	2.70
" No. 3	41,200	2.13
	18,742,745	2.61

Robert Marsh, Jr., the mine superintendent, in his report of April 28, 1913, with which I fully agree, states: "Our greatest expectations lie in the Teniente mine. Here we expect to develop a large amount of ore above Teniente No. 1 level, and also between Teniente levels No. 1 and No. 3. The longitudinal section through this property shows graphically what we can fairly expect. We still have about 400 metres of virgin ground to connect with Fortuna No. 2. Of this, 200 metres shows attractive outcrops. It may be possible, however, that Teniente No. 1 level, being over 1400 ft. deep here, is a little too low for the best results.

"In addition, therefore, to the ore shown in the

*Report to the stockholders as consulting engineer.

above table, the following possibilities may be speculated upon:

	Tons.
Above Fortuna No. 2 and extensions	2,500,000
Above Teniente No. 1	10,000,000
Between Teniente No. 1 and 3 (Doubtful, if any)	.....
Extensions of Teniente No. 1 (above level)	2,500,000

"From this it does not seem unreasonable to expect that ultimately 60,000,000 tons of 2.50% copper ore may be developed."

Though operating on a comparatively small tonnage, the costs have been very satisfactory, and it has been shown that the method of stoping will prove an excellent one. The electric railway, which gave some trouble, is working at a low cost and satisfactorily in spite of the heavy grade. Owing to the extreme toughness of the ore and the necessity for finer grinding, it was decided to increase the capacity of the crushing plant, and this is practically completed. During the past year a great deal of work has been carried on in the new mill, principally in connection with the installation of the Minerals Separation process, which has necessitated the introduction of Hardinge mills, Minerals Separation units, settling tanks for dewatering the pulp to a proper consistence for the Minerals Separation process, classifiers, launders, etc., but this work is not yet completed. Operations have been conducted partly with the Minerals Separation process and partly with the old wet concentration method, but, during the installation of the Minerals Separation process, it has been necessary to operate under conditions satisfactory to neither method.

Minerals Separation Process

The experiments were made with the Minerals Separation process, under the direction of the Minerals Separation, Ltd., last June and July, the plant being situated in the old mill. This test showed the advisability of the installation of the process, and it was arranged to change the method of concentration so as to make use of the Minerals Separation process and a greater profit per ton of ore treated. The first Minerals Separation unit was started in the new mill on November 14, treating material that would have otherwise gone to the vanners, but carrying the pulp less suitable for the Minerals Separation process than would be furnished when operating the plant with the proper installation of Hardinge mills. The results with the incomplete installation have not, of course, equaled what has been obtained in that part of the plant which is more thoroughly equipped. The work has shown, however, that an extraction in the concentrator of between 70 and 75% will be obtained. While these results may seem low, it must be remembered that some of the copper in the Braden ore is in the oxidized form, not capable of high extraction, either by the Minerals Separation or by wet concentration methods.

During the year, the second blast-furnace, 46 by 180 in., was erected and also a second Pierce-Smith basic converter. The second blast-furnace was started in April, and all the concentrate so far produced has been smelted. Owing to the stress of other work, the leaching plant had not been completed at the time of my visit, though roasting experiments had been carried out for some time. Since I left South America, however, the leaching plant had been started for a test run.

The production of sulphuric acid, owing to the small amount of conversion and absorption, has not been sufficient, and it has therefore been decided to add a lead-chamber to increase this. The narrow-gage railway between Rancagua and the plant is in very much better condition than at the time of my last visit, owing to the fact that a greater amount of ballasting had been completed, trestles filled, and substantial culverts put in, replacing wooden trestles, and a number of curves of too small radius have been removed. Last summer (the South American winter) the abnormal rains caused many delays from wash-outs, as was the case with practically all the railways in Chile.

Power Station

The electric power station is completed with the exception of a fourth unit, which will serve as a spare or for the operation of the present leaching plant. So far it has not been necessary to run more than two units, and neither of these at full capacity, but with the increased production of the next few months, the three units will have to be run regularly. The abnormal weather of last year also caused wash-outs on the canal and caused some delays last winter. Much of this should be obviated in the future. During the last year improvements have been made in the way of erection and completion of staff quarters, store and warehouse, and single and married quarters, both for the Chileans and the foreigners. Probably the largest piece of outside work has been in the direction of the flume line and dam, to cut out the tailing, which heretofore had gone into the Coya river.

The next few months will witness a decided increase in production. Enough has been done to prove that the cost for producing copper will be below the limit estimated some years ago, namely 7.5c. The developments in the mine within the last year, coupled with work done in treating ores, gives added confidence in the future of the property and suggests the desirability of increasing the scale of operations.

Dredging the Cucaracha Slide, Panama

A relay pumping station is being installed on the west side of the Culebra cut, near the bridge of the Panama railroad over the Rio Grande, in anticipation of dredge excavation at the foot of Cucaracha slide. The plan as at present contemplated involves passing the discharge pipe-line of two suction dredges across the cut on pontoons, and up the west bank to the relay station; thence down the valley of the Rio Grande about 4000 ft., to discharge west of Cerro Luisa, the hill at the outer end of Pedro Miguel dam. It is probable that an earth dam will be thrown from the lower end of Pedro Miguel lock to the hills on the other side of the river, a distance of about 1500 ft., and the swamp west of the lock will be filled with spoil from the slide.—*Canal Record.*

Discussion

Readers of the MINING AND SCIENTIFIC PRESS are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment. Insertion of any contribution is determined by its probable interest to the readers of this journal.

Minerals Separation v. De Bavay Process

The Editor:

Sir—I have read with great interest T. J. Hoover's book on flotation and also the article by Edward Walker in your January 4 issue. Having been closely connected for a number of years with both the Minerals Separation and De Bavay processes in Australia, where they are being used on a large scale, I would offer a few suggestions as to a comparison of these processes.

In comparing the De Bavay process with the Minerals Separation process as used on Broken Hill ores, many factors have to be taken into account. In the first place, the De Bavay company was the first to recognize that in the treatment of Broken Hill tailing it does not pay to treat the slime product, owing to the high percentage of lead that it contains. By rejecting this slime it has been found that not only a higher grade, and consequently a more profitable zinc concentrate is produced, but the slime itself is kept on hand as a valuable by-product.

Mr. Walker remarks that experience gained during the past year has gone to prove the efficiency of the Minerals Separation process over the De Bavay process. This certainly does not appear to be the case, judging by the enormous profits made by the De Bavay company, in spite of the fact that it paid higher prices for the tailing. Also, an interesting point in this connection is the fact that the South Mines, after various trial runs, decided that, from a commercial point of view at any rate, the De Bavay was the best process. This certainly does not point to the process being inefficient as compared with the other processes which are being worked on Broken Hill ores. From a profit-making point of view, the De Bavay process is ahead of any other process that is working on Broken Hill tailing at the present time. I do not refer to the slime. At the present time there is not much profit in the treatment of slime, but it is hoped that the experiments that are being conducted by the South Mines, Amalgamated Zinc, and other companies will be crowned with success. Mr. Walker further states that, moreover, there is little likelihood of the De Bavay process being applied anywhere else than at Broken Hill, as it is obviously of inferior efficiency to the Minerals Separation process. Why obviously? In the first place, Broken Hill is not the only lead-zinc mining centre in the world, and also, with their present knowledge, the De Bavay people could greatly simplify the design of their plant, making it cheaper to erect. Mr. Walker would be greatly surprised if he knew the actual working cost of this process. I regret that professional etiquette prevents me from giving this information. The recoveries are also high, higher than those given in Mr. Hoover's book, in which a crude value for the tailing is conveniently assumed, would lead one to believe. Both the De Bavay and the Minerals Separation process have their scope, but on different types of ore. The De Bavay process will treat material through 30 mesh with 5 to 10% slime, which is much coarser than can be treated by the Minerals Separation process without crushing. For exceptionally fine-grained ores, for which the Minerals Separation process is eminently suited, the De Bavay process is not so good. In experimenting with the De Bavay process, the method described by Mr. Hoover, in his book on flotation processes, is not suitable, as it will give bad results on any ore. Although I have personally conducted numerous experiments on the De Bavay process, I have never used or seen used anywhere the method referred to above. The stepped cone, or rough design shown in Mr. Walker's article, I have never seen on the De Bavay plant, as the engineering skill of the De Bavay company is more up to date and more original than the design would lead one to believe. The De Bavay process stands as a model of Australian management and metallurgical skill, so lightly spoken of by Mr. Hoover.

In reference to the Minerals Separation process, it is not generally known that it is a development of the Cattermole process. The first plant erected at the Central mine was really a large Cattermole plant using Wilfley tables. In observing the tailing from these tables falling into the tailing boxes, a froth was seen floating on the top of the boxes. Immediately the Central mine staff planned out the scheme of flotation boxes and the treatment was modified accordingly. It will be seen that the process was made commercially successful by the Central mine staff and that Australians had no small share in its development. Thousands of pounds profit were made by the Minerals Separation process on zinc tailing before Mr. Hoover's single-level apparatus, which is undoubtedly the finest mechanical feature of the present plant, was introduced. To Mr. Lavers, chief metallurgist of the Minerals Separation, Ltd., in Australia, is also due the rapid advance of this process in treating copper ores, owing to his brilliant research into the adaptability of eucalyptus and other oils to the treatment of these ores without the necessity of the use of acid.

WILTON SHELLSHEAR.

Mt. Morgan, Queensland, May 8.

A Correction

The Editor:

Sir—In your issue of June 7, 1913, under 'General Mining News' for the state of Nevada, on page 875, you state that the plant of the Nevada New Mines Co. "consists of a crusher, ten stamps, tube-mill, agitators, and Oliver filter." This Company has a Hardinge conical pebble mill in operation, which we believe your correspondent has mistakenly called a tube-mill. Will you kindly correct this misstatement in your next issue, and oblige

HARDINGE CONICAL MILL COMPANY.

New York, June 13.

Coinage executed at the United States mints during the year ended June 30, 1913, was valued at $37,147,000, of which $30,058,000 was in gold.

Special Correspondence

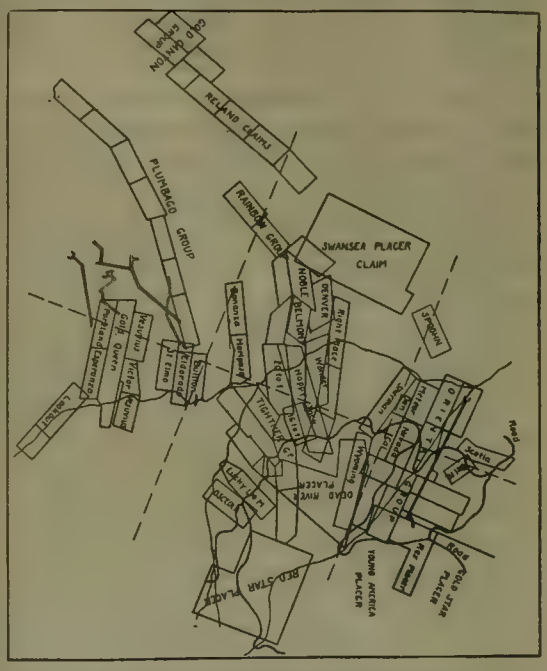
ALLEGHANY, CALIFORNIA

SUCCESS OF TIGHTNER AWAKENS AN OLD DISTRICT.—NEW ROADS REDUCE FREIGHT.—GEOLOGY AND ORE OCCURRENCES. —MANY MINES BEING REOPENED.

The success of the company operating the Tightner mine has aroused considerable renewed interest in this district, as well as surrounding ones, of like character. The proposed new road connecting it with Nevada City by a better and shorter route, is also stimulating activity. This road, which has been surveyed and is now under construction, follows Kanaka creek down to a point below its mouth before crossing into Nevada county. It is largely due to the Tightner people that it is being built, as they have helped materially on the Sierra county end. It will reduce the distance from Nevada City from 39 to 24 miles, and should materially reduce the freight and passenger rates, the former now being 1c. per pound at the most favorable times of the year, and the latter by auto-stage $10 one way, or $18 the round trip. The fare by mail stage is $7 each way, by the old Downieville line to Mountain House and thence to Alleghany by local stage.

The numerous veins of the district strike from north-northwest, to nearly east, those striking nearly north having an easterly dip, and the east and west veins a northerly dip, as a rule. The most common association of country rock with the veins seems to be in contacts of amphibolite and serpentine, but it is dangerous to attempt to generalize much, as it seems to be the district of exceptions. The fact that the bedrock series which makes up the country rock is not often clearly delimited and its members merge into one another gradually, makes it difficult to define a contact, but the Tightner does appear to be on a well defined contact between amphibolite and serpentine, conforming in strike with the direction of lamination of the series, which is a little north of west. Most of the veins follow similar contacts, or are parallel to contacts and near lines of change of character of country rock, though the Gold Cañon, near the southern end of the district breaks the rule by running nearly at right angles to a contact. It is strong in the amphibolite, and extends into the serpentine for about 100 ft., where it dies out. So far, no veins of consequence have been found in serpentine, nor is this rock favorable to their formation.

The veins are usually well filled with quartz and easily followed, except where disturbed by faults, but the distribution of the gold seems to be extremely erratic. It cannot be called a pocket country, for the gold occurs within well defined veins, but it is a country of irregular distribution in extremely high-grade bunches occurring in certain zones, perhaps in the vein areas. There is nothing so far that resembles definite shoots, though it is claimed that with greater depth attained there is a more decided tendency for the ore to occur within certain better defined boundaries, but it is likely that with more work and greater depth simply more is known about the occurrences. There are many theories concerning the best indications to follow in searching for rich bodies, among the things most sought are the following: a hard strongly silicified hanging wall, especially where accompanied by waves or rolls in the vein nearly vertical; the appearance of what is locally known as 'Blue Jay,' a greenish blue rock resembling jasper, evidently a highly altered product; certain small seams, usually quartz filled, coming in from foot or hanging; small cross-faults. The work of H. G. Ferguson, of the U. S. Geological Survey, who has been studying these occurrences there recently, should aid greatly in solving the problem of ore occurrence. Any or all of the indications mentioned may be found with no ore, however. When a high-grade body has been found, it is best to look for more on a line approximately on the dip of the vein, above and below on a line, indicated by the synclines of waves in the hanging wall. Where the hanging wall is smooth and regular for long distances the chances of finding pay seem to be much less remote. The gold in the high-grade spots is free, usually is crystalline, and is in masses of arsenopyrite. This, where separated clean, is often worth $50 per pound or more. This sort of occurrence naturally leads to "high-grading," and the most watchful care on the part of those in charge is necessary to prevent it. No doubt considerable is stolen in spite of the most rigid inspection. The ordinary iron pyrite of the ores is not of much value. The usual concentrate made at the mills of the district rarely assays over $50 per ton, and often as low as $30, which does not leave much margin for profit after shipment and treatment from such a remote point. The milling is very simple, consisting simply of stamping with amalgamation on outside plates and concentration on vanners without classification. The fact that the bulk of the ores are so low grade as hardly to pay for milling, while the bulk of the gold occurs in high-grade that really would not require milling except on a small scale in especially



PLAN OF PROPERTIES IN DISTRICT DESCRIBED.

designed mills, does not offer much encouragement for putting in milling plants. The only excuse for milling much of the ore is that enclosed gold would be recovered that otherwise might be thrown away. Electric power is generally available throughout the district, at reasonable figures, and is the form of power generally used.

Taking up the properties in detail, from north to south, and from east to west, the North Fork, just north of Forest City, is developing the downward continuation of an orebody which was worked originally from a gravel channel drift. The new works reach it through the old Uncle Sam incline with a drift across the old channel, an underground shaft, and drifts from the bottom. It is operated by an Oakland company. The ore is on an amphibolite-serpentine contact, similar at least to that of the Tightner, and possibly the same contact. It is too far away to be at all certain, with the intervening country covered by andesite capping.

The Red Star, formerly worked under bond by L. P. Woodbury and associates, is now being developed by the Tightner people. It is some distance northeast of the Tightner, but probably on a vein of the same system. The property is just to the southeast of Alleghany, and is developed by cross-cuts through amphibolite, and drifts both ways on the vein. H. L. Johnson is said to have taken out over $600,000 from a shoot near surface, before the cross-cut was run. After it had been run, and considerable development done below, the present company bonded it for $600,000, and with a little more development discovered bodies of high-grade ore, from which has been taken prob-

ably more than that amount, with good reserves left. Drifts are now being driven both ways on the vein, raises are being cut at several points, and preparations are being made to sink on one orebody. There appear to be two pay zones discovered, each lying approximately with the dip of the vein, this being about 35° from the vertical. The mine is equipped at present with a 10 by 10-in. belt-driven compressor, from a 60-hp. motor, Waugh stoping drills, and several piston drills, side-dump ore cars of one-ton capacity operated by mules in trains of five or six cars, and a mill of ten stamps, with rock breaker, vanners, and other machinery. The intention is to put in ten more stamps and to increase the air-supply by installation of larger compressor as soon as the new road is opened. Abe Hall, of Grass Valley, is superintendent.

The Twenty One, below Tightner, on Kanaka creek, is being developed by San Francisco people, and is the deepest mine in the 'camp.' It is said to have a strong vein and some good ore developed. The Sixteen to One, above the Twenty One, had a body of high-grade ore several years ago, and is still being developed. Rainbow, on opposite side of Kanaka creek, is working a downward continuation of an orebody discovered and worked in an old gravel channel above. It has a long adit from Kanaka creek cutting the lead at 1500 ft. below the Chips Flat placer diggings. It is said to have considerable pay ore developed, but suffered the loss of its entire plant in early May, as result of placing living quarters too close to the mill. The intention is to rebuild, this time with 20 stamps and more modern concentrating machinery. The compressor has been re-erected and development is proceeding. L. P. Woodbury is president and manager. The Plumbago is near the south end of the district. It is a famous mine with a tremendous amount of development work on a strong east-west vein, and is very regular, dipping 30° from vertical to the north. There is a great extent of low-grade quartz left, largely as pillars, with the greatest development on line of the so-called Robinson shoot, where the vein is 8 or 10 ft. wide. A 20-stamp mill is in rather poor shape, but operating steadily. The place is taking on renewed life under active policy of the new superintendent, A. J. Pierson, lately from Phoenix, Arizona. This property has its own power plant on the Middle Yuba, about a mile and a half from the mine, whence compressed air is carried through a 5-in. line, while a separate generator furnishes current for mill power and for lighting. With investment of more capital to put it in good shape and for deeper development, it may easily become a large producer again. The Gold Cañon is on the Yuba, just below the Plumbago power-house. C. C. Derby is in charge as mining engineer, and is developing the downward course of an ore-zone evidently associated with the intersection of the vein and the contact which it crosses, as noted before. The property has a 5-stamp mill and is well equipped with compressor plant, etc., all operated by water-power developed with a high head. Sufficient ore of good grade has been found in development to keep the mill going with good results.

The Oriental, toward the west edge of the district, is on an east-west vein and was extensively worked from a shaft on the outcrop in early days. Afterward it was purchased by people controlling the Plumbago, and was developed by a cross-cut 4000 ft. long, tapping the vein at 1400 ft. below the outcrop and 600 ft. below the bottom of the old shaft, to which a raise was made. Little more seems to have been done, but considering its advantageous position, it would apparently warrant the considerable investment necessary to further develop the lower portion of the vein and equip with a milling plant. The vein is said to be strong and productive in the upper portion. The Kate Hardie, still farther west, has been worked intermittently for a long time, and is still being worked with fair results. The vein is narrow, but produces some high-grade ore. The Kenyon, on the creek below the Oriental, but on the opposite side, has a good record for production, but is now closed. Conditions in general in Alleghany county point to increased mining activity and the conduct of milling operations on a large scale.

JOHANNESBURG, TRANSVAAL

THE ROBINSON MINE.—CONCENTRATION OF MINING AT CROWN MINES.

Among the richer mines on the Rand, unfortunately fast approaching exhaustion, the old Robinson is of especial notice. Last year's results were not by any means low; for, taking the year on the whole, the mine continued to earn the highest profit per ton of any mine on the Rand. The total revenue last year was £1,260,529, or an average of £2 3s. 8d. per ton milled. Working costs were £451,769, or 15s. 8d. per ton, leaving a working profit of £808,760, or no less than 28s. per ton. Satisfactory as are these figures, they do not compare well with the early achievements of this mine. Starting milling operations in 1888, when ore-reduction methods on the Rand were crude compared with those of today, the recovery averaged no less than £12, the costs of working being at that date about £3, thus leaving a working profit of £9 per ton. In two years the yield fell, however, to £5 per ton, and the working costs to £2, while five years ago the yield was under £3 per ton. Since milling operations commenced at the Robinson mine, over 6,000,000 tons has been crushed, and 4,115,137 oz. of gold recovered, of a total value of £17,300,000, or an average of 58s. per ton. Of this large amount, over £9,000,000 has been paid in dividends. The mine is, however, rapidly approaching exhaustion, and has already ceased to hold the reputation of having the highest yield of any mine on the Rand, that distinction at the present time being held by the Meyer & Charlton. Last year the development footage at the Robinson showed a marked decline, and only amounted to a total of 5823 ft., and soon the whole of the mine area will have been developed.

The Crown Mines Co. may be regarded as the pioneer of what, for want of a better definition in Rand mining, is called the Kimberley system of mining, the chief features of which are to concentrate all underground operations as closely as possible. To carry out this idea, a large main level is being driven, on the horizon of No. 13 level, from one end of the property to the other, and which is now completely equipped and at work between No. 1 and 7 shafts. During the year, this level was driven 984 ft., and is already 1567 ft. west of No. 7 shaft, but it has still 4500 ft. to be driven before it reaches the western boundary of the property. This level is equipped with an elaborate electric-haulage system, and is intended to deal with an output of 10,000 tons per day, and to supply both No. 5 and 7 shafts with ore. New crusher stations have been erected at the head of these two shafts, and a system of electrical transport of the crushed ore to the mills arranged in such a manner that all the mills are linked up with the system. Over £1,250,000 has been spent in this work, and when the whole arrangement is in full swing, lower costs and higher profits are looked for. All the large amalgamated properties on the Rand are now adopting this system of main-receiving levels for the concentration of underground operations, and in the face of the higher costs of working in general on the Rand, it is hoped that the system will bring about the expected reduction in working costs.

BUTTE, MONTANA

COLLAPSE OF BUTTE CENTRAL.—BUTTE & SUPERIOR AND ELM ORLU.—SECONDARY ENRICHMENT AT BUTTE.—A. I. M. E. MEETING.—NEW COPPER DISTRICT?

For the second time the old Ophir mine has proved disappointing to its owners. After a meteoric career in the stock market and in the newspapers, the Butte Central Copper Co. is rapidly dropping into oblivion, leaving its stockholders in a bad mood. The mine and mill are now closed and attached by unpaid employees. The former collapse came after a vain attempt to make a copper mine out of a typical manganese-silver vein. The present calamity results from imagining the existence of commercial silver-gold orebodies where none were to be found. Both failures were due to lack of conservative engineering advice as against that of the old-time miner and practical man. It is one of the numerous cases where it is difficult

to fix the blame. The whole miserable fiasco can be adequately explained on the grounds of ignorance and inexperience in the executive side of mining. If the directors had been wise enough to take their money and mine to reputable engineers in this country or in Europe, and say, 'Here is what we have, can anything be done with it?' they would have been told, after proper investigation, either to distribute their money or look for something else to invest in. But in such a promotion as Butte Central, the promotion and management of the enterprise usually get so badly interwoven that the men who raise the money usually want to run the mine in person, partly from a sense of responsibility to their clients, it may be, but also, in many cases, because of the remuneration connected with such management. Such remuneration may be either direct in salaries, as in the promotions of Stephen R. Dow of Boston, or indirect, as inside information useful in stock manipulation.

It is rumored that the Butte & Superior Copper Co. and Elm Orlu Mining Co. have been considering consolidation in order to avoid the troubles of probable litigation over doubtful orebodies. W. A. Clark, of the Elm Orlu interests, denies this, however. It is at least certain that both parties are doing everything possible to avoid bringing their differences into the courts, and the community at large wishes them success. In the meanwhile, the Butte & Superior mill is doing good work with the zinc ores, and the Elm Orlu is not pushing the construction of its much-heralded mill on Timbered Butte. All of which is food for thought.

Butte can claim distinctions of many kinds—namely, largest mines, biggest copper productions, biggest mining town, strongest labor unions, ugliest appearance from a distance and possibly from nearby, worst moral reputation undeserved, etc.—but one of its unique distinctions is as a battle-ground for theorists on genesis of ore deposits. It certainly has them guessing, and they come in numbers to examine the 'strange' orebodies and speculate on their origin. The bone of contention is the copper-glance ore. According to all theories held heretofore, this should have been worked out long ago. But the mines are still in operation. Neither has the chalcocite cut out, which causes much comment. A big battle of geologists will probably take place in August, when the American Institute of Mining Engineers meets at Butte. Some people think that the chalcocite did not form from descending sulphate solutions, with attendant secondary enrichment, and will be there to prove it. Others are equally convinced that that is the way it did form, and will also be there to prove it. The advance guard of some of the contestants has already arrived in the persons of L. C. Graton and their associates, who are here with apparatus for investigation. The Graton-Murdock idea of examining the ore relations microscopically is really something new, and worth while. Incidentally, these geologists will have one big advantage, in that their opponents will have to get microscopes and polished sections, too, before they can dispute anything. Mr. Graton and his crew are out to clean up this subject of secondary enrichment of copper in general. They expect to spend several years at it, from Alaska to Mexico, and possibly elsewhere. They are a 'live bunch' of young scientists, and something should come from their endeavors.

The geologists are not the only ones interested in the August meeting of the American Institute of Mining Engineers at Butte. In fact, in point of numbers, the geological papers are almost eclipsed by the metallurgical and mining papers. More than 40 papers have been prepared for this meeting, and nearly every phase of milling and smelting practice in Montana will be covered. These papers, and the resulting discussion, promise to be so instructive that no live metallurgist can well afford to be absent, and it is probable that very few of them will be. The thoughtful ones are already making hotel engagements for themselves and friends, and the local committees are busy making things ready for the mental and physical needs of their fellow engineers.

There is so much loud talk going the grounds about a 'second Butte' in Flathead county, Montana, that we are beginning to think that some of the old Nevada expert boosters and 'wind-jammers' have invaded the land. Nothing is known here against the new camp except the talk and newspaper mining. It is hoped that it will prove ten times bigger and better than Butte, if only for the purpose of giving the Copper Producers' Association something new to think about. It must be confessed that, so far, no intelligent coördinated description of the conditions has been forthcoming. These mysterious new bonanzas

END-VIEW OF 2400-VOLT GENERAL ELECTRIC LOCOMOTIVE.

are said to be northeast of Flathead lake, about 30 miles south of the Great Northern railway, and of course in a densely wooded, out-of-the-way locality.

The electrification of the Butte, Anaconda & Pacific railway is nearly completed, and the electric locomotives will soon be displacing the steam-engines. The electrical engines are queer but powerful-looking affairs. They resemble from without old stubby box-cars, such as section gangs inhabit on the sidetrack. They are not impressive and powerful-looking like the big steam locomotives they are to displace. But looks are deceptive, apparently, as they can pull more than their predecessors, and cost more, too, $40,000 being the price of each in round figures. As the main ore line for Anaconda passes through the best residence section of Butte, the people are glad to see the change coming, in the hope that the new motive power will not be so noisy and dirty as the old steam-engines.

The slime and sand from the concentrator at Anaconda are being made into tile and bricks at the Washoe brick plant. The product is experimental so far, but gives promise of success.

NEW YORK

BRADEN REPORT.—CHILE COPPER.—METAL PRICES.—AMALGAMATED DIVIDEND.—OHIO COPPER.—MEXICAN CONDITIONS.

The expected increase in the ore reserves of the Braden mine was announced in a report by Pope Yeatman, made at the stockholders' meeting June 23. The report is reviewed on page 19. Earlier in the week Braden called for redemption $68,500 of its 6% bonds, and a few days later canceled the call on the ground that redemption might lead to dissatisfaction on the part of those bondholders who paid higher prices for the bonds than the redemption figure. Braden bonds sold as high as 210 when the stock was at 10½, so that the present level of around 7 is a poor one at which to effect conversion. There have been persistent rumors that some new financing of Braden will be necessary, but they have been as persistently denied. Thomas W. Proctor has been appointed a master by the Supreme Court in Boston to hear the suit of Louis Ross against A. C. Burrage to recover a share in the promotion

profits of the Chile Copper Co. As it is expected to have that Company at work within three years, producing copper at the rate of 300,000 lb. per day, at a cost of 6c. per pound, it looks as though the supply of cheap copper is in no immediate danger of exhaustion. At any rate, that is evidently the view of the consumers, for none of the big buyers have come into the market during the past week. Producers hope for a speedy resumption of buying at the 15c. level, but meanwhile small lots have changed hands at as low as 14⅝c. European sellers are reported to be out of the market for July-August deliveries, indicating that they are sold out of spot. As much spot remains to be purchased, the sellers have the London spot situation in their hands. The A. S. & R. Co., on June 27, was quoting £69 in London. The Nichols refinery is still tied up by the strike, so Phelps, Dodge & Co. are entirely out of the market. Small sales of lake copper were made at 13⅜c. by a company which needed the money more than the copper. Consumers freely state that they are in no hurry to buy, expecting to get bargain prices later. Exports of copper for the week ended June 26 were 5228 tons, a total since June 1 of 25,341 tons. Exports during the same period last year were 21,930 tons.

Reduction of the dividend rate of Amalgamated Copper is rumored, and is evidently more than a possibility, since the copper metal market is so weak and is threatening to sag lower. Amalgamated is a peculiar stock; it sells now but little above A. S. & R., although it is paying 6% and the latter only 4%. It is quite possible that the decrease has already been discounted, just as the stock sold at a higher figure just before the increase to 6% was announced last fall than it has at any time since. Giroux stockholders have already deposited more than a majority of the shares of that concern for exchange in the new Coppermines merger. By the laws of Delaware, 65% of the stock must be exchanged in order to give the Coppermines company "physical control" of the Giroux, and the deposit of shares is expected to reach that figure before long. It is stated that leading interests in the merger have agreed to underwrite a large part of the $3,000,000 7% bond issue which it is proposed to float.

After having been postponed four times, the annual meeting of the Ohio Copper Co. was held in Boston on June 25. The board, as elected, consists of W. O. Allison, F. A. Heinze, J. W. McKinnon, J. W. Pierson, Jr., W. C. Lewis, W. I. Badger, and Maurice Levy. Mr. McKinnon represents the Assets Realization Co., controlling 163,000 shares of Ohio which formed part collateral of the $1,000,000 loan negotiated by the United Copper. Mr. Lewis represents Walker Bros. of Salt Lake City, and Mr. Badger is said to have been elected because of large personal stockholdings, although he has acted as legal representative for Heinze for a number of years. It is said that Heinze no longer controls Ohio, and will probably not be elected chairman of the board at its organization meeting. The United Copper is about to drill its coal property, held by the New York & Pennsylvania Coal Co., and until this work is finished no reorganization plans will be formulated. It has always been claimed that this coal property formed an exceedingly valuable asset, and the investigation of the value will be a correspondingly careful one.

Mexican railways are in a nervous state. It was reported on June 27 that the National Railways of Mexico had been placed in the hands of a receiver, J. M. Galbraith, the manager in Mexico City for the Waters-Pierce Oil Co. Following the announcement of the resignation of E. M. Brown from the presidency, this created some consternation, but the report is doubted by the banking houses concerned. The resignation of Mr. Brown is also denied. Nevertheless, it is evident that the situation of the railway is bad, and it would not be strange if before long the Mexican government has the obligations and the bankers have the railway. A report from the United States Consul at Chihuahua states that railway communication has been shut off for more than three weeks, and the latest reports from Chihuahua indicate that everything south of Juarez is in the hands of the Carranzistas, and Juarez may fall at any time. General Pedro Ojeda tried to force his way from Guaymas to Hermosillo, but was beaten back, and Guaymas is nearly in the hands of the state forces. On July 1 the bankers interested will offer for sale $8,500,000 of the 6% Mexican government bonds, and $14,250,000 will be issued in France, and $7,250,000 in England. It is reported that the French bankers are taking them at 89 and hope to sell them for 95 or better, so Mexico will have to pay well for her money. The A. S. & R. Co. has been having a hard time in Mexico during the past year, as the operations have only been on a 50% basis at times and are now about three-quarters of normal, with one more furnace about to be blown in at Aguascalientes and two more at Monterey. Earnings are showing a decrease, but the company officials maintain a cheerful attitude. Rumblings of a threatened suit by the Government for the dissolution of the 'Smelter Trust' continue to be heard, so the stock market outlook for the 'Guggenheim' issues is not as bright as it might be.

FEDERAL SOLDIERS IN CAMP.

JOPLIN, MISSOURI

UNDERWRITERS LAND CO. ACQUIRES YELLOW JACKET LEASES. —MINING FROM FLAT-BOATS IN DRIFTS OF YELLOW DOG MINE.—ZINC AND LEAD NOTES.

The Underwriters Land Co., operators of the Priscilla mine in the West Joplin district, has acquired the fee to 132 acres of the McBee land in the Klondike camp, six miles northwest of Joplin, for a consideration of $50,000. J. H. McBee and associates owned the tract, which was not worth $50 an acre, so far as was then known, three years ago. Development by the Yellow Jacket Mining Co. disclosed good zinc and lead deposits, the former ore predominating. O. W. Sparks opened the Yellow Jacket mine, which is a good producer of top-grade zinc sulphide ores. The faith of the Underwriters Land Co., which has operated

in the Missouri-Kansas-Oklahoma district for many years, in the future possibilities of the zinc and lead industry, is one of the best advertisements the district can have.

While the Underwriters company is extending its work in the West Joplin districts, work has been suspended in the formerly rich mines north of Webb City. The pumps have been withdrawn from the old Yellow Dog workings and the water has risen in the old drifts. Sub-lessees are working the rich old pillars that yet remain. They carry the ore from these pillars to the shaft with the aid of large flat boats. It is hoisted to the surface and cleaned by hand jigs. The Yellow Dog is one of the famous old producers of the district. The removal of the pumps will make pumping operations much more difficult in adjoining properties to the south. A substantial concrete dam separates the Yellow Dog drifts from the workings of the mines to the south. When the water rises over this barrier, which is 27 ft. in height and about 75 ft. long, the workmen in adjoining mines will be working far beneath the water-level of this expansive underground lake, which will be scores of acres in extent. The pumps at the Yellow Dog were throwing 3000 gal. per minute, or 4,320,000 gal. per day. The concrete dam is constructed at a depth of 200 ft. beneath the surface.

Interest in large mining operation centres in the West Joplin district, at this time, where some big milling properties are being opened. On the Riseling estate, sheet ore is being blocked out in a number of drill-holes at a depth of approximately 200 ft. The surface is flat prairie and has not been mined extensively. It has only been within the past few years that mining operations of any importance have been carried on in this region. The ore as a rule shows a mill recovery of about 3.5% zinc sulphide with some lead. In places, the lead ore is especially rich. The sheet-ore district is being blocked out over an area of three miles east and west, and about two miles north and south. Among the operators that are active in this work are O. W. Sparks, J. M. Short, the Underwriters Land Co. and the St. Louis-Joplin Lead & Zinc Co. Work on the latter's land is of unusual interest, in view of the greater extent of the mineral formation.

A new concentrating plant is being constructed by the Kansas City Mining Co. on a lease of the Rex land, east of Joplin. The shell of the mill was moved from the Duenweg camp. Dirt from half a dozen small 'gouges' will be handled over the plant. Drilling for deeper ore is now in progress.

LONDON

ZINC CORPORATION AND FLOTATION PROCESSES.—MUREX MAGNETIC CO.'S AFFAIRS.

On many occasions I have given records of the doings of the Zinc Corporation, which was formed in 1905 by Bewick, Moreing & Co. for the purpose of treating the great stacks of zinc tailing at Broken Hill. The early days were occupied in accumulating expensive experience in connection with the many flotation methods then attracting attention. Engineers with varied experience attempted to apply the rival processes, the action of which was little known. Eventually the Elmore vacuum plant came to the rescue of the almost bankrupt company; but in 1910 the improved Minerals Separation process asserted itself as by far the cheapest in first cost and in working, besides having a wider scope as to material. During the past two months two subsidiary processes have been adopted, of which details are given later. In the middle of 1911, it was decided to acquire the South Blocks mine, and thus become a mining company, instead of depending on dumps and tailing produced by other companies. A further venture in this direction is to be chronicled in the acquisition of the control of the Sunny Corner mine in New South Wales, floated as a separate company called 'Zinc No. 1.' The South Blocks mine contains two lodes outcropping on the surface, in which lead and zinc predominate, respectively. Development has been centred on the lead lode. On the first seven levels, this lode has proved to average about 10 ft. wide, but on the eighth it is no less than 80 ft. wide. An inspection of the mine plans leads to the conclusion that the zinc lode also is a spur of this deep wide lode. As the ore disclosed on No. 8 level is higher in quality than the average of the mine, it is obvious that the outlook is excellent. As regards the two new processes mentioned above, the first is the invention of the mill foreman, James Lyster. Its object is to float the galena out of the slime produced in the lead-concentration plant that treats the ore from the South Blocks. The second is E. J. Horwood's roasting process intended for the treatment of the zinc slime that comes from the zinc-concentration plant. Mr. Horwood's process consists in giving a roast at a low temperature sufficient to coat the galena with sulphate, but not affecting the blende. Thus, in subsequent flotation, the blende rises and the sulphated galena sinks to the bottom. I should add that the flotation business, since the erection of the Minerals Separation plant in 1910, has been in the hands of Theodore J. Hoover, first as engineer to Minerals Separation and subsequently as managing director of the Zinc Corporation. During the year 1912, 138,284 tons of South Blocks ore was treated, averaging 15.3% lead, 9.16% zinc, and 2.57 oz. silver, from which 25,227 tons of concentrate was recovered, averaging 67.3% lead, 6.2% zinc, and 9 oz. silver. The zinc-concentration plant treated the zinc tailing from the lead plant, and tailing from the various purchased dumps, the total being 345,425 tons, averaging 14.41% zinc, 5.5% lead, and 6.94 oz. silver. From

ZINC CORPORATION PLANT AT BROKEN HILL.

this, 85,354 tons of zinc concentrate was obtained, averaging 47.2% zinc, 7.4% lead, and 12.5 oz. silver, and 10,881 tons of lead concentrate averaging 57.9% lead, 14.8% zinc, and 32.2 oz. silver. The sale of concentrates brought an income of £644,428, and £206,433 was distributed in dividends.

Mr. Hoover has recently extended his interest in flotation by becoming consulting engineer to the Murex Magnetic Co. This Company provided one of the Stock Exchange booms four years ago, and the shares were rushed to absurd prices. The people behind it were connected with the Shell oil group. As has often been recorded, the process consists of adding oil and magnetite or other magnetic mineral to the crushed ore, and removing the agglomerated magnetite and sulphide by means of magnets. The advantage is that, as no acid is used, the process can be applied to ore that contains much calcite or other carbonate. The process is in use at Corboda copper mine in the South of Spain, at the Whim Well copper mine in the northwest of Western Australia, and at mines in France and Germany. But the board and control have proved to be inefficient in business instincts. A bad mistake was made in connection with the terms under which the South Blocks Extended mine was financed by Murex funds, and the whole of the money thus advanced has been lost. The Company is at the end of its financial tether, and is to be reconstructed with the object of raising a few thousand pounds in order to continue its existence until such time shall arrive that substantial royalties are received. The shareholders have done well in putting things in the hands of an expert with good connections like Mr. Hoover. Under the old regime, engineers all over the world were inclined to regard the Murex company dubiously. They will be more ready to investigate now that a reliable engineer is at the helm.

General Mining News

ALASKA

JUNEAU

The Alaska Mexican stamp-mill crushed 20,286 tons of ore in May, producing $54,052 from amalgamation and concentrate. Operating expenses were $23,591, and construction $2180, leaving a profit of $28,280.

The Alaska Treadwell stamp-mills crushed 71,512 tons of ore, producing $190,073. Operating expenses were $85,486 and construction $8197, leaving a profit of $96,389.

The Ready Bullion and 700-Ft. Claim mills of the Alaska United crushed a total of 36,672 tons of ore in May, yielding $84,452 from amalgamation and concentrate treatment. Operating expenses were $56,430, and construction $2181, leaving a profit of $24,841.

ARIZONA

COCHISE COUNTY

The Mascot Copper Co., three miles from Dos Cabezas and about 17 miles east of Wilcox, the nearest railroad point, promises to begin shipping shortly.

Ore-bins are being built at Wilcox, and auto-trucks will be used to haul ore and supplies to and from the mine. A steam hoist of 1000-ft. capacity has been installed. Two drills are in operation, and one hole was put down 1500 ft. In Dos Cabezas mountains, good vanadium ore has been discovered.

GILA COUNTY

(Special Correspondence.)—At the New Keystone mine, retimbering of all the drifts has been completed. As there has been no work in the way of development performed during the past year, the ore reserves are still estimated at 2,500,000 tons of 2.25% copper ore. The delay in treatment of Keystone ore is accounted for by the existence of so much oxidized ore in the property, rendering treatment by the usual methods uncertain. R. C. Canby, who is experienced in low-grade ore treatment, will subject the Keystone ore to thorough tests during the coming months. It is probable that his experiments will include the erection of a small experimental mill on one of the extra foundations laid down when the Miami mill was built, especially so, as the experiments to be conducted by Mr. Canby will be valuable to the Miami company, with its large tonnage of oxidized ores which must be treated by leaching. Mr. Canby laid out a program of tests here in March, and since then has been investigating the recent developments at Anaconda and other large plants throughout the country. He was in charge of the old ferric-chloride process tested by Hunt and Douglas twenty years ago.

The position of the Iron Cap is improving every day. The cross-vein found recently has been cut in both directions until the width of the orebody at this point is 30 ft. The face of the main drift continues in rich copper ore, and has straightened out again to its main easterly course. On the 800-ft. level the same vein is being followed from a point about 78 ft. east of the shaft.

Miami, June 25.

(Special Correspondence.)—The Apache group of claims, situated in Richmond basin, and owned by Pfeister Bros. of Globe, has resumed shipping ore to the Old Dominion smelter. The ore averages 25% copper and is high in iron content. It occurs in a contact of lime and quartzite. Transport over 12 miles is done by mule-teams.

Miami, July 1.

Improvements at the Ray mill at Hayden, consist of three more settling tanks to take care of overflow water from the 16 concentrate bins; the return water pipe-line is finished; and two more Green chain-grate stokers are being installed at the power-plant.

The Old Dominion Copper Mining & Smelting Co., at Globe, will place in operation additional electrical equipment, including two 815-kva. alternating-current generators; two 100-kva. synchronous motors; one 150-hp., six 75-hp., one 50-hp., one 20-hp., and three 10-hp. motors, and switchboard panels. This apparatus has been ordered from the General Electric Company.

MOHAVE COUNTY

The Gold Road mine produced $80,000 in gold during three weeks of June.

A cross-cut on the 250-ft. level of the Silver Hill mines at Chloride, disclosed a body of ore ranging from five to seven feet, the average value of which is said to be in excess of $70. This mine has been idle the past 25 years and the ore was only found on the property by accident.

A large orebody has been opened in the New Jersey mine, at Chloride. The drilling plant for the Kingman Copper Mining & Milling Co. will soon be ready for installation. The Tennessee mine shaft, at Chloride, is being sunk deeper. Good ore is being opened on the 900-ft. level.

PIMA COUNTY

(Special Correspondence.)—The Empire Zinc Co. is working about 40 men on the old San Xavier claims in the Pima district, some 20 miles south of Tucson, and is shipping about 50 tons of ore per day. The ore contains silver and gold. The copper-bearing portions of the claims will soon be worked again.

Tucson, June 26.

The Old Mammoth mine, which has produced a great deal of gold, has been bought by the Great Western Copper Co., represented by W. J. Young and brother, for a consideration said to be about $150,000. The deal was closed in Detroit with the previous owner, named Fletcher. The Great Western Copper Co. has had engineers testing the ore for the past two months. Development will be started on the 700 and 800-ft. levels. Below the former level there is said to be a large shoot of ore carrying gold, $9 per ton, and 4 to 6% copper.

YAVAPAI COUNTY

(Special Correspondence.)—The Hull tunnel has been driven more than one mile, and is to be cut right through the mountain. A winze is being sunk 5000 ft. from the entrance to the tunnel, on a promising vein opened by the tunnel at that point. The tunnel will connect underground with claims on both sides of the mountain.

Jerome, June 26.

Ample capital has been provided for the development of the Harqua Hala mine of the Yuma-Warrior Mining Co. This mine has produced a good deal of gold in the past.

The Hidden Treasure Mining & Development Co. is sinking the winze from the adit of the Monte Cristo mine. The bottom of the winze shows 10 to 14 in. of rich gold and silver ore.

CALIFORNIA

KERN COUNTY

The Midway Gas Co. will increase its delivery this week from 7,000,000 to 15,000,000 cu. ft. per day, following the bringing in of new gas wells in its territory. The Associated Oil Co. has recently brought in two new gas wells, and the Honolulu Oil Co. another. The new production within the past few weeks will amount to nearly 100,000,000 cu. ft., open measurement, which will be reduced to 15,000,000 to 20,000,000 ft. under pressure sufficient to carry to Los Angeles.

SIERRA COUNTY

A stamp-mill may be erected at the Red Ledge mine, 7 miles west of Alleghany. J. B. Moulton is in charge. The 3-stamp mill at the Kate Hardy, at Forest, is working again. Mine development is encouraging. A. D. Grant is in charge.

TRINITY COUNTY

(Special Correspondence.)—The Enterprise is the only mine being worked in the Helena district. It is operated under lease by R. H. Skinner, J. D. Day, and F. C. Meckel. The 10-stamp mill is working one shift, but as there is plenty of ore opened, another shift will be started. Other properties are being prospected, and generally the position is encouraging.

Helena, June 20.

TUOLUMNE COUNTY

(Special Correspondence.)—The water in the Dutch

mine, at Quartz, has been lowered 250 ft. since the work of unwatering to bottom began. It is estimated that the pumps must continue in operation for at least two months longer to finish the work. It is the intention to open much new ground in the lower portion of the mine by driving. Work has for a long time been confined to the upper levels of the property. The Columbia Basin mine, a deep gravel property, situated near Columbia, is to be reopened for the resumption of mining work. During the last period of activities at the property, a fine surface equipment was put in and extensive development work was done. Preparations are being made by John Segale to begin mining operations in the bed of the Tuolumne river above the Clio mine. The stream will be diverted from its natural course by constructing a dam and large ditch. It is expected that the shaft at the Experimental mine, above Columbia, will cut the vein within a few days, when driving will begin. It has almost reached the depth of 300 ft. A mill-test is to be made of ore from the Sonnet mine, in the Columbia district. A large new pump has been installed at the Shawmut mine at Jacksonville.

Sonora, June 28.

COLORADO

Colorado is the most important coal-producing state west of the Mississippi river, and ranks seventh among all the states. The coal mined in 1912 was 10,977,824 short tons, an increase of 820,441 tons over 1911, according to

COLORADO. MINERAL AREAS IN BLACK. COAL IN SOUTHEAST.

E. W. Parker, of the United States Geological Survey. The value increased from $14,747,764 to $16,345,336. The total area underlain by coal in Colorado is estimated at 17,130 sq. miles, and about 60% of that entire area is believed to contain coal that is workable under present conditions. The state contains areas embracing over 4000 sq. miles, about which little is known, but which may contain workable coal, and nearly 3000 sq. miles in which the coal lies under heavy cover and is therefore not workable at present. In point of production, the most important area is the Trinidad field, underlying considerable portions of Huerfano and Las Animas counties, which in its southern extension into New Mexico as the Raton field is also the most important producer in that state. The coal of this field is a high-grade coking coal, probably the best coal of that grade in the Rocky Mountain states.

The San Juan

During May the Tomboy mill worked 29 days, crushing 12,000 tons of ore yielding $25,000 and $59,000 from 1550 tons of concentrate shipped. The profit amounted to $35,000.

IDAHO

Bonner County

The Buckhorn Mining Co. is building a 5-stamp mill on the east fork of Deer creek. The development of this mine consists of 2000 ft. of adits. Assays run from $16 to $40 per ton. A wagon-road has been constructed to this mine and the crew employed at the mine consists of 18 men under the charge of William Johnson. It is expected that there will be water enough to be used to run the mill when ready for operations.

Clearwater County

A gold nugget weighing 19.6 oz. and worth $290 was found by G. V. Friedman at his placer claim on Snake creek. The gravel here averages 60 to 70c. per yard, and the nugget was found at a depth of 10 feet.

Idaho County

The Moscow mine is changing hands. Mill equipment is of a crude type to treat the low-grade ore mined.

Shoshone County

The Big Creek Leasing Co. has been incorporated at Kellogg with a capital of 5000 shares of $10 each. Its object is principally leasing work. The Interstate and Callahan mines are now connected by a 5400-ft. tunnel, which is being extended 2000 ft. to the Amazon-Manhattan. This property is under option to the Interstate for $160,000. A 300-ton mill is operated by the latter. Ore from the mine is conveyed to the plant by an aerial tramway of 1000-ton daily capacity. The orebodies in the various properties are rich in lead, silver, and zinc. The silver yields as high as 50 oz. per ton, 76% lead, and 59.7% in zinc, and the new mill is making an extraction of 95% of the mineral content.

MONTANA

The production of coal in Montana in 1912 was 3,043,495 short tons, valued at $5,342,168, according to E. W. Parker, of the United States Geological Survey. This is the first time that the output of the state has passed 3,000,000 tons. The coalfields of Montana are widely scattered and their output ranges in quality from lignite to a bituminous coal of fair grade. Nearly all of the eastern third of Great Plains portion of the state is underlain by lignite and low-grade sub-bituminous coal. Toward the mountainous district the coals pass into high-grade sub-bituminous and true bituminous coals. These occur for the most part in relatively small and much scattered areas. In the valley region of the western part of the state the coals grade again into lignite, but unlike those of the eastern part, they are widely scattered and at present are not of economic importance.

Lincoln County

(Special Correspondence.)—J. J. Hibbard and P. S. Rose, who recently leased the Peterson-Bergstrom gold mine about 25 miles south of Libby, have received returns from a mill-test of the ore which they say is very satisfactory. The test showed that 90% of the contents could be saved. The ore vein carries on an average gold to about $20 per ton. It is the intention of the lessees to erect a stamp-mill and concentrator on the property.

Libby, June 22.

Missoula County

The Iron Mask Mining Co. has 10 mining claims, two millsites and two water rights, in the Spring Gulch district, near Keystone. Mining is mostly done by adits, and has been under way since the beginning of 1907. It is intended to erect a mill in the near future.

Silverbow County

(Special Correspondence.)—The new mill of the St. Louis Mining Co. has been placed in operation. It has a capacity of 200 tons per day, and, according to information given out, it is giving general satisfaction. It is being operated by electricity, and those in charge say that this power is much more satisfactory than steam. The Butte-Alex Scott, during the year ended June 1, earned over $81,000 net as compared with $19,000 for the same period last year.

The mine is the best paying independent property in the district at the present time, and as depth is being attained, the mine is making a much better showing than ever before. A. B. Wolvin, of the Butte & Duluth company, says that he will have his enlarged leaching plant in operation within the next two months, and at the present time he is treating 100 tons of 4% copper ore per day, from which he is receiving a return of 98% pure copper. Mr. Wolvin says that when the enlarged plant is completed, he will handle 500 tons of ore per day. The force of miners has been increased for the purpose of getting out a large supply of ore. According to reports given out by the Davis-Daly people, the Colorado mine is fast becoming a producing property. The Hesperus orebody, cut on the 1400-ft. level over eight weeks ago, was picked up a few days ago in No. 2 cross-cut, 125 ft. farther east than where the orebody originally was found. Development has disclosed an orebody 14 ft. in width, averaging about 4% copper with some silver. The Hesperus orebody has been proved for a distance of 325 ft., 200 ft. of which, west from No. 1 cross-cut, shows a shoot, the average width of which is 17 feet.

Butte, June 28.

During the first three weeks of June, the Butte & Superior mill averaged 650 tons of ore daily, with 1½ sections in commission. The concentrate assayed 49% zinc, and recovery was 89 per cent.

The Belmont shaft at the Butte is down 2400 ft., and connections have been made with other mines of the Anaconda group. Underground wiring for electric traction is underway. A 5000-ton ore-bin is being built and will be provided with modern appliances for loading ore into cars for transport to the Washoe smelter. At the Butte & Zenith 500-ft. level cross-cut, a well defined vein has been cut. An electric pump has been installed, and the electric hoist is ready for operation.

NEVADA

Clark County

(Special Correspondence.)—The Eldorado mining district, of this county, better known as the Eldorado Cañon area, is enjoying a revival of activity. From 25 to 30 years ago its surface ores produced several millions of dollars. The district was practically abandoned seven years ago. G. A. Duncan has been developing a large group of prospects, which he afterward purchased, and has been urging the importance of the district on others who were seeking mines. Four good mining companies are now pushing development work on as many different groups of claims, with good cause for encouragement.

Nelson, June 27.

Esmeralda County

On July 4 there will be drilling contests at Goldfield. Prizes for double and single work will be $500 and $200, and $150 and $75, respectively, for first and second places.

Eureka County

(Special Correspondence.)—The work on the Buckhorn mill is going ahead at a good rate. The framework is up for the crushing plant, the tube-mill foundations are in, and the concrete work for the cyanide plant is about completed. The haulage adit has been connected with the mine workings, and about 15 miles of the poles for the transmission line are already up. The power plant is situated at Beowawe, on the main line of the Southern Pacific, some 30 miles north of Buckhorn.

Buckhorn, June 28.

Humboldt County

Sulphide ore has been opened at a depth of 200 ft. in the Big Four mine, Rochester. The vein is 9 ft. wide, averaging $35 per ton. Diamond-drilling will be done at the Seven Troughs Coalition mine.

Lincoln County

The Prince Consolidated is shipping 200 tons of ore per day. Tailing shipments from Bullionville to the Tooele smelter have been curtailed. It is stated that there is 600 ft. of unprospected ground in Prince territory, between the south end of its workings and the Virginia-Louise property, which has proved the Prince iron-ore deposits as large and valuable as in the older mine.

Mineral County

Cinnabar has been opened near Mina, and samples return 6.5% mercury. The Goldfield Consolidated Mines Co. has recently ordered from the General Electric Co. a new 600-hp. induction motor.

Nye County

(Special Correspondence.)—G. A. Duncan, of Nelson, Nevada, has sold his five patents pertaining to the treatment of slime in cyanide mills. As the purchase was made by a consolidation of the milling companies of Tonopah and Goldfield, the active agent in the transaction being Albert Burch, manager of the Wingfield interests, it is possible that questions as to rights and royalties which were supposed to be settled by the court decision in the Moore-Butters case, may be reopened. In an article published in the *Mining and Scientific Press* on June 6, 1908, the statement was made that Mr. Duncan was the first to use and patent the internal water-pressure for tailing discharge, and the perforated-pipe filter-cell frame, which features displaced the internal air-pressure for tailing discharge, and the wooden cell-frame, used by Mr. Moore.

Tonopah, June 27.

Storey County

Comstock mining companies report the following during the week ended June 28: The pumps at the C. & C. shaft worked without trouble, and on the 2500-ft. level the north drift has been repaired a total of 865 ft. to date. The Ophir 2500-ft. level raise produced 96 tons of $35.53 ore. The cyanide plant treated 549 tons of tailing, and bullion valued at $5400 was shipped. The Mexican mill treated 657 tons of Mexican ore, averaging $47.70 per ton, with 93% extraction.

Washoe County

(Special Correspondence.)—The Granite Hill copper mine, 14 miles northwest of Reno, operated by the Warner-Nelson Co., has shipped 51 tons of ore averaging 15% copper and $15 per ton in gold and silver.

Reno, June 23.

White Pine County

Work to be undertaken by the newly formed Consolidated Copper Mines Co., at Ely, includes the following: Development to block out more ore in all the properties concerned; the remodeling of the Giroux mill at Kimberly for experimental purposes, especially as to the adaptation of the oil-flotation process to recovering the metals from low-grade ores; unwatering of the big Giroux shaft, and further development of the Alpha ore deposits, and, possibly, the sinking of a deep working-shaft on the Chainman group.

OREGON

Baker County

A gold nugget weighing 80.4 oz. was found last week by Armstrong & Stuart at their placer claim, three miles from Galena. The district is fairly active. The diamond-drill in operation since spring, prospecting for dredging ground, was taken last week to the Granite district. The bench land near Sumpter has been drilled, and it is reported that another dredge will be erected there. The Sumpter dredge is having new lips fitted to the buckets, and is also operating the plant for about 12 hours per day.

UTAH

Juab County

The report of the Beck Tunnel Consolidated Mining Co. for the year ended June 1, 1913, gives the following information:

Development feet	1,252
Ore production, tons	6,419
Gold content, ounces	785
Silver, ounces	110,890
Lead, pounds	1,880,706
Value	$72,488
Total income	94,500
Expenses	94,500

SALT LAKE COUNTY

The long tunnel of the Utah Metal Mining Co. was completed on June 23, according to information from E. P. Jennings. This drive has been made through the mountains from the Middle cañon side to the Bingham side of the range, and is 11,474 ft. in length. It took 3½ years to complete. With the single exception of the Ontario drain tunnel at Park City, which is 3½ miles in length, this is the longest adit used for mining purposes in the state.

WASHINGTON

FERRY COUNTY

The Surprise mine produced 1160 tons of $12 to $20 ore during the first half of June. This comes from stopes on the 400, 500, and 700-ft. levels. The ore is sent to the Greenwood, British Columbia, smelter.

OKANOGAN COUNTY

(Special Correspondence.)—Engineers from the Trail and the British Columbia Copper Co.'s smelter, at Phoenix, British Columbia, have been examining the Copper World and Copper World Extension mines, on Palmer mountain.

Republic, June 27.

STEVENS COUNTY

A cross-cut in the Butte-Chewelah property, near Chewelah, has cut a 20-ft. vein at a depth of 100 ft. About 5 ft. of the shoot carries gray copper and some silver. A winze is to be sunk 300 feet.

(Special Correspondence.)—The United Copper Co. is installing four new batteries, of three stamps each, and will double the capacity of the mill. Holes have been dug, and the poles have been distributed for the transmission line from Myers Falls.

Chewelah, June 26.

CANADA

ALBERTA

(Special Correspondence.)—The Pelican Portage gasfield and other localities in central Alberta are being examined for the City of Edmonton by L. G. Huntley, of the Associated Geological Engineers of Pittsburgh, Pennsylvania.

Edmonton, June 23.

BRITISH COLUMBIA

(Special Correspondence.)—Ore production for the third week in June in the Kootenai and Boundary districts is reported as being 47,212 tons, making a total for the year of 1,207,712 tons. One hundred thousand dollars will be spent by the British Columbia Copper Co. in the erection of a concentrator at the Voight properties, near Princeton, according to a report from Greenwood. The action is prompted by results obtained from diamond-drilling and other investigations during the past two years.

Spokane, June 27.

The Granby company has acquired the claims of Moult, Hartley, and associates near Portland Canal. The ore opened will be used for fluxing. The British Columbia Copper Co. is employing 110 men on Copper mountain, near Princeton. Recently the Lucky Jim shipped from the Slocan 17 cars of zinc ore to the United States, upon which the duty amounted to $17,000, and may shut down until the tariff is lowered. The streak of high-grade ore in the Dynamo claim has widened to six inches. During the last six years Partman Bros. have expended $20,000 developing this property.

In the Flathead valley, at the junction of Sage creek and the Flathead river, on the British Columbia side of the line, a company composed of Victoria and Vancouver capitalists is now engaged in drilling a well for oil. A contract has been given to California oil-well drillers to sink several holes to a depth of 2700 ft., and, if necessary, 4000 ft. The first well is already down several hundred feet. During the past 100 years or more, Indians have skimmed oil from the seepages on the surface.

KOREA

(Special Corresponednce.)—During April, 240 stamps of the Oriental Consolidated Mining Co.'s mills worked 26 days and treated 26,236 tons of ore, yielding $163,812. Operating costs were $85,280, development and improvements, $2815, leaving a profit of $75,716. The Kuk San Dong mill was shut down during the past month on account of shortage of ore.

TAPOWIE MILL OF ORIENTAL CONSOLIDATED COMPANY.

New York, June 23.

MEXICO

MEXICO

During May the 40-stamp mill of the Mexico Mines of El Oro worked 30 days, treating 13,400 tons of ore yielding $138,530. The profit was $82,780. The 100-stamp mill of El Oro Mining & Railway Co. worked 30 days, treating 23,830 tons of ore and 14,190 tons of tailing, yielding $227,360. The total profit was $92,950, including $5680 from the railway.

SONORA

(Special Correspondence.)—The Calumet & Sonora of Cananea Mining Co., whose property is about two miles northwest of Cananea, and which recently resumed operations after being shut down for almost three months, is now working with practically a full force. One hundred and sixty men are now being employed. Before the shut-down but 60 were working. In fact, conditions are better at the property than they have been for some months, and the production is at the rate of 7000 tons of ore per month. Both the wet and dry mills are again working, two shifts being employed, and it may be only a short time before the mills are working 24 hours each. The ores being handled at present come from the 400 and 500-ft. levels. The new crusher and picking belt which were installed early in the year are giving good results. Fifty per cent of the material passing over the belts is thrown out as waste. W. H. Tangye, the superintendent, reports that development work is being done only on the 400-ft. level, where results are highly satisfactory. The management states that, in the near future, operations will be conducted at full capacity, as a large orebody which was found shortly before the shut-down, three months ago, promises to furnish sufficient ore to run the plant for an indefinite time. An output of 40 tons per day, which will average $30, is figured. This gives a monthly earning of $36,000 at an expense of $12,000. The company has shipped its concentrate which was stored awaiting the end of El Paso smelter's labor trouble. There were six cars which netted $12,000.

Cananea, June 28.

TRANSVAAL

A strike has broken out in the Rand district which threatens to tie up the entire gold-mining industry of South Africa. The dispute arose from a simple question about working hours in the new Kleinfontein mines, and from there gradually spread until the situation became so serious that troops were called out to protect property. The leaders of the unions have called a general strike, and the men have promised to respond. The closing also of some coal mines has aggravated the situation, and the railway employees threaten to come out. Meanwhile, the electricians appear inclined to shut down the power stations, which have therefore been occupied by the military.

Schools and Societies

THE UNIVERSITY OF WISCONSIN held its sixtieth commencement on June 18, Charles R. Van Hise delivering the address.

THE UNIVERSITY OF CALIFORNIA, at Berkeley, opened its summer school on June 23, with over 2000 students, and will continue for about six weeks.

A PARTY of seventeen students of mining from the Case School of Applied Science, Cleveland, Ohio, has been inspecting the mines and mills of the Coeur d'Alene. They are also doing some practical work.

THE MASSACHUSETTS 'TECH' held its commencement on June 10, and about 300 students received degrees, of which 21 received the degree M.S., and 269 the degree B.S. Chas. Ransom Hill presented a thesis, the title of which was 'Cyanidation of Low-Grade Silver Ore from Utah.'

THE UNIVERSITY OF ILLINOIS summer session opened on June 16, and will close August 16. Courses offered are arranged primarily for the needs of teachers, principals, and superintendents. Many of the regular university instructors will offer instruction during this special summer session.

The UNIVERSITY OF VIRGINIA, at Charlottesville, held its commencement exercises, finishing the eighty-eighth consecutive session, during the week ended June 21. There were 116 graduates. A gift providing for 10 scholarships of $300, or 5 of $600, per annum, to be awarded to young Virginians was announced.

HARVARD UNIVERSITY held its annual commencement starting June 14. Work is practically finished on the new Coolidge laboratory for the department of chemistry. The new building, which will be in active use with the opening of college in the fall, is a memorial to T. Jefferson Coolidge, '84, whose family subscribed $50,000 for its construction.

ANNOUNCEMENT is made that the first work in which cooperation between the Massachusetts Institute of Technology and Harvard University is to be effected has been outlined, and the confirmatory votes have been cast by the members of the two corporations. It is an arrangement whereby the students in public health, biology, and sanitary matters may have the benefits of corresponding courses.

COLUMBIA UNIVERSITY will have about 4000 students attending the six weeks' summer school which opens early in July. There are to be 243 instructors and 38 assistants. Students planning to spend the summer or the remainder of the year in Germany have been aided by a new department in the Deutsches Haus. It is called the Bureau of Academic Information, and is open daily, except Saturday, from 9 until 5 o'clock. It contains the announcements of the various German universities and scientific schools, as well as many books and pamphlets pertaining to higher education. Under the joint auspices of Columbia's Maison Française and the Paris Sorbonne, a students' tour of France is also planned for the summer.

Arrangements for the twenty-fourth general meeting of the AMERICAN ELECTRO-CHEMICAL SOCIETY, to be held at Denver, September 9 to 11, are progressing well. Offers of papers for the meeting have increased to twenty-one; four papers are already at hand, and one has been distributed. Several more will be ready for distribution with the July *Bulletin*. Those having papers to present at this meeting should bear in mind that in order for them to be printed and distributed in advance of the meeting, the manuscript should reach the secretary not later than July 15. If the title of the paper has not been sent in, it should be as soon as possible. Joseph W. Richards is secretary, at the Lehigh University, South Bethlehem, Pennsylvania.

Personal

Professional men are invited to send news of their engagements and travels. Such news is interesting to friends.

J. W. FINCH is in the East.

W. A. HALL has gone to Europe.

THOMAS F. COLE is in New York.

JOSEPH W. RICHARDS is in France.

JAMES DOUGLAS has gone to Europe.

BARTON SEWALL has sailed for Europe.

P. D. BURTT has gone to Seward, Alaska.

F. G. COTTRELL was in New York last week.

H. F. WIERUM is expected in San Francisco.

THOMAS T. READ was in Boston early in the week.

F. C. ALSDORF is visiting Cobalt and neighboring districts.

A. B. WILLARD is president of the Republic Mines Corporation.

THOMAS JAY is superintendent at the Frisco mine, Mullan, Idaho.

HERBERT C. ENOS is now at Edificio La Mutua, No. 200, Mexico, D. F.

HENRY BISHOP is superintendent at the Last Chance mine, Coeur d'Alene district.

HARRY J. WOLF has been examining a property in Calaveras county, California.

W. L. Anderson is local manager for the Mother Lode Sheep Creek Mining Company.

C. F. RAND and BRADLEY STOUGHTON attended the recent meeting of the American Society for Testing Materials at Atlantic City.

T. R. WOODBRIDGE, who has been visiting sampling works in the interest of the U. S. Bureau of Mines, was in San Francisco this week.

J. A. HOLMES and a party of engineers from the U. S. Bureau of Mines will sail from Seattle on the *Admiral Sampson* today to investigate the Matanuska coalfields.

H. FOSTER BAIN will leave for Denver and the East, Tuesday. He will attend the International Geological Congress at Toronto in August as a representative of the American Institute of Mining Engineers.

Japanese Coal Situation

The Imperial Government of Japan has placed an order for about 150,000 tons of Fushun coal for the railways for the current year. The aggregate annual consumption by the whole of the service is figured about 1,200,000 tons per year, and Fushun coal now comes in for the supply of one-eighth of the total consumption. The appearance of this coal on the field at home little disconcerts the suppliers of home coals. Such is stated to be the case by a good authority, who ascribes it to the rapid growth of industrial enterprises all over Japan. The demand for coal is rising year by year, and the import of Fushun coal in considerable quantities is no longer looked upon as a trespass upon the legitimate market for home coals. Two shafts have been sunk on Shimoputago islet, Japan, the work marking an important development of the Takashima collieries, which are owned by the Mitsu Bishi Co. It is estimated that 34,000 tons of coal will be obtained from the new shafts this year and that a monthly output of 30,000 tons will be possible when the preparatory work is complete. The colliery will be known at Futagoshima. The coalfield tapped by the shafts is called Nakanoshima and contains, according to experts, 11,520,000 tons of coal. The yield is estimated to last 34 years. Another coalfield lies between Nakanoshima and Takashima and will be reached in the near future. Its area is far greater than the dimensions quoted above and 70 years is estimated as necessary to exhaust the reserves of both fields. The daily outputs of Takashima and Hashima mines, which up to now have supplied all the famous Takashima coal, are about 300 tons and 500 tons, respectively.

New York Metal Market Review

Copper declined steadily in June, the concessions being made principally by second-hands; various influences both at home and abroad being held accountable, in addition to lack of demand. Lead, despite the absence of any really good demand, held up well, but the course of the metal in London and the consequent effect on the New York market was disappointing. Spelter was uniformly dull and declined steadily. Antimony was without any interesting feature beyond the continuance of low prices. The demand for tin was not heavy, prices declined, and London, always irregular, was unusually erratic. Aluminum was lower at the end of the month and much affected by tariff possibilities.

COPPER

The Waterbury average for May was 15.87½c. The early days of June were almost completely devoid of demand, not even re-sale lots of electrolytic at around 15.25c. cash, New York, inducing consumers to enter the market. At no time was there much betterment. When the month opened, the large agencies were holding to their prices of 15.75c. cash, New York, for electrolytic and 15.87½ to 16c. for Lake, with the latter scarce for early delivery. At this time it was freely admitted that consuming mills were receiving fewer orders, though they were busy on those previously booked. In London the market weakened in the early days of June. About June 7 there were some sales of electrolytic by second-hands at 15.37½c. cash, 30 days delivered, equal to 15.25c. cash, New York. London continued to decline. In the second week of the month there were additional sales of electrolytic, also by second-hands, who accepted substantial concessions according to report. One of the large agencies did not deny on June 18 that its price abroad had been reduced to 15c. Many rumors were rife in the second week of the month, and the situation was rather unsettled in consequence. An added cause of uneasiness was a strike at the Laurel Hill, L. I., refinery of the Nichols Copper Co., which to some extent curtailed production. In the third quarter of June the quiet continued. Lake copper of a good grade, but not equal to prime Lake, was offered at 15c. cash, New York, but no takers came forward. For actual prime Lake, an offer of 14.75c. was made, but holders would not sell at this figure. In fact, practically no business was stirring, and producers saw no incentive for reducing their prices. Some re-sale lots were sold at 14.50c. cash, New York, but the quantities were not great. Four reasons were advanced for the quiet which prevailed: the fact that consumers were comfortably well supplied for their June needs, the falling off in new business, fears of tariff changes, and unsettled finances abroad. Toward the latter part of the month the American Brass Co. reduced the price of sheet copper and copper bottoms one cent, making the new base price for sheets 20c. and that for bottoms 26c. per pound. Near the end of June the price of electrolytic copper was weak at 14.50c., and that of Lake almost as weak at 15c. In Lake, especially, prices were largely nominal. Up to June 27 exports amounted to 23,858 tons.

LEAD

In the latter part of May there was a little flurry in lead, though no buying that might be called heavy. Early in June interest died out, but the metal remained firm at 4.35c. New York and 4.20c. St. Louis. Approaching the middle of the month, an interesting situation developed because of the price advances in London. The foreign quotation June 11 was £20 7s. 6d, equal to 4.36c. New York. It was foreseen that if the foreign price went up a few points more to cover freight to London, English buyers could come to the New York market. A week later, June 18, the London price was £21, equal to 4.48c. New York. Subtracting 15c. per 100 lb. for freight left 4.33c., the price at which London could buy in New York. This was within two points of the New York price. The situation greatly strengthened the market, although New York quotations did not advance. Still another supporting influence was a fire which damaged the plant of the St. Joseph Lead Co., Herculaneum, Missouri, and which interfered with deliveries by that Company. The situation resulted in 4.22½c. St. Louis being asked by some interests. Expectations of any large business from abroad were quashed when it developed that the high London price was the outcome of a corner not strong enough to stand. The foreign price declined and the incident was closed. Domestic consumers at the end of the month were buying only in a hand to mouth fashion.

SPELTER

The market at the beginning of June was about 5.30 New York and 5.15 St. Louis, very quiet and weak. It was reported that the demand of the galvanizers had fallen off. As the month progressed there were repeated declines, and the only demand that might be called even fair was for future metal. Toward the end of June the metal was quoted at around 5.16c. New York and 4.95 St. Louis and sellers were not inclined to press sales at these prices. It came to light that about 2000 lb. of spelter which had been smelted in bond from Mexican ore had been shipped to Europe. In the last few days of the month a little better demand developed and better buying was expected to soon materialize because of the fact that consumers had been out of the market so long that their stocks were low.

ANTIMONY

Throughout the month antimony was dull and without sufficient business to fully test prices. Hallett's was quoted at from 8.15 to 8.25c.; Cookson's at from 8.60 to 8.70c; and Chinese and Hungarian grades at from 7.50 to 7.75c.

TIN

The month opened quietly following the heavy buying in the last days of May referred to in the last report. The buying in that movement was caused by heavy unloading by one London house. Early in June the price dropped to 46.60c. New York, a decline of several points under what purchasers had paid a few days previously, and they naturally were much disappointed. On June 9 about 300 tons was sold for delivery in various months, the spot price being 45.37½ to 45.50c. At this time the supply was pretty well concentrated in a few hands. London had shown a persistent declining tendency. Toward the middle of June the market was very dull, so much so that 100 tons of Banca tin was re-shipped to London. Straits tin is always preferred in the New York market, though Banca is acceptable in times of shortage. The London market was very erratic in the third and last quarter of the month. June 17 London declined £3, which was attributed to financial conditions abroad unfavorable to speculation and to the poor demand from this country. On June 18 the London price touched £203 5s. for spot, which up to that day was the low point of this year, but there was a rally after this low figure. In the last part of the month the market was very dull, and for much the same reasons as were mentioned in the copper report. In London there was much liquidation, forced, it is understood, by the withdrawal of loans to Vienna operators by the bank which was financing them. The result was a decline of £12 in four days, which was followed by a recovery of £6 in two days. On June 23, spot tin was down to £193 in London. On June 27 the metal suffered another decline in London, falling £3 10s., the cause being reports from the United States that tin-plate mills might curtail consumption. These reports were not borne out by statements which followed here. The tendency throughout the month was a declining one, the month opening at 46.60c. and prices standing at 44.10c. on June 26. Arrivals up to June 27 totaled 3000 tons and there was afloat 875 tons.

ALUMINUM

In June aluminum declined by easy stages from 25-25.50 to 23.50-24.50c. The most interesting feature of the month was the proposal of the United States Senate to fix the duty on aluminum ingots at a flat rate of 2c. per pound, instead of the duty of 25% ad valorem proposed by the Underwood bill as passed by the House of Representatives. The present rate on ingots is 7c. per pound. Authorities have pointed out that the cost of foreign aluminum is at present 18½ to 19c. per pound c.i.f. New York, which, with a 2c. duty would make it 20½ to 21c. per pound. This compares with the present price of 23.50 to 24.50c. to the disadvantage of the American product, as can be seen.

The Metal Markets

LOCAL METAL PRICES

San Francisco is not a primary market for the common metals except quicksilver. The prices quoted below therefore represent sales of small lots and are not such as an ore-producer could expect to realize. Ore contracts usually call for settlement on the basis of Eastern prices, less freight and treatment charges. The prices quoted are in cents per pound, except in the case of quicksilver, which is quoted in dollars per flask of 75 pounds.

San Francisco, July 3.

Antimony	12—12½c	Quicksilver (flask)	$41
Electrolytic Copper	16—16½c	Tin	50—51½c
Pig Lead	4.80—5.55c	Spelter	7—7½c

Zinc dust, 1400 lb. casks, per 100 lb., small lots $9.50—9.75; large $7.50—8.50

EASTERN METAL MARKET

(By wire from New York.)

NEW YORK, July 2.—Copper remains unchanged, though small lots have been sold at a slight concession. In general, buyers are waiting, and the Copper Producers' figures are anticipated with much interest. Lead is steady, the fire at Herculaneum having made no impress on the market. Spelter is beginning to show the effect of curtailment of production, and prices are firm, though no higher.

SILVER

Below are given the average New York quotations, in cents per ounce, of fine silver.

Date.		Average week ending	
June	26	May	21
"	27	"	28
"	28	June	4
"	Sunday	"	11
"	30	"	18
July	1	"	25
"	3	July	2

	58.12	60.66
	58.12	60.08
	58.37	59.99
		59.75
	58.37	59.08
	58.12	58.12
	58.12	58.20

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	56.25	63.01	July	60.67	....
Feb.	59.06	61.25	Aug.	61.32	....
Mch.	58.37	57.87	Sept.	62.95	....
Apr.	59.20	59.26	Oct.	63.16	....
May	60.88	60.21	Nov.	62.73	....
June	61.29	59.03	Dec.	63.38	....

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.			Date.		
June	19	4.33	June	26	4.33
"	20	4.33	"	27	4.33
"	21	4.33	"	28	4.33
"	22 Sunday		"	29 Sunday	
"	23	4.33	"	30	4.33
"	24	4.33	July	1	4.33
"	25	4.33	"	2	4.33

Average week ending

May	21	4.33	June	18	4.33
"	28	4.33	"	25	4.33
June	4	4.33	July	2	4.33
"	11	4.33			

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	4.43	4.28	July	4.71	....
Feb.	4.03	4.33	Aug.	4.54	....
Mch.	4.07	4.32	Sept.	5.00	....
Apr.	4.20	4.36	Oct.	5.08	....
May	4.20	4.34	Nov.	4.91	....
June	4.40	4.33	Dec.	4.20	....

ZINC

Zinc is quoted as spelter, standard Western brands, St. Louis delivery, in cents per pound.

Date.			Date.		
June	19	4.93	June	26	5.03
"	20	4.95	"	27	5.05
"	21	4.95	"	28	5.05
"	22 Sunday		"	29 Sunday	
"	23	5.00	"	30	5.08
"	24	5.00	July	1	5.10
"	25	5.00	"	2	5.10

Average week ending

May	21	5.28	June	18	4.90
"	28	5.19	"	25	4.97
June	4	5.11	July	2	5.07
"	11	4.94			

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	6.42	6.88	July	7.12	....
Feb.	6.50	6.13	Aug.	6.96	....
Mch.	6.57	5.94	Sept.	7.45	....
Apr.	6.63	5.52	Oct.	7.36	....
May	6.68	5.23	Nov.	7.23	....
June	6.88	5.00	Dec.	7.09	....

L. Vogelstein, in a trade letter dated June 27, points out that consumption of spelter has, as yet, been but little reduced. It is the decrease in future orders for iron, steel, and brass goods that makes buyers nervous and which has affected prices. The Senate proposes to raise the tariff from 10 to 15%, and on ores from 10 to 12½%. Assuming that spelter abroad goes as low as £20, and that the Senate rates stand, 5.25c. would be the lowest New York price for imported spelter, and this would constitute no menace to American producers. It is well known that there has been insufficient spread between prices of ore and metal, and that new works have been building. Present conditions discourage the builders from firing up, and mines are closing. It is worth remembering, however, that the present financial storm has been foreseen and largely discounted. While, therefore, immediate prices may be low, it may be but a short time before good conditions return.

COPPER

Quotations on copper as published in this column represent average wholesale transactions on the New York market and refer to electrolytic copper. Lake copper commands normally from 1-5 to 1-4c. per lb. more. Prices are in cents per pound.

Date.			Date.		
June	19	14.60	June	26	14.43
"	20	14.50	"	27	14.43
"	21	14.50	"	28	14.43
"	Sunday		"	29 Sunday	
"	23	14.40	"	30	14.43
"	24	14.43	July	1	14.43
"	25	14.43	"	2	14.43

Average week ending

May	21	15.50	June	18	14.70
"	28	15.43	"	25	14.47
June	4	15.18	July	2	14.43
"	11	14.79			

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	14.09	16.54	July	17.19	....
Feb.	14.08	14.93	Aug.	17.49	....
Mch.	14.68	14.72	Sept.	17.56	....
Apr.	15.74	15.22	Oct.	17.32	....
May	16.03	15.42	Nov.	17.31	....
June	17.23	14.71	Dec.	17.37	....

COPPER SURPLUS

Figures showing the visible supply of copper at the beginning of each month are now widely available. Below are given the amounts, in pounds, known to be available at the first of each of certain months. The figures are those of the Copper Producers' Association supplemented by Merton's figures of foreign surplus.

		U. S.	European.
July	1912	44,335,004	107,817,920
August	"	50,281,280	113,285,760
September	"	46,701,376	112,743,680
October	"	63,065,587	107,396,800
November	"	76,744,967	103,803,840
December	"	86,164,059	96,949,440
January	1913	105,311,360	96,859,840
February	"	123,198,352	100,067,520
March	"	122,302,198	95,542,720
April	"	104,269,270	106,565,760
May	"	75,549,108	102,654,720
June	"	67,474,225	93,378,880
July	"	.....	85,565,760

UNITED STATES PRODUCTION AND CONSUMPTION

		Production.	Domestic deliveries.	Exports.
May	1912	126,737,836	72,702,237	69,485,945
June	"	122,315,240	66,146,229	61,449,650
July	"	137,161,920	71,093,120	60,121,600
August	"	145,628,521	78,722,418	70,485,150
September	"	140,089,819	63,460,810	60,264,796
October	"	145,405,453	84,104,734	47,621,342
November	"	134,695,440	69,369,795	55,906,550
December	"	143,353,280	58,490,880	65,712,640
January	1913	143,479,625	65,210,030	60,383,845
February	"	130,948,881	59,676,402	72,168,623
March	"	136,251,849	76,585,471	77,699,306
April	"	135,333,402	78,158,837	85,894,727
May	"	141,319,416	81,158,800	68,286,007

The fortnightly statistics of copper show that the European stocks, including Hamburg and Rotterdam, on June 30 decreased 1727 tons, while copper supplies afloat decreased 50 tons, making a total decrease in the visible supply of 1777 tons to 38,199 tons, as compared with 39,976 tons on June 14 last.

QUICKSILVER

The primary market for quicksilver is San Francisco, California, being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher

price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending		Week ending	
June 5	41	June 19	41
" 12	41	" 26	41
		July 3	41

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	43.75	39.37	July	43.00	....
Feb.	46.00	41.00	Aug.	42.50	....
Mch.	46.00	40.20	Sept.	42.12	....
Apr.	42.25	41.00	Oct.	41.50	....
May	41.75	40.25	Nov.	41.50	....
June	41.30	41.00	Dec.	39.75	....

TIN

New York prices control in the American market for tin, since the metal is almost entirely imported. San Francisco quotations average about 5c. per lb. higher. Below are given average monthly New York quotations, in cents per pound:

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	42.52	50.45	July	44.25	....
Feb.	42.96	49.07	Aug.	45.80	....
Mch.	42.58	46.95	Sept.	48.64	....
Apr.	43.92	49.00	Oct.	50.01	....
May	46.05	49.10	Nov.	49.92	....
June	45.76	45.10	Dec.	49.80	....

The Stock Markets

NEVADA STOCKS

(By courtesy of San Francisco Stock Exchange.)

San Francisco, July 2.

Atlanta	$ .15	Mizpah Extension	$ .50
Belmont	6.05	Montana-Tonopah	1.00
Big Four	.42	Nevada Hills	.93
Buckhorn	1.30	North Star	.87
Con. Virginia	.05	Ophir	.18
Florence	.33	Pittsburg Silver Peak	.45
Goldfield Con	1.70	Round Mountain	.47
Goldfield Oro	.10	Sierra Nevada	.12
Halifax	1.45	Tonopah Extension	2.07
Jim Butler	.71	Tonopah Merger	.61
Jumbo Extension	.11	Tonopah of Nevada	5.50
MacNamara	.17	Union	.08
Mexican	.70	West End	1.35
Midway	.43	Yellow Jacket	.19

COPPER SHARES—BOSTON

(By courtesy of J. C. Wilson, Mills Building.)

	July 3.			July 3.	
	Bid	Ask		Bid	Ask
Adventure	$ 1⅛	1¼	Mohawk	$ 43½	44
Allouez	31	32	North Butte	24½	25
Calumet & Arizona	59⅛	59¼	Old Dominion	44	45
Calumet & Hecla	415	[illegible]	Osceola	76	78
Centennial	[illegible]	11	Quincy	58	60
Copper Range	39⅛	[illegible]	Shannon	7	7⅛
East Butte	10	10½	Superior & Boston	1⅛	2
Franklin	5	5⅛	Tamarack	23½	24⅛
Granby	55	56½	U. S. Smelting	35½	35½
Greene Cananea	5⅛	6	Utah Con.	9	9⅛
Hancock	15⅞	16⅛	Victoria	1⅛	1⅜
Isle-Royale	19	19⅛	Winona	1⅛	1⅜
Mass Copper	2⅜	3⅛	Wolverine	60	80

NEW YORK QUOTATIONS

(By courtesy of E. F. Hutton & Co., Kohl Building.)

July 3.

	Bid.	Ask.		Bid.	Ask.
Alaska Mexican	8¼	8⅜	Mason Valley	5⅛	6
Alaska Tread	36½	38½	McKinley-Dar.	1⅝	1⅞
Alaska United	17½	18¼	Miami 6s	168	173
Alaska G. M.	15⅝	15¾	Mines Co. Am.	2⅜	2⅝
Braden Copper	6⅝	6⅞	Nipissing	8½	8⅝
B. C. Copper	2⅛	2⅜	Ohio Copper	⅝	¾
Davis-Daly	1⅞	2⅛	San Toy	18	20
Dolores	2	[illegible]	Sioux Con.	2	4
El Rayo	1	2	S. W. Miami	5	7
Ely Con.	8	10	So. Utah	¼	⅝
First Nat.	1¾	2	S. O. Calif.	170	172
Giroux	1⅜	1½	Tri Bullion	½	¼
Greene Can.	5⅞	6⅛	Tuolumne	1⅜	1½
Hollinger	16	17	United Copper	..	½
Kerr Lake	3⅛	3¼	Wettlaufer	11	13
La Rose	2¼	2½	Yukon Gold	2¼	2½

COPPER PRODUCTION of the Utah Copper and Nevada Consolidated companies in May was 9,834,894, and 5,933,275 lb., respectively.

COPPER CONCENTRATE produced by the Elmore process at the Sulitjelma mines, Norway, in May, amounted to 850 tons.

LONDON QUOTATIONS

(By cable, through the courtesy of Catlin & Powell Co., New York.)

	July 3. £	s.	d.		July 3. £	s.	d.
Alaska Mexican	1	17	6	Kern River Oilfields	0	5	0
Alaska Treadwell	7	17	6	Mexico Mines	5	12	6
Alaska United	3	17	6	Messina	1	10	0
Arizona	1	17	6	Oroville	0	5	0
California Amalg	0	2	6	Pacific Oilfields	0	2	6
California Oilfields	4	0	0	Rio Tinto	71	17	6
Camp Bird	0	15	0	Santa Gertrudis	0	17	6
El Oro	0	15	0	Stratton's	0	2	6
Esperanza	0	17	6	Tanganyika	2	1	3
Granville	0	7	6	Tomboy	1	7	6

AUSTRALIAN

	July 3. £	s.	d.		July 3. £	s.	d.
British Broken Hill	2	0	0	Mount Boppy	0	12	6
Broken Hill Props	1	15	0	Mount Elliott	4	10	0
Golden Horse-Shoe	2	12	6	Mount Lyell	0	15	0
Great Boulder Props	0	13	9	Mount Morgan	3	6	3
Ivanhoe	2	5	0	Waihi	2	2	6
Kalgurli	2	0	0	Waihi Grand Junc	0	17	6

Dividends

THE Shattuck-Arizona Copper Co. has declared a dividend of 50c. per share, making $4 to date. During 1912 no payments were made.

THE Ahmeek Mining Co. has declared a quarterly dividend of $5 per share, as against $7 paid in the two previous distributions.

THE Bunker Hill & Sullivan Mining & Concentrating Co., on July 3, paid dividend No. 190, amounting to $65,400. This makes a total to date of $14,369,550.

THE Federal Mining & Smelting Co. will pay a dividend of 75c. per share, on July 15, on the common stock. This is the first payment on this stock since January 1909. On the same date, the preferred stock will be paid 87½c. per share, the second during 1913. Total dividends declared to date amount to $10,399,750.

THE Consolidated Mining & Smelting Co., operating a smelter and a number of mining properties in British Columbia, paid a semi-annual dividend of $220,000, on July 5. The disbursement is based on a rate of 8% per year on the issued capitalization, and will bring the total payments of the company to $1,234,061.

IN July a total of $263,419,305 will be paid to investors representing dividend and interest disbursements by railroad, industrial, and traction corporations, banks and trust companies, the national government, and New York City. This compares with $253,267,992 last year. This month the sum of $95,885,055 will be paid to stockholders in the way of dividends, or an increase of $3,430,263.

THE Abangarez Gold Fields Co. of Costa Rica reports the following results of operations at its mines:

	April, 1913.	Four months of 1913.	Four months of 1912.
Ore crushed, tons	5,221	17,353	15,116
Tailing leached, tons	482	1,662	2,104
Slime treated, tons	4,468	14,462	11,101
Extraction by amalgamation	$13,680	$39,781	$65,928
Extraction by cyanide	30,956	113,843	67,520
Total	$44,636	$153,625	$133,449
Less cost of operation, marketing and administration (exclusive of betterments)	44,071	184,829	260,747
Profit from operations	$565	*$31,203	*$127,298
Betterment expenditures	18,187	36,339	115,436

*Deficit.

LONDON ADVICES report that the Pato dredge of Oroville Dredging Co., Ltd., recovered $1550 from 11,200 cu. yd. in the week that ended on May 27, and $2560 from 21,400 cu. yd. in the week that ended on June 3.

Current Prices for Ores and Minerals

(Corrected monthly by Atkins, Kroll & Co.)

The prices are approximate, subject to fluctuation, and to variation according to quantity, quality, and delivery required. They are quoted, except as noted, f.o.b. San Francisco. Buying prices marked *.

	Min.	Max.
Antimony ore, 50%, ₱ ton	*$22.00	$25.00
Arsenic, white, refined, ₱ lb	0.04	0.04½
Arsenic, red, refined, ₱ lb	0.08	0.08½
Asbestos, according to length and quality of fibre ₱ ton	100.00	350.00
Asbestos, lower grades, ₱ ton	5.00	50.00
Asphaltum, refined, ₱ ton	10.00	20.00
Barium carbonate, precipitated, ₱ ton	42.50	45.00
Barium chloride, commercial, ₱ ton	42.50	45.00
Barium sulphate (barytes), prepared, ₱ ton	20.00	30.00
Bismuth ore, 10% upward, ₱ ton	*75.00	upward
Chrome ore, according to quality, ₱ ton	10.00	12.50
China clay, English, levigated, ₱ ton	15.00	20.00
Cobalt metal, refined, f. o. b. London, ₱ lb	2.50	
Coke, foundry, ₱ 2240 lb	14.50	15.00
Diamonds:		
Ballas according to size and quality, ₱ carat	70.00	
Borts, according to size and quality, ₱ carat	2.00	15.00
Carbons, according to size and quality, ₱ carat	55.00	90.00
Feldspar, ₱ ton	5.00	25.00
Firebrick:		
Bauxite, ₱ M	175.00	
Magnesite, ₱ M	190.00	275.00
Silica, ₱ M	42.50	55.00
Flint pebbles for tube-mills, ₱ 2240 lb	19.50	22.50
Fluorspar, ₱ ton	10.00	15.00
Fullers earth, according to quality, ₱ ton	20.00	30.00
Gilsonite, ₱ ton	35.00	40.00
Graphite:		
Amorphous, ₱ lb	0.01½	0.02½
Crystalline, ₱ lb	0.04	0.13
Gypsum, ₱ ton	7.50	10.00
Infusorial earth, ₱ ton	10.00	15.00
Magnesite, crude, ₱ ton	5.00	7.50
Magnesite, dead calcined, ₱ ton	20.00	25.00
Magnesite, brick (see firebrick).		
Manganese ore, oxide, crude, ₱ ton	10.00	25.00
Manganese, prepared, according to quality, ₱ ton	50.00	70.00
Mica, according to size and quality, ₱ lb	0.05	0.30
Molybdenite, 95% MoS_2, ₱ ton	400.00	450.00
Monazite sand (5% thoria), ₱ ton	150.00	200.00
Nickel metal, refined, ₱ lb	0.45	0.60
Ochre, extra strength, levigated, ₱ 100 lb	2.25	3.25
Platinum, native, crude, ₱ oz	30.00	45.00
Silex lining for tube-mills ₱ 2240 lb	32.50	35.00
Sulphur, crude, ₱ ton	20.00	25.00
Sulphur, powdered, ₱ ton	35.00	45.00
Sulphur, 80%, ₱ ton	16.50	18.50
Talc, prepared, according to quality, ₱ ton	20.00	50.00
Tin ore, 60%, ₱ ton	550.00	600.00
Tungsten ore, 65%	425.00	450.00
Uranium ore, 10% min.	25.00	per unit
Vanadium ore, 15% V_2O_5, ₱ ton	150.00	180.00
Wolframite (see tungsten ore).		
Zinc ore, 50% up, ₱ ton	*15.00	20.00

Current Prices for Chemicals

(Corrected monthly by Braun-Knecht-Heimann Co.)

Prices quoted are for ordinary quantities in packages as specified. For round lots lower prices may be expected, while in smaller quantities advanced prices are ordinarily charged. Prices named are subject to fluctuation. Other conditions govern Mexican and foreign business.

	Min.	Max.
Acid, sulphuric, com'l, 66°, drums, ₱ 100 lb	$0.75	$1.00
Acid, sulphuric, com'l, 66°, carboy, ₱ 100 lb	1.00	1.50
Acid, sulphuric, C. P., 9-lb. bottle, bbl., ₱ lb	0.13	0.18
Acid, sulphuric, C. P., bulk, carboy, ₱ lb	0.09½	0.12
Acid, muriatic, com'l, carboy, ₱ 100 lb	1.60	3.00
Acid, muriatic, C. P., 6-lb. bottle, bbl., ₱ lb	0.15	0.20
Acid, muriatic, C. P., bulk, carboy, ₱ lb	0.10½	0.15
Acid, nitric, com'l, carboy, ₱ 100 lb	6.00	6.50
Acid, nitric, C. P., 7-lb. bottle, bbl., ₱ lb	0.16	0.22
Acid, nitric, C. P., bulk, carboy, ₱ lb.*	0.12½	0.15
Argols, ground, bbl., ₱ lb	0.10	0.20
Borax, cryst. and conc., bags, ₱ 100 lb	3.00	4.35
Borax, powdered, bbl., ₱ 100 lb	3.38	4.50
Borax glass, gd. 30 mesh, cases, tin lined, ₱ 100 lb	10.50	13.50
Bone ash, 60 to 80 mesh, bbl., ₱ 100 lb	5.50	6.50
Bromine, 1-lb. bottle, ₱ lb	0.55	0.65
Candles, adamantine, 14 oz., 40 sets, ₱ case	4.80	4.80
Candles, adamantine, 14 oz., 60 sets, ₱ case	5.25	5.45
Candles, Stearic, 14 oz., 40 sets, ₱ case	5.00	5.20
Candles, Stearic, 14 oz., 60 sets, ₱ case	5.70	5.90
Clay, domestic fire, sack, ₱ 100 lb	1.50	2.00
Cyanide, 98 to 100%, 100-lb. case, ₱ lb	0.20½	0.24½
Cyanide, 98 to 100%, 200-lb. case, ₱ lb	0.20	0.24
Cyanide, 128%, 100-lb. case, ₱ lb	0.27½	0.28½
Cyanide, 128%, 200-lb. case, ₱ lb	0.26½	0.27½
Lead acetate, brown, broken casks, ₱ 100 lb	9.50	10.50
Lead acetate, white, broken casks, ₱ 100 lb	10.50	10.75
Lead acetate, white, crystals, ₱ 100 lb	12.50	13.25
Lead, C. P., test., gran., ₱ 100 lb	13.00	15.00
Lead, C. P., sheet, ₱ 100 lb	15.00	18.00
Litharge, C. P., silver free, ₱ 100 lb	11.50	13.50
Litharge, com'l, ₱ 100 lb	8.00	9.50
Manganese ox., blk., dom. in bags, ₱ ton	20.00	25.00
Manganese ox., blk., Caucasian, in casks, ₱ ton (85% MnO_2—1% Fe)	36.00	47.50
Nitre, double ref'd, small cryst., bbl., ₱ 100 lb	7.00	8.00
Nitre, double ref'd, granular, bbl., ₱ 100 lb	6.50	7.50
Nitre, double ref'd, powdered, bbl., ₱ 100 lb	7.25	8.00
Potassium bicarbonate, cryst., ₱ 100 lb	12.00	15.00
Potassium carbonate, calcined, ₱ 100 lb	7.50	9.00
Potassium permanganate, drum, ₱ lb	0.10½	0.13
Silica, powdered, bags, ₱ lb	0.03	0.05
Soda, carbonate (ash), bbl., ₱ 100 lb	1.50	1.75
Soda, bicarbonate, bbl., ₱ 100 lb	2.25	2.75
Soda, caustic, ground, 98%, bbl., ₱ 100 lb	3.15	3.50
Soda, caustic, solid, 98%, drums, ₱ 100 lb	2.65	2.85
Zinc shavings, 850 fine, bbl., ₱ 100 lb	10.55	12.00
Zinc sheet, No. 9—18 by 84, drum, ₱ 100 lb	8.75	10.00

*Extra charge for packing nitric acid for shipment to conform to regulations.

Joplin Ore Market

At the beginning of July, zinc sulphide ores brought $39 to $43 per ton, assay basis of 60% metallic zinc, and spelter at East St. Louis was quoted at $5 per cwt. These figures compared with those of the corresponding period of 1912 are discouraging, but conditions throughout the district nevertheless are fairly good. At this time a year ago zinc sulphide ores brought $54 to $58, basis, with better grades selling for $61, and spelter brought $7. Shipments are less than 5000 tons per week, and the output is possibly a few hundred tons in excess of this, as a number of operators are holding for better prices. This indicates a gradual increase in the surplus reserves, which are now about 4500 tons. Calamine brings $20 to $21 per ton, assay basis 40% metallic zinc. Lead ore is unchanged at $52.50 per ton, 80% metallic lead.

Coal Mining in China and Japan

There is a colliery at Huashihling, northeast of Changchun, with a coal seam said to 15 ft. thick. At present about 13 tons is produced daily. With the use of modern machinery the daily output will easily be considerably increased. The Chinese tax collector at Changchun resigned his office recently to assume management of the colliery. He has paid about $37,500 to the concessionaire as the price of the property and is said to have a similar amount to invest in the mine. Recent coal production of the Kailan mining administration's mines was as follows:

	Output, tons.	Sales, tons.
Week ended March 22	28,656	44,685
Week ended March 29	39,686	40,352
Week ended April 5	39,932	40,404
Week ended April 12	36,101	50,597

NORWAY'S ore production in 1912 was as follows: pyrite, 43,000 tons; iron, Norway and Sweden, 400,000 and 2,800,000 tons respectively; and nickel ore, about 250,000 tons. The Sultijelma copper mine produced 149,600 tons of ore, yielding 11,500 tons concentrate by the Elmore process. There are 11 Elmore machines in operation. A Wedge roasting furnace was installed to deal with the Elmore concentrate. The Sydvarangar Iron Ore Co. will soon be in a position to produce 650,000 tons per annum. The Evje nickel mine produced 240,000 tons of ore, and the refinery produced 400 tons of nickel and 200 tons of copper.

PIG-IRON PRODUCTION of Germany during 1912 was 17,852,571 metric tons.

Recent Metallurgical Patents on the Rand

REGULATING UNDERFLOW FROM CONE SAND CLASSIFIERS

The application of Charles William Dowsett is for the purpose of providing automatic means for regulating the underflow from cone sand classifiers. An outlet valve at the underflow aperture is made to open when the frictional engagement of the moving sand overbalances a weighted level which again comes into operation to close such valve when the sand is below a predetermined level so that the vertical surface supplied for the frictional engagement presents a smaller area of contact.

REGULATING UNDERFLOW OF CLASSIFYING CONES

The application of William Arthur Caldecott refers to the means for regulating automatically the underflow of a classifying cone or similar apparatus, the main part consisting of a buoyant body or float which actuates a valve or equivalent device placed at or near the outlet of the cone, the said body of float falling or rising according to the depth of settled solids increases or decreases inside the cone and thus automatically opening or closing the outlet. This apparatus is used in combination or otherwise with the diaphragm forming the subject matter of patent No. 231 of 1908.

TUBE-MILL DISCHARGE

The application of William Calder has reference to the discharge of ground pulp from tube-mills and consists of a perforated plate through which the pulp enters a lift chamber having means, such as radial arms, to elevate the pulp and discharge it into the discharge trunnion of the mill. Its usefulness lies in the free and rapid discharge of comminuted ore from the mill, giving the effect of a peripheral discharge.

Barytes Production, 1912

The production of crude barytes in the United States in 1912, according to figures compiled by J. M. Hill, of the United States Geological Survey, was 37,478 short tons, valued at $153,318. Compared with the production of the preceding year this was a decrease of 967 tons in quantity, but an increase of $30,521 in value, the average price per ton reported to the Survey in 1912 being $4.09, compared with $3.19 for 1911. At the close of 1912 there were 6262 short tons of crude barytes unsold at the mines. There was also 29,865 tons of barytes imported, having a value of $79,315, and $376,017 worth of barium salts, including artificial barium carbonate and blanc fixe.

The greater part of the barytes produced in the United States is used as a pigment in the manufacture of mixed paints. It is also used in the manufacture of lithopone, a white pigment. Other uses for the mineral are in the manufacture of rubber, wall paper, asbestos cement, and poker chips, and in tanning leather. A use of barytes reported from Italy is in the manufacture of gorgonzola cheese. The cheese receives a covering in the form of a thick heavy crust of the finely ground material which has the property of affording just sufficient protection from aeration.

Chilean Sale of Nitrate Lands

A decree has been issued fixing November 17, 1913, as the date of the next public sale by auction of nitrate lands belonging to the Government. The lands to be sold are known as the Santa Laura de Wendel property, and it is estimated to contain 15,000,000 metric quintals of nitrate (metric quintal, 220.46 lb.). It is situated in the province of Tarapaca. The Government reserves the right to divide the property into two lots if desired. The sale will be held before the Junta de Almoneda in Santiago under the usual terms and conditions.—*Consular Report.*

ST. JOHN DEL REY mine, Brazil, produced gold valued at $153,000 from about 14,000 tons in May.

POTASH PRODUCTION of German mines during 1912 was 4,736,105 tons.

Decisions Relating to Mining

Specially reported for the MINING AND SCIENTIFIC PRESS.

OIL LEASE—TREATED AS AN OPTION

An oil and gas lease was held to be a unilateral contract which did not bind the lessor unless certain conditions were performed by the lessee. If the lessee failed to perform such conditions within the time prescribed, then the lease was to be treated as a forfeited option and the lessor released from all obligations thereunder.

Witherspoon *v.* Staley (Texas), 156 Southwestern, 557. March 12, 1913.

OIL PLACERS—INJUNCTION DENIED

In an action to determine the ownership and right to possession of certain mining claims, a complaint alleging the hauling of lumber on the claim and the erection of a rig by defendants for the purpose of boring for oil failed to show irreparable injury such as would justify the issuance of a temporary injunction, where it did not show that defendants were extracting, or threatening to extract, oil from the ground.

Martin *v.* Dunziger (California), 132 Pacific, 284. March 25, 1913.

MINER'S LIEN—ALASKA STATUTE CONSTRUED

Section 262, Civil Code of Alaska, giving a lien to persons performing labor on the construction, development, alteration, or repair of any building, flume, mine, tunnel, aqueduct, or other structure, limits the lien to work done in the development or improvement of a mine; and hence did not confer a lien for sluicing up the dump or for extracting gold therefrom, which was the ordinary work of a miner in the operation of a placer claim, having no relation to the development or improvement of the mine.

Noble *v.* Gustafson (Alaska), 204 Federal, 69. March 3, 1913.

COAL LEASE—CONSTRUCTION

Where the lessor of a coal mine, through mere oversight on the part of its employees and not from a consideration or interpretation of a mining lease, failed to demand an excess royalty to which it was entitled, this did not amount to a contemporaneous interpretation by the parties of a royalty clause in the lease. Such a clause will only be construed in light of the whole contract, and should be given such a construction as will not result in giving one party an unfair or unreasonable advantage over the other, though such construction violates the rules of punctuation and grammar.

Hillside Coal & Iron Co. *v.* Sterrick Creek Coal Co. (Pennsylvania), 86 Atlantic, 865. February 24, 1913.

MINING CO-TENANTS—ACCOUNTING

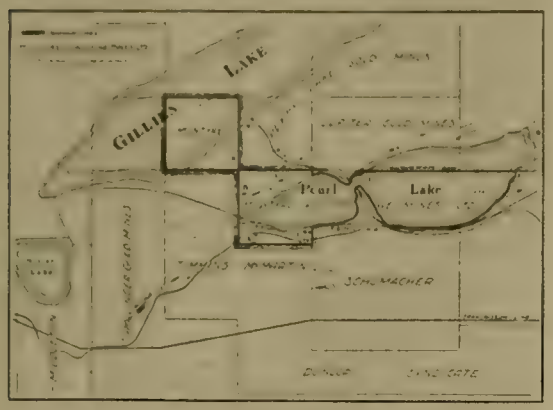
Two mining companies were equal owners and tenants in common of certain mining properties. One of them secretly worked the properties, extracted a large quantity of ore and appropriated the proceeds therefrom without accounting to its co-tenant. Subsequently it sold its interest to another company, part of the consideration being that the grantee should assume the debts and obligations of the grantor. In a suit by the defrauded co-tenant against the grantee for an accounting and damages, it was held (1) that the grantee could be sued directly for an accounting by reason of its outstanding contract to pay the grantor's obligations; (2) that the measure of damages should be the value of ore taken less the cost of mining the same. The usual rule fixing the gross value of the ore as the measure of damages against a trespasser who wilfully and unlawfully converts another's ore to his own use does not apply to co-tenants because the taking in the latter case is lawful, although it may have been done with bad intent. It is the refusal to account and divide the proceeds which gives rise to the cause of action.

Silver King C. M. Co. *v.* Silver King C. M. Co., 204 Federal (Utah), 166. April 5, 1913.

Company Reports

McINTYRE-PORCUPINE MINES, LTD.

This Company operates a gold mine at Porcupine, Ontario, and the report covers the work of the second year. The property covers about 148 acres, the largest portion of which is under Pearl and Gillies lakes. The available ore reserves are contained in not over 10 acres, which will supply enough ore for several years. The two largest veins discovered were cut by a diamond-drill under Pearl lake. The rocks outcropping on the McIntyre may be roughly



MAP OF M'INTYRE-PORCUPINE PROPERTY.

divided into three kinds: (1) a dark fine-grained basic-schistose rock which has been called 'basaltic' schist, and which, on close microscopic examination, appears to be an altered and recrystallized diabase; (2) a crystalline pearl-gray acid-schistose rock, showing distinct and plentiful quartz phenocrysts which has been called 'quartz porphyry'; and (3) a massive igneous rock which has been called a diabase, and which intrudes the basaltic schist on the north boundary either as a stock or laccolith. Broadly speaking, there are two bands of this basaltic schist enclosing a body of quartz porphyry; one band on the south and the other on the north of Pearl lake. The lake bottom itself is believed to be lying in the porphyry.

No. 1 and 4 shafts are down 300 ft. and levels have been driven at 100, 200, and 300 ft., and at 200 and 300 ft. respectively. Ore reserves opened are estimated at 129,478 tons, worth $1,470,522, while probable reserves total 371,250 tons, worth $3,408,750. A mill of 150-ton capacity is in operation, and duplication is now under way. A description will appear in another part of this journal. Mining and milling costs total $4 per ton.

GOLDFIELD CONSOLIDATED REPORT

During the month of May, according to the report of Albert Burch, the general manager, the total production of the mine was 31,047 tons, of which the mining realization was $43,767, and Milling & Transportation Co.'s profit and miscellaneous earnings were $175,677. Operating costs per ton were as follows:

Mining, including stoping and development	$3.31
Transportation	0.09
Milling	1.93
Marketing	0.05
General expense	0.25
Bullion tax	0.04
Construction	0.03
Marketing ore shipped	1.46
Total costs	$7.16
Miscellaneous earnings	0.02
Net costs	$7.14

Development covered 3898 ft. While this work did not result in the discovery of any new orebody of sufficient importance to deserve mention, it did open for stoping several small shoots, as is evidenced by the fact that the value of the ore obtained from development was more than sufficient to pay for this work, including the cost of the usual large amount of work done in barren ground. On the second level of the Combination, the 136 BX sill was extended, and produced 180 tons of ore averaging $12 per ton. The 414-D winze was sunk 86 ft. vertically below the bottom level preparatory to cross-cutting to the Reilly vein at that depth.

The No. 3 R sill on the new No. 1 level of the Mohawk mine was extended, and produced 189 tons of ore averaging $16.50 per ton. On the old No. 1 level, about 600 ft. northwest of the shaft, the 170 BX sill was started and produced 244 tons of $7 ore. The 345 A sill on the No. 3 level was extended, and produced 188 tons of ore averaging $9 per ton. Driving was continued during the latter part of the month on the narrow streak of high-grade ore reported last month in the 293 D raise. It has improved in grade, but has not developed an important orebody as yet.

The 901 E sill on the intermediate of the Clermont-Jumbo below the No. 8 level, produced 432 tons of $38 shipping ore.

COMPANIA MINERA CHONTALPAN Y ANEXAS

The property of this Company, which is situated in the Zacualpam district of the state of Mexico, has been operating almost continuously during the past year, according to the annual report which has just been issued. The Company has experienced some trouble with the Zapatistas, who have been in this district for some time, but the loss to this source up to date has been small, not exceeding ₱4000, which damage was done to the assay office on one occasion. The concentration plant has been running without interruption for the past year. Plans have been made for the construction of a cyanide plant and the machinery has been ordered. It was expected to have this plant in operation by the first of the present year, but owing to the difficulties of transportation to the mines, due to disturbed conditions, this work has progressed slowly. It is expected, however, to have this plant in operation some time in July. The Company is capitalized at ₱350,000 and its present position may be summarized as follows:

Development work, feet	2,910
Cost of development	₱ 41,589
Ore reserves, net value	420,900
Total production during the year	355,498
Expenditure in all departments	165,133
Profit	190,365

It was expected to begin the payments of dividends on March 15 of the current year of ₱1 monthly. The condition of the business is reported to warrant larger dividends, but as the expenses of constructing the other new plant and other improvements have not as yet been paid, the larger dividends which are expected will be deferred until a later date, when the present obligations have been met.

BRISEIS TIN & GENERAL MINING COMPANY, LTD.

This Company operates tin mines at Derby, Dorset county, Tasmania, and gold properties in northeast Victoria, Australia, being worked by hydraulicking and dredging, respectively. During 1912, the tin properties yielded 539 tons of black tin, equal to 391 tons of metal, realizing an average of $1033.44 per ton, a total of $404,075. The dredges handled 1,547,600 cu. yd. of gravel averaging 11c. per yd., or $170,230. Working costs were 5.5c. per yard. The total income was therefore $574,305. The year's profit on all operations amounted to $297,600, while $216,000 was paid in dividends, and $101,000 carried forward. The original Briseis property is nearly exhausted of tin 'drift,' and production will in future depend on the Krushka and Ringavoona sections, which will entail considerable engineering work. These sections are estimated to contain 800,000 and 8,947,300 cu. yd. of 'drift' respectively, containing 750 and 4569 tons of black tin, which should be won at a cost of $908 per ton.

Concentrates

Most of these are in reply to questions received by mail. Our readers are invited to ask questions and give information dealing with the practice of mining, milling, and smelting.

MACHINE-DRILLS totaling 9018 are in commission in Rand mines.

BORAX, MAGNESITE, AND CHROME production of the United States in 1912 came solely from California, according to the State Mining Bureau.

BUILDING PERMITS issued in San Francisco between April 1906 and June 25, 1913, totaled $50,000, involving an expenditure of $225,227,000.

QUARTZITE PEBBLES suitable for tube-mills are being procured from the Powder river, Baker county, Oregon, for the Cornucopia Mines Company.

THE NEW 2-COMPARTMENT SHAFT of the Commonwealth Extension Mining Co., at Pearce, Arizona, was recently sunk 206 ft., and timbered 196 ft., in 30 days.

THE ARTHUR MILL of the Utah Copper Co. at Garfield originally contained 312 Nissen stamps. These were replaced by twenty-six 16 by 37½-in. Garfield rolls, and a similar number of 6-ft. Chilean mills. The capacity of the plant was increased from 3000 to 9000 tons per day.

FLUORSPAR PRODUCTION in the United States in 1912 amounted to 116,545 tons valued at $769,163. This came from Illinois, Kentucky, Colorado, New Hampshire, and New Mexico, in the order named. Analyses of gravel fluorspar show 71.65 to 92.31% CaF_2, 4.15 to 28.33% SiO_2, 1.19 to 6.41% $CaCO_3$, and 1.07 to 4.75% Fe_2O_3.

COKE PRODUCTION of the United States in 1912 was 43,916,834 tons, valued at $111,523,336, an increase of 8,365,345 tons, valued at $27,392,487, over that of 1911. The output from by-product ovens is increasing, this being 3,200,000 tons, compared with the previous year. In all, there were 102,080 coke-ovens in operation. The average quantity of coke made from coal was 67 per cent.

MELANOCHALCITE is a copper oxide with SiO_2, CO_2, and H_2O. It is massive, occurring as a pitchy black layer a few millimetres in thickness over a nucleus of cuprite, this kernel being surrounded by a banded green zone of chrysocolla and malachite, and this again by quartz, the whole forming nodules having an average diameter of 120 mm. and of much beauty in cross-section. The black mineral when pure has a brilliant lustre and is very brittle. Hardness 4, and specific gravity 4.141. Analyses show the following composition: SiO_2, 7.80; CO_2, 7.17; CuO, 76.88; ZnO, 0.41; Fe_2O_3, 0.07; and H_2O, 7.71.

BULLION ASSAYS are made at the Perth (Western Australia) mint in duplicate, one by weighing the cornets by a modification of Foord's compensating weight method, and the other by a direct-weight system. It has been found that under the conditions of work employed, there is the same difference in surcharge for equal differences in fineness, so that the surcharge of a cornet can be resolved into two parts: one a correction proportional to the fineness of the bullion, or proof, but constant for all fires, and the other a correction constant for all cornets in a fire, but varying in different fires. The first correction is made by adjustments applied to the weights and ordinary rider used, and the second by placing an extra 'surcharge' rider in the requisite position on the beam. The balance reading thus gives the fineness directly, corrected for surcharge.

GRAPHITE is useful in steam boilers to prevent formation of scale. The best and simplest way is to feed it into the feed-pump suction line. Feed about one pint (0.5 lb.) graphite into each boiler each day of 12 hours. For every 100 hp. above 250 hp. an extra one-third pint of graphite should be used. Boiler graphite forms a thin slippery film over the boiler linings, protecting them from the action of acids in the water and associates itself with the sediment which is formed. This prevents the formation of hard scale and keeps the solid residue thrown down by the evaporation of the water in such a soft condition that it can easily be ejected from the boiler by the process of blowing off. If the water is not blown off sufficiently often, this sediment forms in quantities large enough to necessitate cleaning the boilers. Any boiler using bad water should be blown off every 12 hours. After all the old scale has been removed, the daily injection of graphite may be decreased slightly. It is the continual introduction of a small amount of graphite that brings about satisfactory results. In addition to the above, put about two quarts of graphite into a boiler each time after cleaning. The water will aid to distribute the graphite evenly over the heating surfaces. Boilers of more than 250-hp. capacity require an extra pint of graphite for each additional 100 horse-power.

AGRICOLA, in 1556, wrote the following in 'De Re Metallica' regarding *venae profundae*, or fissure veins. The direction in which the 'head' (outcrop) of the vein comes into the light, or the direction toward which the 'tail' extends, is indicated by its foot-wall and hanging wall. The latter is said to hang, and the former to lie. The vein rests on the foot-wall, and the hanging wall overhangs it; thus, when we descend a shaft, the part to which we turn the face is the foot-wall and 'seat' of the vein, that to which we turn the back is the hanging wall. Also in another way, the 'head' accords with the foot-wall and the 'tail' with the hanging wall, for if the foot-wall is toward the south, the vein extends its 'head' into the light toward the south; and the hanging wall, because it is always opposite to the foot-wall, is then toward the north. Consequently, the vein extends its 'tail' toward the north if it is an inclined *vena profunda*. Similarly, we can determine with regard to east and west and the subordinate and their intermediate directions. A *vena profunda* which descends into the earth may be either vertical, inclined, or crooked; the foot-wall of an inclined vein is easily distinguished from the hanging wall, but is not so with a vertical vein; and again, the foot-wall of a 'crooked' vein is inverted and changed into the hanging wall, and contrariwise the hanging wall is twisted into the foot-wall, but very many of these crooked veins may be turned back to vertical or inclined ones.

A PECULIARITY common to all the mines in the Kolar goldfield, India, is the amount of mercury which is extracted during treatment by cyanide. It was a distinct trouble to the chemist in charge, according to H. M. Leslie, and entailed a great deal of extra work at clean-up. The amount of mercury which was extracted from the pan slime was considerable, as much as from ¾ to 1 oz. per ton being common. This mercury was deposited in the zinc-boxes, and materially and adversely influenced the quality of the bullion which was obtained. Its effect was to make the whole of the zinc exceedingly brittle, so that the contents of the first three or four compartments were amalgamated and formed a zinc sludge, the greater part of which was zinc. This had all to be removed at clean-up, together with a proportionately large amount of short zinc from the other compartments, in order to prevent a continual congestion of the boxes. The extraction of gold by cyanide was always satisfactory, notwithstanding the presence of the mercury in the material. The average original assay was from 2 to 3½ dwt. per ton, and the residue assayed from 8 to 21 gr. of gold per ton, as the weather and other conditions of treatment varied. A precaution which was found to be necessary in dealing with the 'leachings' from this class of material, was that the gold-bearing solution, before passing into the zinc-boxes, had to be freed of any slime which might have been drawn through the filter-cloths of the percolators. The most efficient type of settling-vat for this purpose was found to be one constructed after the pattern of a zinc-box, but of much greater depth, each compartment being packed with cocoanut fibre to which the fine particles adhered. These were cleaned out at intervals.

Recent Publications

LABOR LEGISLATION OF 1912. Labor Laws of the United States, Series No. 1. Bulletin of the U. S. Bureau of Labor, No. 111. P. 263. Chart. Washington, 1913.

RETAIL PRICES, 1890 TO 1912, INCLUSIVE. Bulletin 113. Cost of Living Series, No. 5. P. 162. Bureau of Labor Statistics. Washington, 1913.

ANNUAL REPORT ON THE MINERAL PRODUCTION OF CANADA, 1911. Compiled by John McLeish. Department of Mines bulletin. P. 316. Ottawa, 1913.

U. S. Geological Survey papers. Washington, 1913:

PRODUCTION OF ABRASIVE MATERIALS IN 1912. By Frank J. Katz. Advance chapter from 'Mineral Resources of the United States, 1912.' P. 14.

RECURRENT TROPIDOLEPTUS ZONES OF THE UPPER DEVONIAN IN NEW YORK. By Henry S. Williams. Professional Paper 79. P. 103. Ill., chart, index.

University of California publications, Department of Geology. Berkeley, 1913:

SKULL AND DENTITION OF A CAMEL FROM THE PLEISTOCENE OF RANCHO LA BREA. By John C. Merriam. P. 18. Ill.

PETROGRAPHIC DESIGNATION OF ALLUVIAL FAN FORMATIONS. By Andrew C. Lawson. P. 9.

NOTES ON SCUTELLA NORRISI AND SCUTASTER ANDERSONI. By Robert W. Pack. P. 7. Ill.

Western Australian Government Water-Supply papers. Perth, 1912-13:

WATER SUPPLIES IN AGRICULTURAL AREAS. P. 52. Maps.

METROPOLITAN WATER-SUPPLY, SEWERAGE, AND DRAINAGE DEPARTMENT OF PERTH, ANNUAL REPORT 1911-12. P. 27. Plans, maps.

GOLDFIELDS WATER-SUPPLY ADMINISTRATION. Annual report, 1911-12. P. 31. Diagrams. This report deals with the operation of the water scheme, 353 miles long, supplying the Eastern Goldfields of the state.

Bureau of Mines publications. Washington, 1913:

FLASH POINT OF OILS. By Irving C. Allen and A. S. Crossfield.

TECHNICAL PAPER 49. Petroleum Technology 10. P. 31. Ill.

FOUNDRY-CUPOLA GASES AND TEMPERATURES. By A. W. Belden. Bulletin 54. P. 29. Ill.

PERMISSIBLE EXPLOSIVES. By Clarence Hall. Technical Paper 52. P. 11. This paper gives details of such explosives tested prior to March 1, 1913.

RULES AND REGULATIONS TO GOVERN THE COAL MINES AT GEBO, WYOMING, LEASED TO THE OWL CREEK COAL CO. P. 13. These mines have been leased by the United States to this company.

Colorado State Geological Survey bulletins, Denver, 1913:

GEOLOGY AND ORE DEPOSITS OF THE ALMA DISTRICT, PARK COUNTY. By Horace B. Patton, Arthur J. Hoskin, and G. Montague Butler. Bulletin 3. P. 284. Ill., maps, charts, table, index.

GEOLOGY AND ORE DEPOSITS OF THE MONARCH AND TOMICHI DISTRICTS, by R. D. Crawford. RECONNAISSANCE OF THE GEOLOGY OF THE RABBIT EARS REGION, by F. F. Grout, P. G. Worcester, and Junnis Henderson. PERMIAN OR PERMO-CARBONIFEROUS OF THE EASTERN FOOTHILLS OF THE ROCKY MOUNTAINS IN COLORADO, by R. M. Butters. Bulletin 5. P. 418. Ill., maps, charts, index.

COMMON MINERALS AND ROCKS. Their occurrences and uses. By R. D. George. Bulletin 6. P. 406. Ill., map, index.

REPORT OF THE CONSERVATION COMMISSION OF THE STATE OF CALIFORNIA. By George C. Pardee, Francis Cuttle, and J. B. Baumgartner, Commissioners. P. 502. Ill., maps, chart. Sacramento 1912. This Commission has been 18 months investigating the natural resources of California, including forests, water supply, irrigation, and flood-water control. The subject of irrigation is of great importance to the farming industry, and this covers 244 pages in the volume. The 'Irrigation Resources of Southern California' is discussed by C. E. Tait. Mineral lands, embracing dredging, oil, placer, and quartz operations, is given five pages, and a special report was made on dredging by C. B. Lipman, but the Commission's report seems to be rather antagonistic to this mode of mining.

United States Geological Survey advance chapters from 'Mineral Resources of the United States, 1912.' Washington, 1913:

PRODUCTION OF BAUXITE AND ALUMINUM. By W. C. Phalen. P. 16.

PRODUCTION OF FLUORSPAR AND CRYOLITE. By Ernest F. Burchard. P. 9. Ill.

PRODUCTION OF ANTHRACITE. By Edward W. Parker. P. 19.

STATISTICS OF THE POTTERY INDUSTRY. By Jefferson Middleton. P. 16.

SURFACE WATER-SUPPLY OF THE UNITED STATES, 1910. Part XII. North Pacific Coast. Prepared under direction of M. O. Leighton by F. F. Henshaw, E. C. La Rue, and G. C. Stevens. Water-Supply Paper 292. P. 695. Ill., index.

A New Mine-Rescue Telephone Equipment

The problem of devising ways and means for the protection of human life in mines is probably the most important question before mine-operators and the United States Bureau of Mines today. The laws of practically every state in which mining operations are carried on, call for regular inspections and also contain many safety regulations, not the least of which, in a number of states, is a section making compulsory the use of telephones underground.

During the past few years, the Western Electric Co. has furnished several thousand mine telephones for underground use. Through this intimate association with those interested in mine-safety work, attention was directed to the urgent need for some means of instant and continuous communication between an advance or rescue party equipped with its oxygen apparatus and the rear party outside the mine. In the past, members of rescue parties have lost their lives where loss of life could have been prevented by a quick and reliable means for summoning aid. The demand for this type of equipment has been met by the Western Electric Co., which has succeeded in producing a light, serviceable, and extremely simple telephone equipment for use in rescue work. In developing the apparatus, the United States Bureau of Mines was frequently consulted, in order that every requirement of this severe service might be fully covered.

A man wearing an oxygen helmet, which covers his mouth, cannot use the ordinary type of telephone transmitter, so that a special type of transmitter, known as the 'throat' transmitter, has been developed to meet this unusual condition. The transmitter is light and compact, and is provided with a soft rubber cup to adapt itself to the curves of the throat. This throat transmitter has been found by actual test to transmit speech practically as well as the standard Bell instruments. Both receiver and transmitter are held firmly in position in such a manner that they will not interfere with any type of oxygen apparatus now on the market. The telephone equipment used by the man on the outside is a standard switchboard operator's set consisting of a chest type transmitter and head-band receiver.

The rescue party is connected with the rear by means of a small wire cable consisting of two insulated copper conductors covered with a stout linen braid impregnated with moisture-resisting compound. This wire is in 500-ft. coils and is carried in a leather case fastened to the helmet man's belt, paying out as he advances. As the

coils are light, weighing less than 3 lb. apiece, several of them can easily be carried, and as one is run out, another can be connected by means of a plug and jack combination. The wire is so wound that it cannot become tangled and will pay out in whatever position the helmet man may have to assume. The total weight of telephone equipment carried by the helmet man, including one coil of wire, is a little over 5 lb. One end of the coil carries an aluminum-encased plug which connects with the head receiver and throat transmitter by means of an aluminum-encased jack. The other end is equipped with a similar jack connecting with a plug and cord running to a battery and apparatus box. This box is an essential part of the equipment and must be situated at the point from which the rescue party is being directed. It contains eight dry batteries mounted in a Patterson screw-type battery-holder, and a key, two jacks, and a battery gauge mounted in a removable compartment. The operator's telephone set is connected to the apparatus and battery box by means of a cord, plug, and jack.

In many cases it may be found desirable to use cable for carrying the talking circuit down a shaft or to the edge of the danger zone. For this purpose a large box, including a cable reel, is furnished. The box holds 1300 ft. of specially strong and flexible cable. A heavy ratchet and pawl are provided to prevent the reel from turning after enough cable has been paid out. Connections with the apparatus box and the coil carried by the helmet-man are effected by means of aluminum-encased jacks and plugs, while electrical contact with the inside end of the reeled cable is made through collector rings and commutator brushes connected to a jack.

The entire outfit has been designed and constructed with a view to providing practical and serviceable telephone equipment for mine-rescue work. Service tests have proved that this object has been attained, and the telephone equipment should be of incalculable benefit to those engaged in rescue work.

The Haldane Flame-Test Apparatus

While the percentage of fire damp in mine-air can be readily estimated by means of the cap on a lamp-flame, no equally simple test has hitherto been available for estimating the amount of black-damp in the air. Black-damp, as ordinarily met with, is simply nitrogen mixed with from about 5 to 20% of carbon dioxide. It is the residual gas resulting from various oxidation processes in mines and the surrounding strata. It might, perhaps, seem simpler and more logical to discard the use of the term 'black-damp' and refer only to the deficiency of oxygen and excess of carbon dioxide in the air. To the miner, however, black-damp is a real entity; and although the proportion of carbon dioxide in black-damp varies, black-damp is quite definitely characterized by its origin and by its effects on lights and on men. When air is mixed with black-damp, the oxygen percentage of the air is lowered in proportion to the amount of black-damp added. The percentage diminution in the oxygen is thus a measure of the percentage of black-damp, unless fire-damp or some other gas is present in appreciable amount, and helps to lower the oxygen. A flame-test can thus be graduated either to percentages of oxygen, or, as seems simpler, to percentages of black-damp. As the oxygen percentage in air diminishes, the flame of a candle or lamp is affected in two ways. In the first place, the light given steadily diminishes. Roughly speaking, the light of a candle or lamp diminishes by 30% with a fall of 1% in the oxygen percentage, and the flame will no longer burn when the oxygen has fallen from the normal (20.93%) to about 17.5%. A further effect is that the flame becomes less and less stable as the oxygen percentage diminishes; it is more and more easily blown out by any chance draught or movement. To those who work or move about in 'dull' air, this is painfully familiar: their light is constantly going out. It is upon this latter fact that the test now to be described is based.

The apparatus for the test consists of a piece of glass tube and some thin tapers. When a lighted taper is held inside the tube, an upward draught is, of course, produced by the heat; and this draught varies in strength, according as the taper is held high up or low down in the tube. The draught tends, naturally, to blow the flame out; and, according to the percentage of oxygen in the air, the flame is extinguished at a point lower down or higher up in the tube. The size of tube chosen as being convenient for the test is one 7 in. long by 0.75 in. internal diameter. The main graduations are in percentages of black-damp, from 0 up to 10½; and there are subsidiary corresponding graduations in percentages of oxygen, from the normal of 20.9 down to 18.8. Below about this percentage the taper will no longer burn in the tube; and when held upright, it will no longer burn outside the tube with less than about 18.2% of oxygen or 13% of black-damp; but, when held in a horizontal position, it will still burn until the percentage of oxygen has fallen to about 17.2, or 18% of black-damp. There is thus a wide range within which the proportion of black-damp can be estimated by the taper and tube. As the flame becomes very small when it is just on the point of extinction, its position with respect to the graduations on the tube can be determined quite easily. The lighted taper should be first pushed up to a point where it burns easily, and then gradually lowered. With a little practice, it is easy to find with considerable exactness the point at which it just extinguishes. If there is much black-damp in the air, it may be necessary to push the taper through the tube before lighting it, and then to lower it cautiously into the tube. The tapers used are 1/16-in. diameter, the thinnest that it was possible to obtain. Thicker tapers are much less convenient, and are apt to crack the glass. The tubes must, of course, be held vertically while the test is being made and to prevent the glass from cracking. The tube of the size specified has been graduated by experiments in an air-tight chamber, the black-damp being produced either by respiration or by allowing gas to burn in the chamber. The experiments showed that the tube indicates the state of the air with surprising sharpness and accuracy. Experiments show that, under favorable conditions, the accuracy is greater than that ordinarily reached by a Hempel gas-analysis apparatus. Similar accuracy cannot, however, be expected in tests made underground, unless troublesome corrections are introduced for the varying percentage of moisture in the air and the varying proportion of carbon dioxide in the black-damp, and unless great care is taken as to the exact point at which the flame is just extinguished.

It appears from these experiments that the method is sufficiently delicate to make it very useful in estimating the percentage of oxygen, or of black-damp, in the air of a mine. For ordinary practical purposes, it is greatly preferable to chemical analysis, as it gives the information at once, and the test can be repeated in as many places as may seem desirable. It does for black-damp what the cap-indications do for fire-damp, and with its help the proper distribution of air in a naked-light mine can readily be controlled. For instance, the return-airways may be tested at different points, and excessive leakage, or defective arrangement of regulators, can be detected at once. The tube method must not, however, be supposed to do more than it actually accomplishes. For instance, it does not, of course, detect carbon monoxide. Air containing after-damp, or fumes from explosives or an underground fire, might be excessively dangerous, although the tube test would show that the air contained less than 8% of black-damp. Unless the tube gave practically no indications at all of impurity, one could not be sure from its readings alone that dangerous proportions of carbon monoxide were absent from the air of a mine. Of course, the tube would be far better than a lamp. Arrangements have been made with Siebe, Gorman & Co., Ltd., H. N. Elmer, Agent, 1140 Monadnock block, Chicago, to supply the whole apparatus complete, with metal case and an inner tube to hold the tapers, and a holder for use when a taper has to be held far up in the tube.

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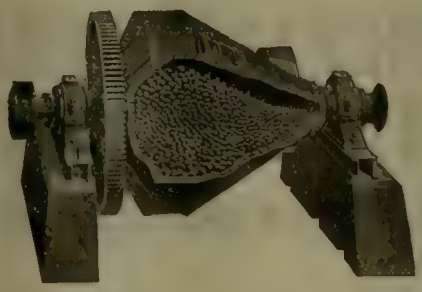

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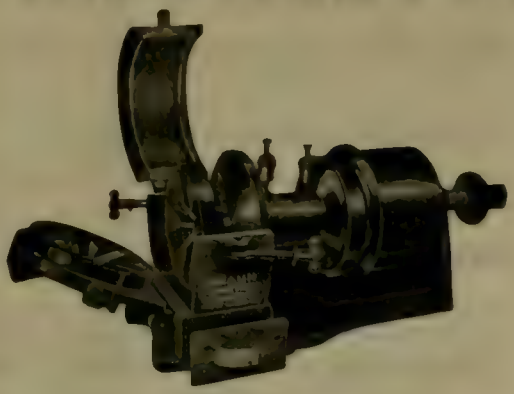

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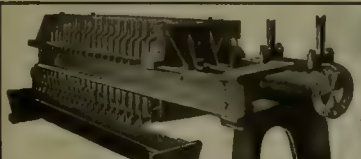

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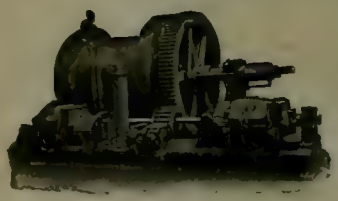

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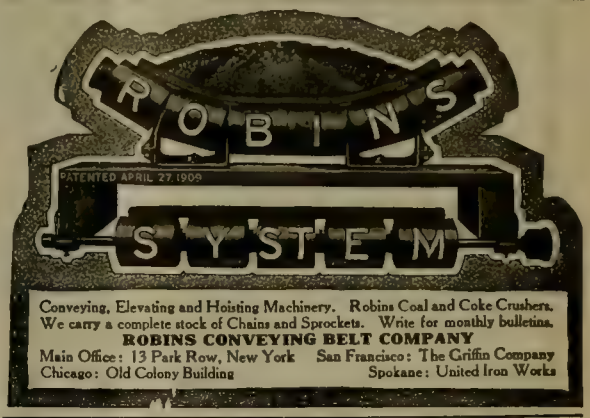

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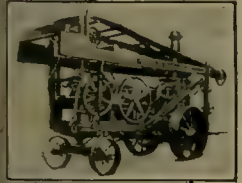

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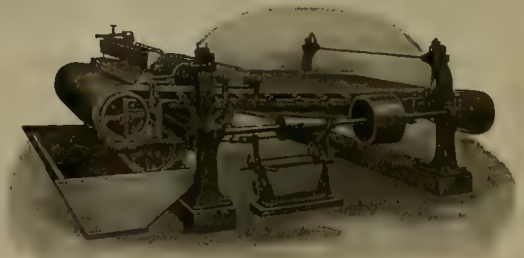

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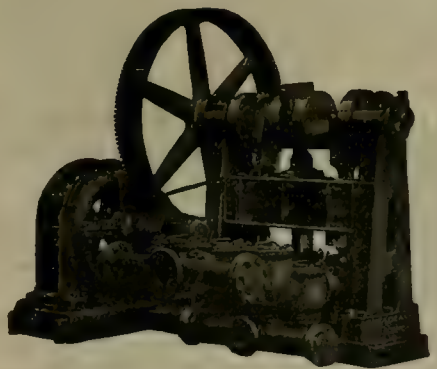

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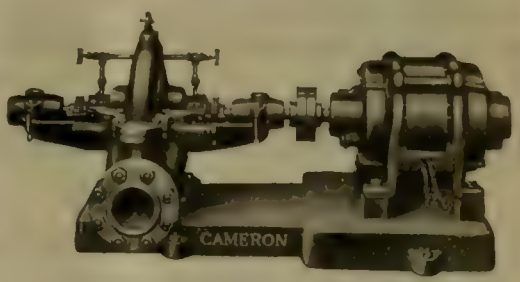

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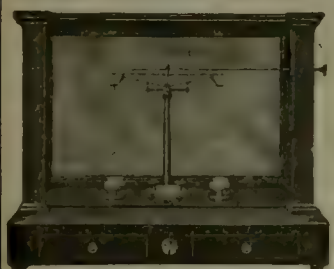

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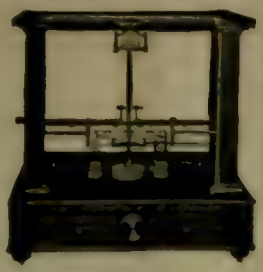

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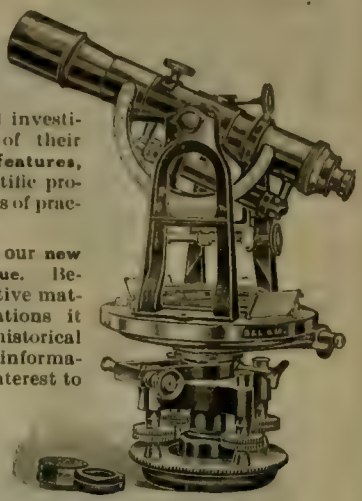

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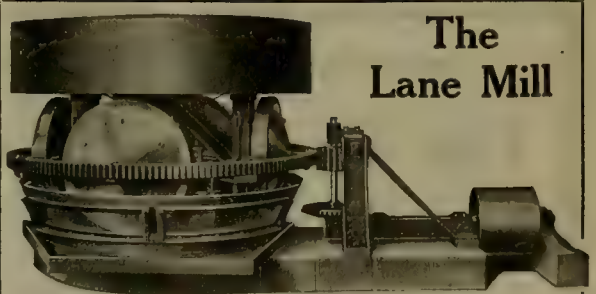

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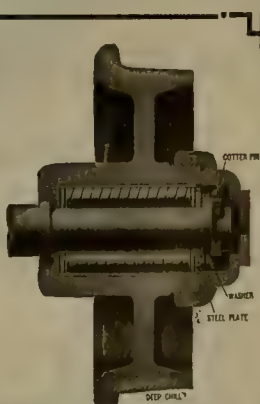

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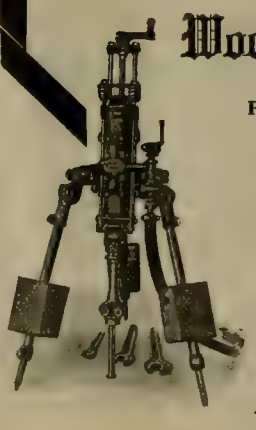

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COMPANY MEETING

Minerals Separation American Syndicate (Limited)

THE PORPHYRY PROBLEM SOLVED

Remarkable Results Achieved by the Minerals Separation Flotation Process at the Great American Copper Mines

The 2ND ANNUAL ORDINARY GENERAL MEETING was held at the offices of the syndicate, 62, London-wall, in the City of London, on Monday, June 16, Mr. JOHN BALLOT (chairman of the syndicate), presiding.

The SECRETARY (Mr. A. O. Williams), read the notice convening the meeting and the auditors' certificate.

The CHAIRMAN, after dealing fully with the directors' report and accounts, said that shareholders have every reason to be much gratified with the very substantial progress already made, as well as with the very great prospects before the syndicate. The two years and seven months since the formation of the syndicate have been spent in what may be called careful and well considered exploration work, during which the great possibilities of our process have been brought home to the serious attention of the great copper groups and other important mineowners in the United States, Canada, and elsewhere in such an effective and convincing manner that any doubts which may have existed hitherto have now almost disappeared.

At the Britannia Mines, in British Columbia, where the plant has been in operation for many months, recoveries of over 94 per cent. are being regularly obtained, and the management of that company say that they will be disappointed if they do not get 98 per cent. recovery from their first 600 tons per day unit, which they hoped to put into commission early this month. Later on the Britannia Company purpose largely increasing the capacity of their mill and flotation plant.

At the Cuba Copper Mines the whole mill output is also now treated with excellent results by our flotation process.

At the Inspiration Consolidated Mines of Arizona, one of the great Porphyry propositions, our 50-75 ton test plant has yielded recoveries well in the 90 per cent., with low working costs. With the exception of the oxidized capping, every possible class and grade of ore in the mine has been tried with the same result. From the oxidized capping also we have proved that we can get better recoveries and better economical results than is possible by any other known method. This problem, however, has been very carefully studied, and I think that I am already justified in telling you today that I believe that Minerals Separation has already solved it successfully, and if that is so it will enable us to give as good recoveries from this oxidized material, as from the great bulk of the ore in the Inspiration Mine, which can be treated so successfully that the mine authorities estimate that by using our process they will make an additional profit of over $1,300,000 a year more than by any other known method, as well as save $1,500,000 in the first cost of their treatment plant. These are stupendous figures in themselves, but I am assured that they are even well on the conservative side.

The Inspiration Company, as you know, is now crushing about 50-100 tons per day. With that mill they carried out an exhaustive series of tests by all known methods including our process, with the result that they decided to take a license from us and to install our process. A first section of 600-ton per day crushing plant with flotation unit is now in course of erection; this it is hoped will be ready to start work by September next. Meanwhile, excavations are in progress for a complete mill and flotation plant to treat 7,500 to 8,000 tons per day. The 600-ton section will be ready long before the larger mill can be built, and on its results will depend whether the whole output will be treated by our flotation method. Although the management have adopted this conservative policy, I do not think that either their or our own engineers have the least doubt as to the final result being successful. I, myself, have no doubt whatever, and feel confident that results of large scale work at Inspiration will soon convince the managements of the other great Porhyries that our flotation process can and will yield very large additional yearly profits from the treatment of the same grade of ores over any other possible methods.

After carrying out tests on his ores, at Elm Orlu, and the Colusa-Parrot Mining and Smelting Company, at Butte, Montana, that well-known mineowner, Senator Clark, who owns these properties, took a license from us for each of them. The Elm Orlu Mine adjoins the Butte and Superior.

Tests on average bulk samples of ores from several of the most important groups of big mines in America have indicated results so favorable that the mineowners can safely be assured that they may expect anything from 20 to 30 per cent. additional saving of copper from their ores, and I have every reason for believing that such saving will be made by us at no appreciably, if any, greater cost per ton of ore treated than by present methods; even if our royalty be allowed for, the profits will reach figures not hitherto thought possible.

We have carried out most successful tests on parcels of ore from several of these great mines. Without mentioning any names, I will give you some comparative figures based on actual results obtained at one mine by present methods and what they would have been if our process had been employed.

The company in question treated 2,852,515 tons of ore during 1912, assaying 1.69 per cent. copper for a recovery of 68.25 per cent. This yielded a total of 65,881,116 lb. of copper. In the tests by minerals separation process the same ore yielded a recovery of 85 per cent., or at the rate of 82,049,741 lb. of copper from the same tonnage treated, which, by assuming the same grade of concentration and with copper at 14c., would have yielded an additional income of $933,639, after deducting royalty and cost of reagents and adjusting smelting charges; but as a matter of fact by our process we produced a grade of 16 per cent. copper against 10.49 per cent. by the mining company, so that the actual figures in our favor, after deducting royalties, cost of reagents, and adjusting smelting charges, would have amounted to no less a sum than $1,795,161. These are eloquent figures, which I feel certain may be left to speak for themselves.

I only wish to add that my estimates are based on very safe and conservative lines, and that I have every hope that the mineowners will soon be convinced when they realize these facts, for no efforts will now be spared by us in laying

Needless to say that important negotiations are already in progress with several more very large mines for the adoption of our processes.

The CHAIRMAN then formally moved the adoption of the directors' report and accounts, which was seconded by Mr. F. S GIBBS and carried unanimously. Dr. S. Gregory was re-elected a director, and Mr. N. M. T. Sondheimer was elected in the place of Dr. S. Sondheimer, retired. Messrs. Monkhouse, Stoneham, and Co. were re-elected auditors for the ensuing year.

A vote of thanks to the chairman terminated the proceedings.

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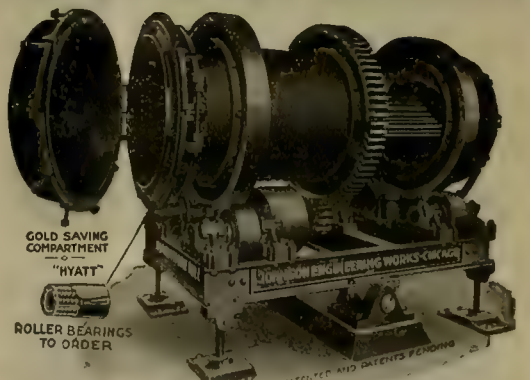

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Catalog 124 by return mail if you say so.

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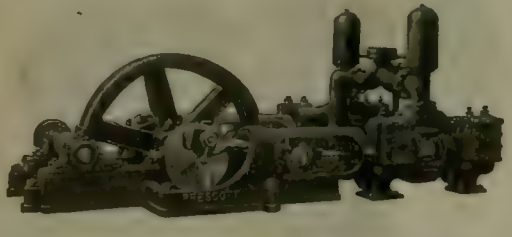

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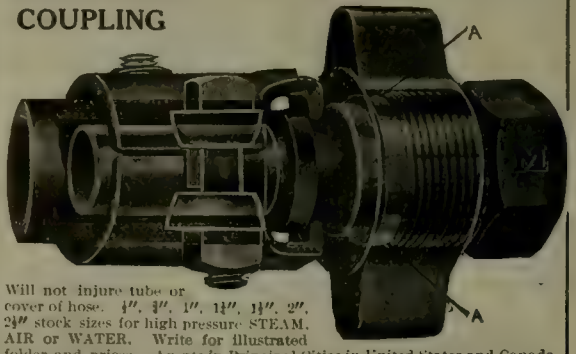

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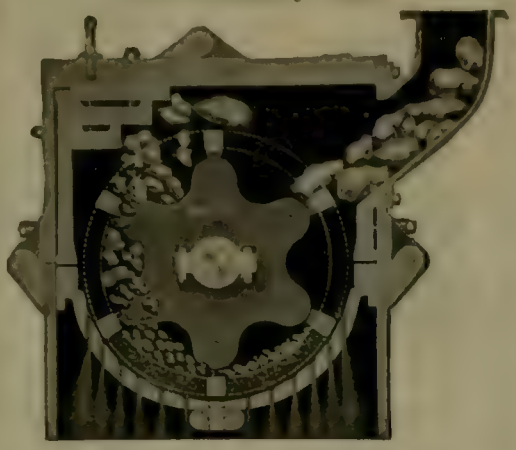

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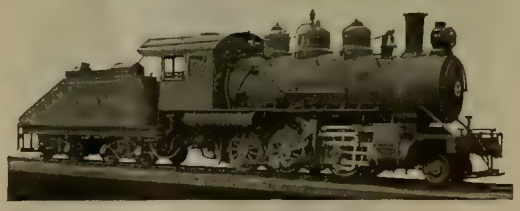

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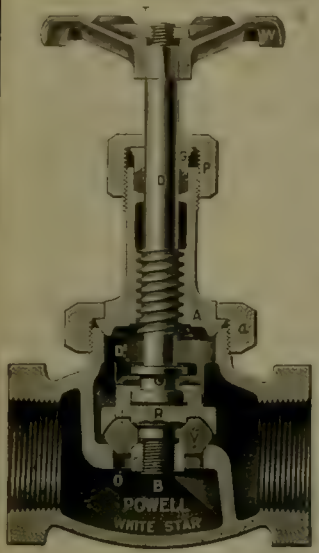

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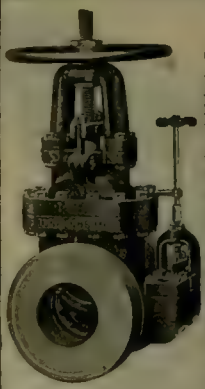

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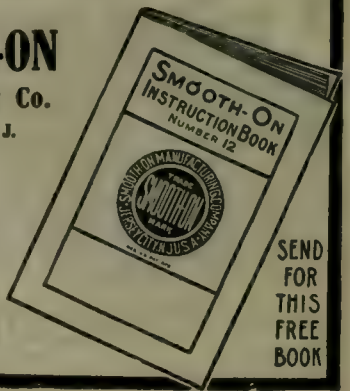

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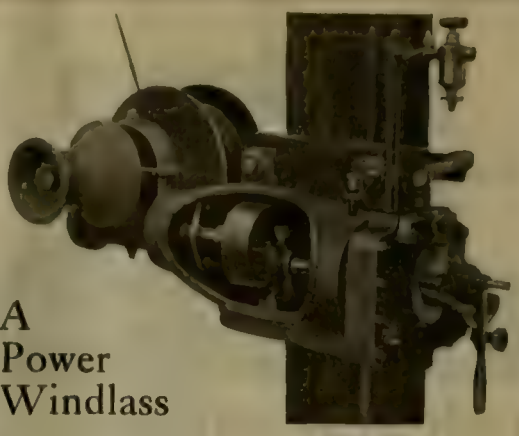

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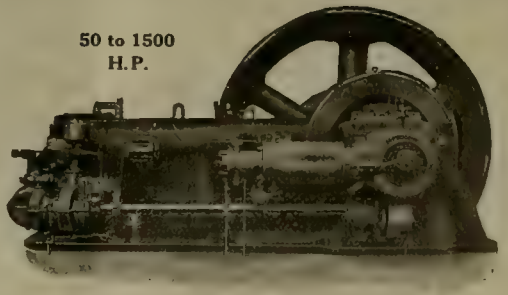

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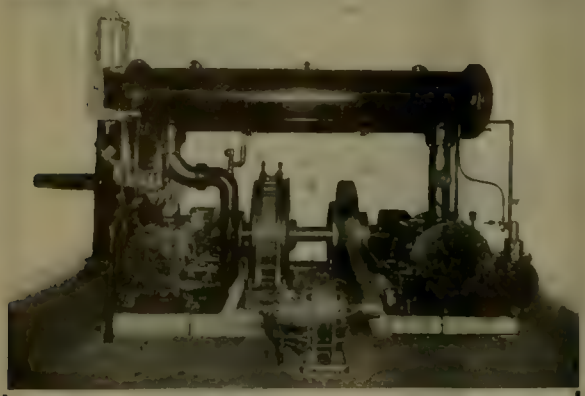

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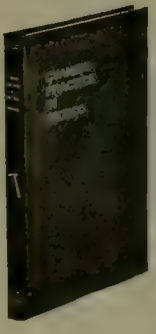

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Nov., "	57,408	—	84%
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Jan., 1912,	65,384	—	80%
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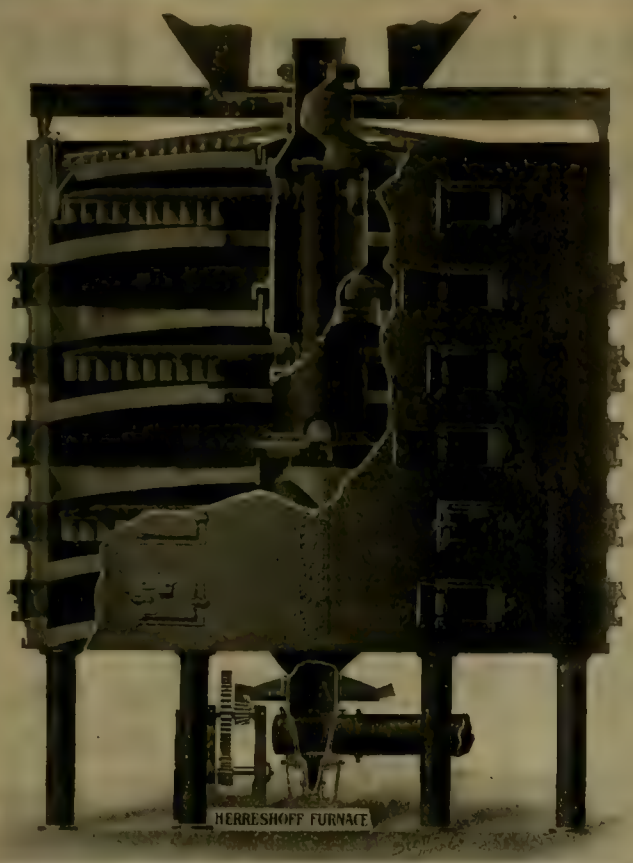

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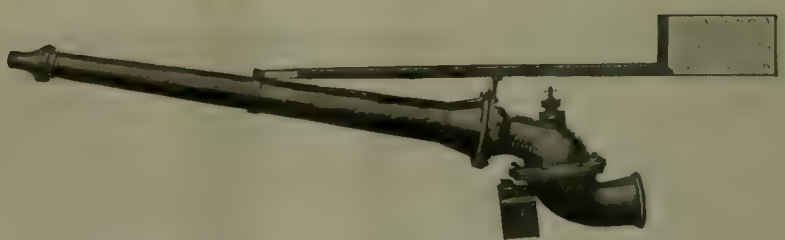

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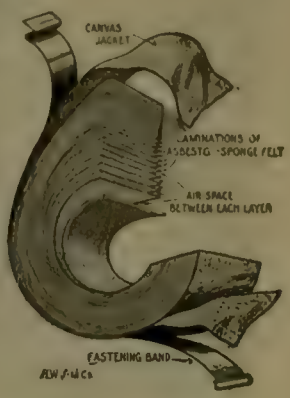

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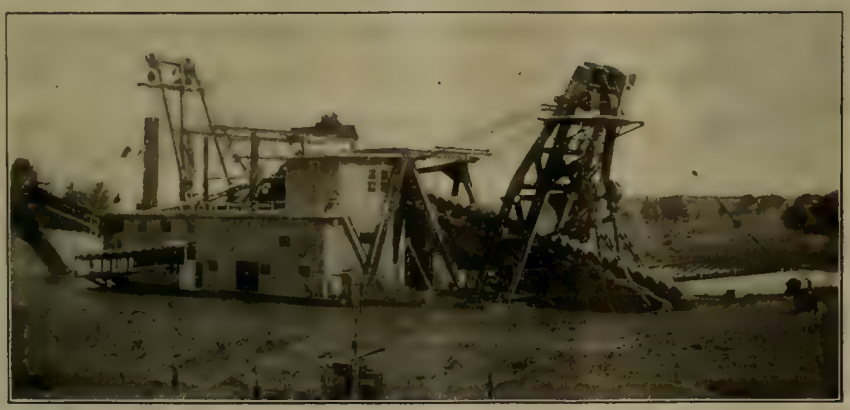

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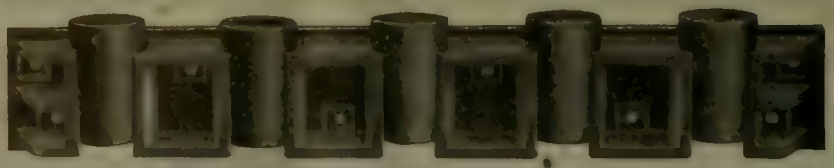

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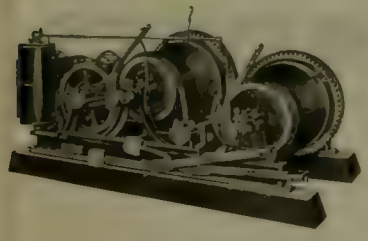

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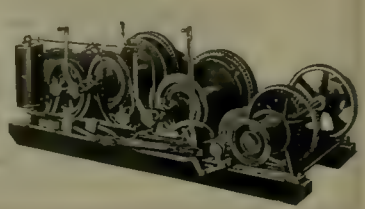

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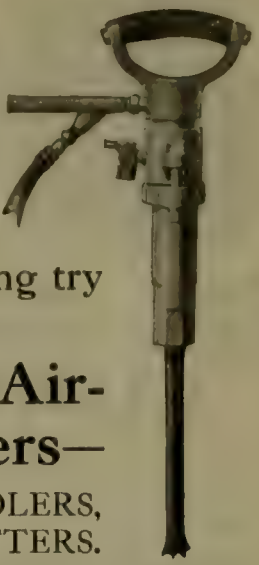

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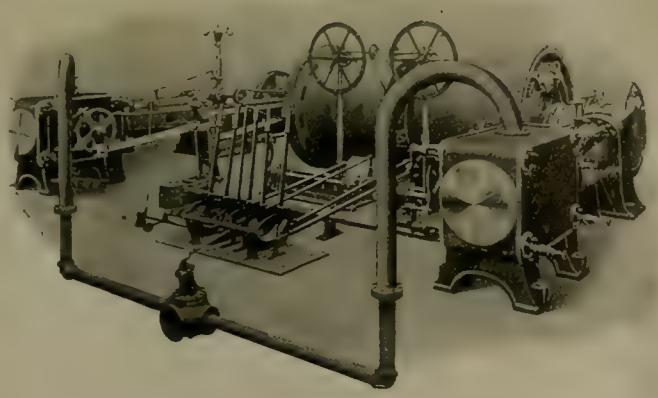

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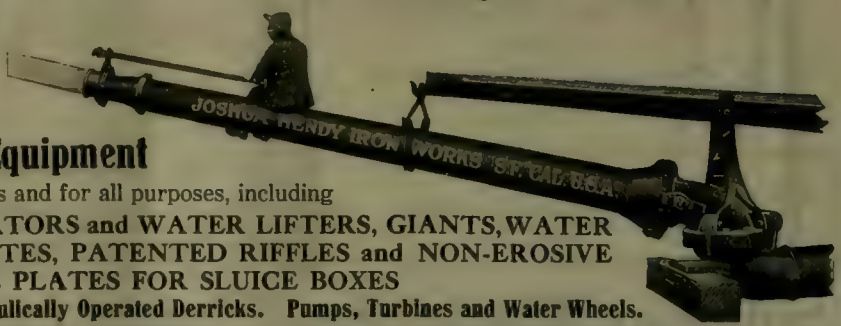

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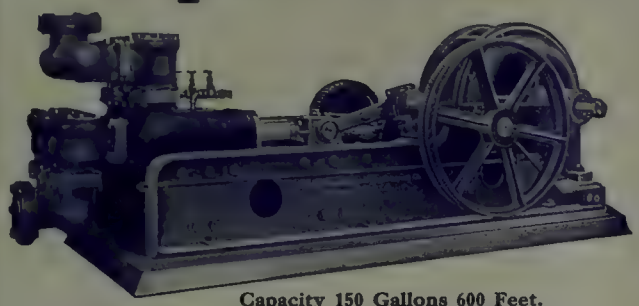

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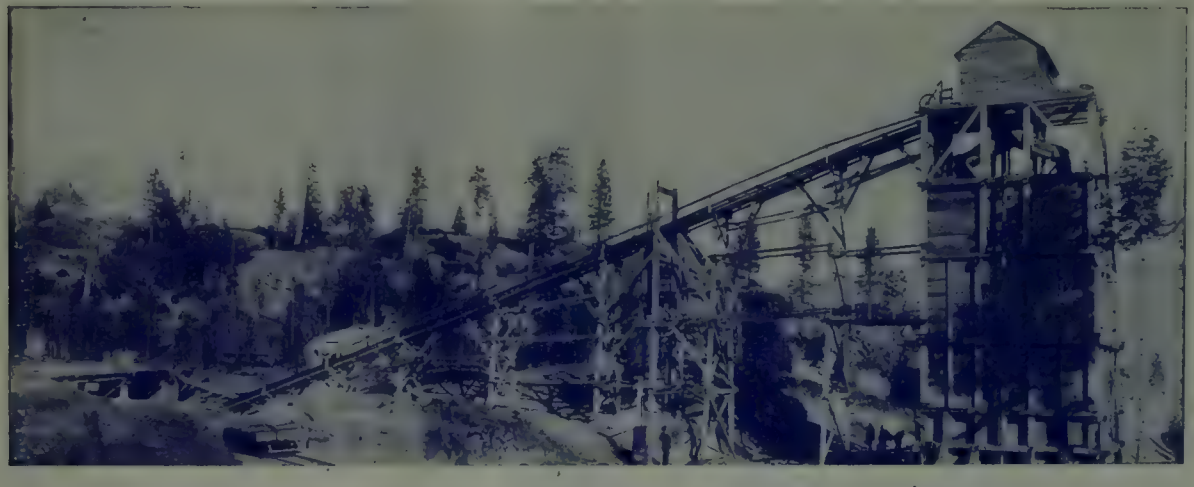

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EDITORIAL

A GERMAN professor with a new divining rod has arrived in this country on the same steamer with a scientist who has a light that duplicates daylight. We second the suggestion of the New York *Sun* that they get together and hunt turtles for the Friedmann Institute.

NOME citizens are reported to have held a mass-meeting to protest against the new mining law passed by the territorial legislature and to appeal to Congress for its revision; rather a sorry comment on the vociferous demand for home rule that has been coming from Alaska.

REPORTS from Antwerp state that the control of the Trinidad Oilfields, Ltd., has passed to the Royal Dutch-Shell company, unusual interest being lent to the transaction by the statement that the purchase was made jointly with the British Western Isles, Ltd., a Rothschild company. The co-operation of two such large interests in the Trinidad fields is strong evidence of their great probable value.

HAVING two trains pass on the same track has been frequently, if inadvertently, tried, but the experiment has been wholly without success. At the Rosas mine in Sardinia, Mr. E. Praetorius has found how to make two buckets on an aerial tram pass on the same rope; and as usual, it is simple when you know how. This ingenious piece of engineering is described and pictured in the June number of our London contemporary, *The Mining Magazine.*

SHIPMENT of an initial consignment of East Texas brown iron ores from Galveston to Philadelphia has been made as part of a contract to supply 300 tons per day. The outcome of the venture will be a matter of interest to the West generally. The brown ores of Texas, while low in phosphorus, are also rather low in iron, and shipments on a large scale can scarcely be expected to maintain a grade of over 32 to 35 per cent. Freight rates to the ore fields are heavy, and there seems to be a better opportunity for the development of iron smelting within Texas. There is a fair market for pig iron in that state, and a larger market for such steel products as cotton ties and fence wire, while the demand is brisk for the ammonium sulphate that is a by-product of coke-making. Plans are well advanced for the beginning of smelting in Texas, and it is to be hoped that iron-making may take its way westward in company with 'the star of empire.'

POISONING from an unusual cause is reported by Dr. Louis Casamajor in a recent number of the *Journal* of the American Medical Association. The men affected worked in the mill of a large mine, of which zinc was the chief product, and after periods of from six months to three years developed a pathological condition of the central nervous system, affecting principally the mechanism of walking and equilibrium. The ore was practically free from lead and arsenic, but contained quantities of manganese, to which Dr. Casamajor is inclined to attribute the effect produced. At the risk of seeming to treat a serious subject with undue levity, we venture to suggest that a similar effect is exhibited within a shorter period following the ingestion of *spiritus frumenti*.

SUGGESTIONS for a scientific non-partisan tariff commission are met regularly at Washington by the statement that the members of Congress concerned in the revision, themselves constitute a commission directly chosen for the task in hand. An excellent side-light on their competence is thrown by the testimony of Mr. A. B. Fall, senator from New Mexico, to the effect that there is a 'zinc trust' and that it controls most of the zinc deposits and smelters of this country. In fact, the most important sources of zinc ores in the United States are the Joplin, Leadville, and Wisconsin districts, and no company controls any one of these. The most important use of spelter is for galvanizing, and probably the largest user is the United States Steel Corporation, which controls the Edgar Zinc Company, which, however, operates less than 10 per cent of the retorts in this country. The New Jersey Zinc Company is the largest single concern and does dominate the zinc oxide business. In the mining of ore, however, or the making of spelter it plays only a minor part. The zinc business is particularly free from control, and it is a pity that matters so important as the tariff should be decided by those who are so ignorant.

JULY brings dog days (elsewhere than in California) and also dividend disbursements. According to the computations of the leading financial journals, over $266,000,000 in dividends and interest on railroad and industrial securities was paid on July 1. This represents an increase of $12,000,000 over July 1, 1912. But what is more encouraging is the decrease in new securities issued. Railroads have placed $152,000,000 less of new securities in the first half of this year than they did in the corresponding period of 1912, while industrial corporations have issued $227,000,000 less. This shortening of sale is most encouraging for the country at large, but leads to dull times in Wall Street. It is related that the junior partner of a firm of brokers that formerly did a large business was recently observed leisurely taking a hearty lunch. To the question as to how he could afford to remain away from his office for so long a time, he replied, "Our customer is sick." Preparations to finance the moving of crops next fall are already under way, and call money in New York during June commanded 2.291 per cent, or over 3½ per cent less than well secured time loans, an unusually large margin, and one that should result in a good supply of ready money in the autumn.

CONDITIONS in Mexico appear to be growing steadily worse, regardless of the efforts which the present administration has made to stem the tide of revolution and brigandage which has swept the country from the Rio Grande to Guatemala. The latest reports from Mexico state that the Huerta government is bankrupt and on the verge of collapse; Felix Diaz, the instigator of the revolution which resulted in the overthrow of the Madera regime, and who has been generally accepted as the next president, has sailed for Europe; President Huerta is anxious to be relieved of the presidency; and Francisco de la Barra, Mexico's foremost diplomat, who will be remembered as the representative of Porfirio Diaz at Washington and who succeeded him as president, has resigned as Minister of Foreign Affairs. So it would appear evident that the present administration is facing a more serious situation at the present than at any time since taking up the reins of government. With the revolution gaining ground and the apparent inability of the federal troops to cope with it, a lack of funds and an ever changing personnel of the government officials, it would seem that there is no hope within Mexico for her salvation. However, to those who have tried and are trying to keep the mines and mills going in spite of the many handicaps and discouragements, while there is apparently no immediate solution, it is a long road that has no turning, and it is to be hoped that the pendulum will soon swing in the opposite direction.

ELSEWHERE in this issue, Mr. Herbert Lang discusses the conditions governing the combustion of liquid fuel. An atomized liquid, which superficially resembles a gas, differs essentially from a true gas, and even more markedly from a solid combustible, in its method of burning. In the case of a gas, it is easily seen that proper care must be taken to secure its thorough mixing with a sufficient quantity of air in order to provide the oxygen necessary for the heat-liberating reaction, avoiding any undue excess, since air consists largely of nitrogen, which carries away heat without having been productive of any. In the case of solid fuel, this almost adjusts itself in any reasonably well designed furnace, since the fuel and air move in contrary directions, the fuel burning away as fast as air is supplied for the purpose. In an oil-fired furnace the fuel and air move in the same direction at nearly equal speed, cross-currents providing for the proper mixing. Careful regulation is necessary to constantly maintain the proper proportion of air and liquid. In addition, the minimum temperature of combustion must be maintained as well. A hot coal will continue to burn, though in contact with a cold surface, if supplied with air for combustion, because the coal keeps itself hot enough by the heat it liberates. A gas-air mixture, or an air-liquid mixture, will not continue to burn under such circumstances, because it radiates heat so rapidly that

it quickly cools itself below the minimum combustion temperature. The solid fuel burns on its grate and radiates its heat to nearby objects; a gas or liquid burns throughout the combustion space, and, if allowed to radiate its heat too quickly, soon cools below the temperature of combustion. Hence it follows that the proper mechanical construction of a firebox or furnace for burning liquids differs markedly from that which gives the most satisfactory results with solid fuel.

FURTHER details are now available concerning the huge metallurgical plant to be erected to treat copper ore by leaching at Chuquicamata, as discussed at some length in our editorial columns of June 21. The ore, which is mined by steam-shovels, will be subjected to a preliminary crushing in gyratories, crushers, and rolls, and then distributed, by a system of belts, into concrete vats, lined with acid-proof materials and holding 9000 tons each. It is estimated that one day will suffice for filling a vat, two to three days for acid treatment, and washing, and one day for discharging, each vat holding one day's ore supply. The extraction process might perhaps be more accurately termed soaking, rather than leaching, since it is not necessary to cause the solvent to percolate through the ore to the same degree as is required in cyaniding gold ores. The pregnant solution will be drawn off into solution tanks, preliminary to electrical precipitation. The leached residue will be excavated from the vats by clam-shell buckets operated from a traveling bridge, somewhat resembling the system used in reloading coal from stockpiles, and the residue will be piled upon the waste dump by a series of belt conveyors. The plant is to be built upon a side-hill having a 6° slope and of sufficient extent to provide ample storage room for the great quantity of tailing which will in time be produced. The contract for the construction of the electrical power-plant and transmission line has already been let to the lowest bidder, a German firm, for approximately $3,000,000; the equipment including a 40,000-kilowatt, oil-fired power-plant on the seacoast, a 100-mile transmission line to the mines, and the necessary auxiliary sub-stations and transformers. It is hoped to have the plant in full operation within three years, but construction work on so large a scale at so great a distance from headquarters may easily involve unexpected delays.

Law and Mining in West Virginia

We have so far refrained from comment on the coal-mining situation in West Virginia, for much the same reason that an onlooker might well hesitate to assess the blame in the progress of a Donnybrook fair. We can, however, agree heartily with Mr. Theodore Roosevelt in putting the blame squarely up to the courts for the part they have played in a situation which in no phase evokes admiration. On the one hand, it has been charged that armed attacks upon labor camps were made by men who were presumably agents of the operators, that the declaring of martial law was unjustified, and "the employing operators have not only discriminated in utterly unjust and anti-social fashion against labor unions, but have endeavored to keep the miners in a state of practical serfage by the use of company stores." On the other hand, it is alleged that demoralization of the profitable mining industry of West Virginia was incited by operators in other districts, who found a ready tool in labor leaders anxious to reap personal profit through stirring up trouble. Of the measure of truth in these counter allegations we profess no special knowledge. But it must be evident to any sober thinker that the courts of West Virginia, in declaring unconstitutional all the legislative measures intended to prevent the exploitation of employees through the aid of the company store and, on the other hand, in refusing to permit that degree of combination among operators which would preserve them from cut-throat competition, is in large degree to blame for a condition which is almost synonymous with anarchy. It is truly remarkable that the courts, supposed to be the guardians of the rights of the people, have developed into institutions of slow-witted legalism which seem to be chiefly effective in obstructing the securing of the rights of labor and capital alike. That anarchy which is misnamed socialism by such organizations as the Industrial Workers of the World finds its chief justification in the manner in which the courts defeat the will of the people in attempting to adjust themselves to the ever-changing conditions of that social organism which we call the American nation. Cannot some effective means be devised to convey to the legal mind the fact that we are now living in the twentieth century?

Geology of Kalgoorlie

Kalgoorlie is one of the world's great goldfields, and to engineers it is of wide interest, not alone because of the production, notable as that is, but because of the occurrence of the ore, the presence of tellurides, and the marked advances that have been made in mining and metallurgy in the field. A detailed study of the mode of occurrence of the ore is well worth while. We are glad, therefore, to print this week the first of a series of articles written by Mr. Malcolm Maclaren, and describing the geology. The articles are taken by permission from an unpublished report upon the field made for three of the leading companies. They cover the main part in its scientific phases, except a most interesting chapter on petrology more appropriate for publication elsewhere. The parts of the report dealing specifically with the ore deposits, being the private property of the companies, cannot be printed at this time, but in the material now so generously made public, enough is given to enable the trained student of ore deposits to recognize the essential steps in the deposition of the ore. Those not already familiar with the district should read in this connection the admirable account of the ore deposits prepared by Mr. C. O. G. Larcombe, and forming volume V of the *Proceedings* of the Australian Institute of Mining Engineers. While the nomenclature of the rocks differs in the two reports, in which particular they run true to form for geological reports on the pre-

Cambrian, the general sequence is the same.

Except the quartz veins, here of minor import, and the alluvial deposits, which are aside from the general discussion, the ore occurs at Kalgoorlie in two forms: The first is the wonderful Oroya Brownhill 'pipe', a great body of ore outcropping in Brownhill ground and dipping through the Brownhill Extended, Associated Northern, and Oroya. It is found in what Mr. Maclaren calls the 'Older Greenstone' near the contact of the latter with his 'quartz-dolerite'. For these rocks Mr. Larcombe uses the terms 'metamorphic tuff' and 'quartz-andesite', respectively. This orebody was formed by replacement in a position determined by intersecting fault planes. The bulk of the orebodies, however, occur in the quartz-dolerite (or quartz-andesite) along fissures or 'shear zones.' In this they resemble the veins at Cripple Creek. These fissures are only significant and only contain valuable orebodies when in the quartz-dolerite; presumably because it was the only rock that was sufficiently brittle to break in long fissures, thereby forming what Mr. C. R. Van Hise has called 'trunk channels' for underground circulation. Both Mr. Larcombe and Mr. Maclaren agree as to the ores being primary and intimately related to the quartz-dolerite. Mr. Larcombe sees no reason why the ore-shoots should not continue indefinitely in depth. Mr. Maclaren says that the value of a given lease is conditioned by the extent to which it covers the quartz-dolerite; plainly indicating a belief that the veins will be found of no value where they pass outside this especial rock. It is perhaps unfair to speculate more closely as to what Mr. Maclaren does or does not believe about the genesis and structural features of these ores, since the time is not ripe for full exposition of his views. That they are well founded will be certain to everyone who reads the part of the report now made public.

It remains but to express here appreciation of the far sightedness of Mr. H. C. Hoover, who projected the work, and the liberality and broad-mindedness of Messrs. Bewick, Moreing & Co., who, charged with the management of the companies concerned, saw the value in and supported the making of a geological survey of the district as complete and as scientific as any conducted elsewhere at government expense. Science has no enemy save the ignorant, and the miner has no such helper as science. It is a pleasure to print in a mining journal a scientific report made by a distinguished geologist for a firm of engineers managing a group of mines of first magnitude.

The Rand Strike

Not since the days of the Jameson raid and the war of 1898 has Johannesburg been the scene of as much turmoil as has recently been experienced in that city as a result of the strike of the Rand miners. At the New Kleinfontein a dispute over working hours led to a strike, which was settled by the management granting the requests of the men. The next demand was for the dismissal of those strike-breakers who refused to join the union. The management was obdurate and the workmen of mine after mine struck in sympathy with the New Kleinfontein men, the strike even spreading to the coal mines, and the railway employees threatened to go out. Only the presence of troops maintained electric-power service. After several days of rioting, in which over a hundred lives were sacrificed in addition to property being damaged and the losses due to the closing of the mines, a settlement of the difficulties was reached by a committee appointed by the Government and a committee of the strikers. The terms of settlement were that the strike should be declared off; the New Kleinfontein strikers are to be reinstated, and the Government is to grant suitable compensation to the strike-breakers, who are in no way to be victimized; the strikers in other mines are to return to their work and are to be taken back as mining operations are resumed; representatives of the workers are at liberty to lay any other grievances before the Government, which will inquire into them. While the strike is regarded by the miners as a victory for organized labor, are the terms of settlement commensurate with the loss of life and property which has been occasioned, and could not the same results have been accomplished by more peaceful means? Like the disarmament of the nations and the much-talked-of universal peace, it seems to be a matter of theory rather than of practice, but it is to be hoped that by a closer relation and a better understanding between employer and employee, such catastrophes as the present one may be avoided and the questions in dispute decided by arbritation, which is always the ultimate result, regardless of how much blood has been shed previous to the settlement.

While most of the strikers have returned to work, the peace terms have not been generally accepted. Six thousand native black laborers from three of the large gold mines have refused to go into the mines unless granted an increase in wages, and a thousand in another property are reported to have broken out of their compound and were only made to return when forced to by the troops. Should this attitude of the native labor spread to the other 250,000, which are employed in the district, the result might be disastrous.

The Government has recently ordered a cessation of recruiting native laborers in the district north of 22° south latitude, which will eventually cause the mines to lose 25,000 native laborers, and this fact has accentuated the difficulties experienced in handling the white workmen. Not a few observers consider that the gold production on the Rand has already reached its zenith, and if to the increasing operating costs and a decreasing return per ton milled are to be added the heavy burdens resulting from the exactions of labor unions, the repaid decline of the gold-mining industry on the Rand is not far in the future. The present outbreak must seem peculiarly ungrateful to Mr. R. W. Schumacher, of the Rand Mines, and the Central Mining & Investment Corporation, Ltd., who has been especially active in securing for miners the opportunity to purchase homes on the easiest possible terms and also in securing them more favorable terms for contract work.

Geology of the Kalgoorlie Goldfield—I

By Malcolm Maclaren and J. Allan Thomson

The geological and other data contained in the following pages form a portion of the results of a geological survey of the Kalgoorlie goldfield in Western Australia, extending from April 1909 to March 1910. The initiation of the survey is to be ascribed to H. C. Hoover, whose knowledge of the field had indicated the probable utility of a close geological examination. It was at first hoped that the leading companies of Kalgoorlie and perhaps the

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Government of Western Australia would unite in sharing the cost of the survey. Finally, however, it was borne by the Ivanhoe Gold Corporation, Ltd., the Oroya Brownhill Co., the Lake View Consols Co., and in a certain sense by the authors. The burden of the work fell on the senior author. The petrologic work was largely left in the hands of the junior author, who also was responsible for much of the mapping of the northern end of the Kalgoorlie auriferous area.

Situation and Topography

The Kalgoorlie goldfield lies on the great inland plateau of Western Australia. The western boundary of this plateau is the sharply defined fault escarpment lying parallel to and only a few miles from the coast at Perth. Its main southern boundary is apparently the fault line that forms for so great a distance the shore of the great Australian Bight. To the east the plateau probably reaches to the South Australian border, the surface then sinking to the Central Australian depression. Its northward extension is somewhat indefinite, but it passes at least beyond the Pilbara goldfields. In the immediate neighborhood of Kalgoorlie the average height of the plateau above sea-level is some 1250 ft., while the maximum height is reached at Mt. Burges (1922 ft.), nine miles north Coolgardie. No figures are available for the majority of the lake-beds, but that of Hannan's lake, 1060 ft. above sea-level, may be assumed to represent the average level of these. The physiographical feature of the region is thus its low relief, Mt. Burges, Mt. Robinson, Mt. Hunt, Mt. Monger, and others, being merely semi-isolated mounds or the higher portion of short ridges, in a gently undulating plain.

Physiographical Features

In a region of long-continued erosion, physiographical features become inevitably the expression of the geological structure, and here is no exception to the general rule. The ridges are generally the harder greenstones, though at Kanowna, quartz-porphyry, and at Kurrawang, coarse conglomerate rise to ridges. The valleys and lower land generally is occupied by sedimentary rocks or by porphyrite, which decomposes just as readily and to a very similar product. The general aspect of the region is one of broad shallow valleys with low comparatively narrow ridges. To the south of Coolgardie as far as the Londonderry, in the contact-metamorphosed amphibolite, ridges and valleys are narrower and the surface assumes a comparatively rugged character. On the whole, the general trend of the ridges is north-northwest with the strike of the rocks, but low watersheds trending east-west have been occasionally developed, as between Coolgardie and Kalgoorlie, by the ancient drainage system of the area.

The mines of Kalgoorlie itself are disposed along a low ridge some five and one-half miles in length, of which, however, only the southern portion has been as yet highly productive. This is 'The Mile' of the inhabitants and 'The Golden Mile' of journalists and company promoters. The ridge strikes with the foliation of the country north-northwest and south-southeast, and is flanked on either side by a broad shallow valley. Its average height is only 100 ft. above that of the valley bottoms. Its highest point is Mt. Charlotte (1378 ft.), which has been utilized as the site of the reservoir from whence the water brought from the Darling ranges, near the coast, is distributed. The lowest point in the immediate neighborhood is, as already mentioned, the bed of Hannan's lake (1060 ft.), some two and one-half miles south of the principal mines. The total difference in level is therefore only 320 ft., and the most striking features in the Kalgoorlie landscape are indeed not natural, but are the great tailing dumps of the various mines. The valleys of the region occupy the lines of an ancient drainage system, now largely

filled and buried by wind-driven sand and débris. They contain no defined watercourses or thalwegs.

History of the Kalgoorlie Goldfield

The discovery of gold at Kalgoorlie may be regarded as an indirect result of the impetus given to prospecting in Western Australia by the finding of gold at Kimberley in 1886, and at Yilgarn (Southern Cross) a year later. Western Australia had previously been considered a country barren in gold, an illusion shaken by these discoveries and completely shattered by later reports, in rapid succession, of gold from the Pilbara, Ashburton, and Murchison. Finds so widespread and so rich as some of these were, naturally attracted the attention of the vagrant prospectors of the eastern states, who searching for new fields, soon arrived in the colony, and pushing beyond the outposts of civilization, spread eastward with horses and camels into the dry and poorly watered inland plains. Previously the country had been known only to explorers, of whom the principal were Lefroy (1863), Hunt (1864), Forrest (1871), Giles (1875), and Lindsay 1891). Their attention was directed rather to the pastoral than to the mineral resources of the country. Hunt, in particular, with a large wagon train, had discovered and occupied the areas now held by the Hampton Plains Co. in the vicinity of the goldfields. His object was solely the acquisition of pastoral lands; to this end he selected the valleys and carefully avoided the poorer stony ridges on which Coolgardie and Kalgoorlie are situated. By so little, in view of the immense area taken up, was fortune missed.

Hunt spent some time in the country digging wells and tanks to fit the areas selected for occupation by cattle, and had had more opportunity than other explorers for examination of the rocks. He noted numerous quartz outcrops, and it was perhaps the rumor of these that determined several prospectors to examine the country lying east of Southern Cross. Favored with good rains, two, Bayley and Ford, pushed eastward in June 1892, across the great granite belt, following the track of Hunt's wagon wheels, not wholly obliterated after 28 years of desert dust and storm. They rested at the Gnarlbine 'soak,' and then moved northeast to a 'gnamma' hole, known to the aboriginals as Gulgurda, afterward to be softened by the digger to Coolgardie. Camping on what is now known as Fly Flat, they soon detected gold lying on the surface, Ford picking up a slug weighing half an ounce.

Alluvial Gold

Western Australia is one of the few auriferous areas in the world in which direct support is given to the vulgar belief that gold nuggets lie on the surface for the picking up. After rains and before the winds have had time to obscure the washed surface with the light desert dust, grains and nuggets of gold are readily seen by the trained eye, a method of search known as 'specking.' Three or four weeks dry-blowing and specking had yielded to Ford and Bayley 200 oz. of gold, when they were forced to return to Southern Cross to replenish their supply of provisions. With the digger, shallow alluvial gold is merely the promise of great stores of vein gold. and the two prospectors on their return lost no time in examining the adjacent quartz outcrops. They were more fortunate than the majority of prospectors who have acted on this assumption, for a short search disclosed the cap of a rich gold-quartz vein, from which they had by the end of the day and with the aid of a hatchet and pestle and mortar obtained more than 500 oz. of gold. They had allowed no inkling of their first discovery to escape, and it was not until the application for a reward claim was safely lodged, on September 17, 1892, with the warden at Southern Cross that the news of the great value of the discovery and of its locality was made public.

A steady inrush to the new Eldorado naturally took place, but its magnitude was at first limited by the difficulty of transport, by the high cost of provisions, and most of all, by the great scarcity of fresh water. When all available auriferous ground had been taken up at Coolgardie, prospectors spread out from that centre scouring the country for many miles in search of new fields. When the discovery was reported, a wild scramble took place to peg out in the neighborhood of the original reward claim. In these 'rushes' every available means of transport was pressed into service, camels, horses, bicycles, carts, and even wheelbarrows being mingled with the throng that pressed forward on foot and carried their supplies on their backs. Most ended in disappointment, one or two in disaster. Kalgoorlie was discovered in 1893 and Londonderry, Black Flag, Kanowna (White Feather), and Bulong (I. O. U.) in 1894. By the end of 1895 more than 10,000 people were collected in the various camps.

Gold Discovery at Kalgoorlie

Gold was discovered at Kalgoorlie on Saturday, June 17, 1893. The finders were Patrick Hannan, Thomas Flannagan, and Dan Shea, who were on their way from Coolgardie in response to a nebulous rumor of rich gold at Mt. Yule (perhaps Mt. Jewel, northwest of Kurnalpi). It proved an *ignis fatus* in the end, and the three had camped for the night on the western side of a ridge 22 miles east-northeast of Coolgardie, near the site of the present Hannan street railway station. The first-named seized the opportunity afforded by the halt to search for gold in the neighborhood of the camp and soon discovered ('specked' in local parlance) gold lying in small nuggets on the surface. All thought of the district of Mt. Yule was abandoned, and Hannan hastily returned to Coolgardie to secure a 'reward' claim. The following day, Sunday, June 18, the whole available population flocked to the new Eldorado of 'Hannan's Patch,' as it was then called. The so-called 'alluvial' ground west and southwest of Cassidy hill and Maritana hill (Mt. Gledden) proved very rich for a time, and occasional large nuggets were obtained, none, however, weighing more than 24 oz. These are, of course, small in comparison with the famous nuggets of Victoria and New South Wales, but the climatic conditions obtaining in the interior of Western Australia preclude the accretion of gold necessary for the growth on a large scale of alluvial gold. Other 'dry-blowing' areas

were soon discovered, the principal being in the neighborhood of Slug hill to the south of the present Boulder mines. So-called 'deep-leads' were also found both east and west of the main ridge, but the yield of surface gold was never important.

Lode Mining

The lack of alluvial gold turned the attention of the diggers toward the possibility of discovering the lodes from which the surface gold was assumed to have been derived, and claims were pegged out in all directions, but mainly north and south along the Kalgoorlie ridge. Most of the miners on the new field had gained their experience in Victoria, New South Wales, Queensland, and New Zealand; it was therefore natural that the search for vein gold should be confined to quartz outcroppings. These had furnished the gold of the neighboring Coolgardie field and there was nothing to indicate that different conditions obtained at Kalgoorlie. It thus happened that the rich mines of the Boulder belt, two miles south of the original discovery, were pegged out on account of their worthless quartz veins. Capital from Adelaide and Melbourne was furnished to open up most of these mines, but development was for a long time exceedingly slow. It was known even then that the rich deposits of the outcrops of the majority of Western Australian lodes did not persist below the zone of oxidation; it was therefore feared that Kalgoorlie lodes would form no exception to the general rule and there was, from market considerations, a rooted disinclination to pass into the sulphide zone lying at an average depth of 180 ft. beneath the surface. The Great Boulder mine led the way into this zone, and its success encouraged others to follow.

The first real hope for the permanence of the field was, however, engendered by the discovery of tellurides of gold. An event of such importance warrants some description in detail, the more so as after the lapse of only 14 years there is now a conflict of opinion not only regarding the events that led up to the discovery, but even with regard to the identity of the discoverers. With some trouble the following sequence has been pieced together.

The First Tellurides

The scene of the discovery was the Block 45 mine, now included in the ground of the Oroya Links, Ltd. The then manager, Richard Eades, had obtained rich assays from samples that showed little or no free gold. Repeated tests had proved that the gold was associated with or contained in a soft pale bronze mineral, and samples were therefore sent both to Kalgoorlie and to Coolgardie assayers. Eades indicated the mineral carrying the gold and asked for a determination of its nature. The assayers tentatively suggested one of the iron sulphides, but the extreme softness of the unknown mineral at once showed that this suggestion was incorrect. On Sunday, May 24, 1896, specimens were taken by Robert Gibson from the Block 45 mine to his 'camp' on Maritana hill and were there shown to Allen Davidson and Erle Huntley as typical of the rich 'sulphides' of the mine. The last-named had had some experience of telluride ores at the Mt. Shamrock mine in the Mt. Burnett district, Queensland, where gold is associated with hessite (silver-gold telluride), tetradymite (bismuth telluride), and frenzelite (bismuth selenide), and he suggested that the new mineral was a telluride of gold. This mineral was unknown to the others present and its very existence was indeed scouted, but the question was soon settled by a reference to a 'Dana' lying handy. Huntley tooled away fragments of the mineral and on the following day made blowpipe tests on them, confirming the accuracy of his suggestion. That evening, in the course of conversation, he communicated the news of his discovery to Peter MacIntyre, then representing the company holding the rights to the cyanide patents in Australia.

Definite Proof of Discovery

On Wednesday, May 27, 1896, Eades forwarded two samples to A. G. Holroyd, of Holroyd & Tinley. These, on assay, yielded respectively 31 oz. 10 dwt. and 92 oz. 7 dwt. gold per ton. Following his usual custom, Holroyd 'panned off' some of the ore and was immediately struck by the discrepancy between the high assay value of the original samples and the meagre quantity of free gold in the pan. The first sample indeed showed none, while the second gave only 2 oz. 7 dwt. per ton of ore. The concentrate obviously contained nearly all the gold. As in most new mining camps, there was then a considerable interchange of ideas among members of the same profession at Kalgoorlie, and Holroyd showed samples of the ore and of the concentrate therefrom to Peter MacIntyre, who informed Holroyd that Huntley's tests already made had indicated telluride of gold. Tellurides of gold were then almost unknown minerals, although the great richness of the Cripple Creek mines in Colorado had impressed their importance on the mining world, and there was naturally some haziness concerning the nature of the tests for them. MacIntyre therefore lent 'Fresenius' to Holroyd and shared in the tests. The existence of telluride of gold was soon proved by blowpipe and wet tests. On Friday, May 29, Holroyd communicated the news of the discovery to the press, probably to the *Coolgardie Miner*, for the first reference to the matter in the *Kalgoorlie Miner* is in the issue of June 1, where also it is stated that the priority of discovery was claimed by Mr. Hunter. Meanwhile Erle Huntley and A. J. McGeorge had been making further investigations and on June 2 they published the first complete analysis of a Kalgoorlie telluride of gold: gold, 42.6; tellurium, 54.1; silver, 0.7; iron, 0.9; arsenic, 1.1; sulphur, 0.4; total, 99.8. The iron, arsenic, and sulphur were obviously due to a fragment of mispickel that had not been separated from the calaverite.

Before the publication of the discovery Huntley and MacIntyre had discussed it in all its bearings, and naturally saw in it the solution of the problem that for three years had puzzled mining men at Kalgoorlie, the source of the rich deposits of 'mustard' gold and 'sponge' gold that were so characteristic of the oxidized zone of the Boulder mines.

On June 1 the Block 45 mine was thronged with

assayers and others in quest of specimens of the new mineral, and a vigorous search for it was commenced at other mines. On June 4, J. Collet Moulden obtained at the Croesus mine assays of 13 oz. 15 dwt. gold from telluride ore that had been lying on the dump for months. A few days later Holroyd found rich telluride ore at the Australia mine (Associated Gold Mines), where it had been found in the shaft at a depth of 90 ft., but, having been mistaken for pyrite, had been thrown over the dump. Blocks of ore assaying more than 500 oz. per ton had been used as a fireplace in a miner's hut. Within a few months gold tellurides had been found at the Great Boulder, Hannan's Star, Lake View Consols, Golden Horse-Shoe, and Kalgurli mines. The Ivanhoe, South Kalgurli, Brownhill, and Oroya were the last of the important mines to find the ore.

On November 13, 1896, more than six months after the original discovery, gold telluride was obtained at a depth of 140 ft. in the Great Boulder Main Reef mine, then under the management of Modest Marijanski, a German mining engineer, who has, strangely enough, been hailed by the German press as the discoverer of telluride of gold in Kalgoorlie. Throughout these notices there sounds a note of self congratulation that by virtue of his thorough German training this engineer had made a discovery that had escaped the notice of his British colleagues, and also that the discovery had been made at a most auspicious moment, just in time to prevent the contemplated withdrawal of English capital from the West Australian mining industry!*

Later History

A very serious hindrance to progress in the earlier days of Kalgoorlie was the lack of fresh water both for domestic consumption and for mining and metallurgical purposes. The prompt assistance afforded by the West Australian Government in building a railway to Kalgoorlie and more particularly in furnishing an abundant supply of fresh water from a source near the coast and 350 miles away went far to remove the most insistent discomforts naturally attendant on life in the midst of an arid desert, and more important still from a mining point of view, materially reduced working costs. The history of the field has, on the whole, been one of continued prosperity, mitigated during the past few years by the exhaustion of the rich, easily accessible oxidized ores and by the restrictions in working the lower grade sulphide ore brought about by lack of cheap fuel and water, by distance from the seaboard, and by the high wages and the correspondingly high costs both of mine supplies and of living entailed by the current Australian canons of political economy.

In technical practice the principal difficulties encountered at Kalgoorlie have arisen from the refractory nature of the ore, necessitating an enormous amount of experimental work with correspondingly large expenditure on new mill plants, as the older methods become obsolete and uneconomical. At the present day both in mining and in milling methods, Kalgoorlie stands well in the forefront of modern practice. The weak feature in the former branch is the small size of shafts: this has not arisen from lack of knowledge or of foresight, but from the fact that there has never been a time when the prospects in depth warranted the enormous capital expenditure required for the substitution of the larger shafts. The greatest depth reached on the field is at the 2650-ft. level of the Great Boulder mine; the other six important mines of the belt are working near or below the 2000-ft. level.

The yield of the East Coolgardie goldfield (which has produced little gold outside Kalgoorlie) is shown in the following table. The gold yield of the state for corresponding years is attached to indicate the importance of the Kalgoorlie field.

	Kalgoorlie.	Western Australia.	
Year.	Crude oz.	Crude oz.	Value.
1893	.....	110,891	£ 421,385
1894	.....	207,131	787,099
1895	.....	231,513	879,748
1896	.....	281,265	1,068,808
1897	296,764	674,993	2,564,977
1898	422,391	1,050,184	3,990,698
1899	860,371	1,643,877	6,246,733
	Fine oz.	Fine oz.	
1900	657,864	1,414,311	6,007,610
1901	856,749	1,703,417	7,235,653
1902	941,436	1,871,037	7,947,662
1903	1,062,898	2,064,801	8,770,719
1904	1,050,923	1,983,230	8,424,226
1905	997,193	1,955,316	8,305,654
1906	989,357	1,794,547	7,622,749
1907	937,238	1,697,552	7,202,411
1908	888,415	1,648,505	7,037,579
1909	896,900	1,595,263	6,779,463
1910	*850,000	1,470,626	6,212,832
1911	809,547	1,370,861	5,823,009
1912	788,786	1,282,651	5,463,723
1913 (3 months)	*180,000	303,461	1,289,019
Total fine ounces.	13,209,483	†26,041,559	†£111,621,168

*Estimated. †Official.

Dredging at Panama

The total excavation by dredges during May was greater than during any previous month since the beginning of canal construction. The total output from Atlantic and Pacific entrances was 1,522,102 cu. yd. Of this, 957,889 cu. yd. was from the Atlantic entrance channel; a large part of it, however, was in the removal of silt from the previously excavated channel. About 300,000 cu. yd. of this relatively light material was pumped out by the pipe-line suction dredge No. 4, operating opposite the mouth of the Mindi river, in the French canal. Excavation in the first district of the sixth division, covering the Pacific entrance channel and Balboa harbor, amounted to 564,213 cu. yd., about an average output for the fleet. The dipper dredge *Cardenas* established a local record for rock excavation in deep water. On June 4 it removed 1750 cu. yd. of hard rock from a depth of 45 ft. below mean sea-level in 9¾ hours of actual working time. On account of the great depth of the channel, the dredge is able to work only between mean ebb tide and mean rising tide, which allows two watches of five hours each.

**Bergingenieur Modest Marijanski in Great Boulder Main Reef bei Kalgoorlie eine Entdeckung gemacht, die für Bergwerksindustrie der australischen Kolonie von der grössten Bedeutung ist . . . Der Entdecker, von dessen Namen augenblicklich alle australischen Zeitungen vollsind, hat . . .*" *Zeitschrift für praktische Geologie*, February, 1897, p. 72.

The Olancho Country

By A. D. Akin

No miner has ever been down the 'Spanish Main' who has not heard of the fabulous washings of the Guayape river, a stream in the mountains of Olancho, one of the departments of the Republic of Honduras. In this country, as well as the other little republics that make up the revolution-infested tail to the cornucopia of the North American continent, placer mining can never be mentioned without some one putting in a word concerning the great wealth in Olancho and the Guayape.

So when I was asked to go to Olancho, the gentleman who wanted some quartz reported on in that district did not know what a favor he was conferring on me. In the interim I looked into the history of the country. To one who investigates the old Spanish writers, and some of the modern ones, it is refrshing to see how calmly they can tear the heart out of the truth and present you with the remains; but one can be charitable and suppose that they were assuming to give as first handed the tales that some one had told them.

RIVER SCENE IN EASTERN HONDURAS.

Guayape Placers

E. G. Squire, in his admirable work, the most valuable published in the opinion of many people, says: "There can, however, be but little doubt that the gold washings of the rivers Guayape and Mangualili and their tributaries are equal in value to those of California. The principal supplies of this metal in the state are from the gold washings of Olancho, which are exceedingly productive. The river Guayape has always enjoyed great celebrity for the amount of gold contained in its sands; but, since the early period of Spanish occupancy, washing has not been carried on except on a small scale by the Indians, and even with them the process was generally left to the women and children, who only work for a few hours on Sunday mornings. Yet the amount thus obtained and carried into Juticalpa in the year 1853 was valued at $129,600."

Dr. Charles Doratt, who visited the region in the year 1853, wrote in private letters: "Among the rivers of Olancho, which we visited and prospected, the Guayape and Jalan are decidedly the richest in auriferous sands. We found gold in the alluvions half a mile distant from the present bed of the river. Leaving Juticalpa in a northeast direction * * * there is not a streamlet over an area twenty leagues long and ten broad, however insignificant, which does not contain gold in its sands and in the banks which border it. For the most part * * * these streams fall into the Guayape and Jalan." He also names the Sulaco, Cayminto, and Pacaya in Yoro as good placer ground, but I cannot agree with him as to the Sulaco, though I have had good pans at certain points on that stream.

Early Writers

So one might quote dozens of writers: Wells, Herrera, Juarro, Montifiore, Bailey, Bryne, Lombard, and others, but what is the use? They all are alike. So I will notice but one more, and that the honorable board of Frenchmen who formed a scientific commission from their Government to these regions, the results of their investigations being published by the Honduran Government in 1897. Among other things, they say: "The most famous rivers are the Guayape and Jalan, from where the Spaniards, during the colonial epoch, extracted fabulous quantities of gold. The quantity of gold exported, won in this manner (by *batea*.) varies annually from 750 to 1,250,000 francs, according to

the rainy season being more or less copious. Nuggets are frequently found weighing from one to seven or more ounces."

Crammed with information in four languages, I went to Olancho and went up the Guayape, first visiting the aforesaid gold prospect. I did not see the maidens and little children frisk down to the river on Sunday morning and extract enough of the yellow metal to buy next week's *frijoles* and *tortillas*, nor could I find that they had any particular affection for the Guayape, but I did find that they went long distances from their homes to places on the tributaries of the river and stayed there for months washing gold to support them during the dry season. I found that the matter of washing was not confined to the women and children, but is participated in by the men to the extent that they do their share of the excavation, the women doing the actual concentration and separation. These women are wonderful in their skill with a great, clumsy, wooden pan, and their muscular development is almost unbelievable.

Cost of Operation

There is comparatively little ground on the Guayape proper that can be washed without extensive and costly preparation, and I am frank to say that I believe some parts of it are absolutely inaccessible within the bounds of reason in cost. The native washes some gravel along the Guayape, picking out the bars and detritus after a rain that raises the river to flood stage. He simply skims the top, and anything like deep washing is unknown to him, as the deepest I have ever seen them work was about shoulder deep. They dig holes to this depth under the water, scoop up as much gravel as they can, and pass it out to the washer on the bank. This manner of working is now generally abandoned for reasons that can readily be realized by anyone who has ever attempted to shovel auriferous gravel from under water. A great part of the Guayape, in common with the other rivers of Olancho, is in a deep cañon. It is probable that the bottom of this cañon, where the gold is concentrated, is in many places not less than one hundred feet below the present river bed. Without surmising or stating the whys and wherefores of this conditions and others related, I will make a quotation which sums up the whole condition. A. T. Bryne, late engineer to the Government of Honduras, under date of November 15, 1888, says: "The mountain ranges show volcanic origin, and are generally composed of basalt, trachyte, porphyry, and granite with frequent limestone outcroppings. The hills and flats are for the most part composed of detrital matter of the Pliocene, or more recent origin. The hills are covered with clay and ferruginous loam; beneath this cap is the detrital matter, composed of conglomerates of fine sand, gravel, quartz, greenstone, shales, and all the metamorphic rock of the neighboring mountain ranges. Local stratification is frequently met, but there is no evidence of continuity of its bedding. The depth of the detrital mass is from 20 to 300 ft., the layers becoming coarser as the depth increases, the lower ones being composed of large boulders and gravel cemented together into a hard and compact mass, resting directly upon the bedrock. This lower layer may properly be termed the paystreak. The bedrock varies in the different portions, being either chloritic slate, garnetiferous mica schist, secondary granite, gneiss, diorite, porphyry, and the various rocks of the Cambrian formation. The gold is found disseminated through the entire mass of these deposits." My personal observations accord with those of Mr. Bryne, and the individual supply is supplemented by the contributions of the streams that feed it. These cemented strata of detrital matter have always given me results sufficiently satisfactory to warrant the conclusion.

It is commonly said that placering is a poor man's business, but no poor man would do well to tackle it here. With sufficient money, properly applied, the working of these placers would be a tremendous enterprise and worthy of the mettle of any mining man. However, Olancho does not have to depend on its placers to be a mining country, for the veins bearing gold are numerous, and some of them are of surprising richness. Copper is abundant in places. One day an Indian brought some bullets whittled out of solid chalcocite. He said there was a vein of about four feet of the same metal. Crossing a little river only a couple of miles from the Guayape, is a vein of bitumen which melts and flows under the heat of the tropic sun. A short distance from this point are beds of nitre, and nearby native sulphur is found. Silver, of course, is present, and some nickel. Undoubtedly, careful prospecting will develop other minerals, for the country is an unknown land a short distance from the traveled roads, except in a few instances.

Evidence of Early Workings

Ruins of ancient civilization are common, and some of them are interesting. Many evidences of the Spanish occupation before the revolt of 1821 are to be found, and when one of their old mines is found, one generally finds something worth while, for in those days of crude mining methods there was no time wasted on low-grade. I know one mine that has been idle ever since the Spanish owners threw down their tools and fled before the advance of the enslaved peons, until two years ago, when the owner of the land was out hunting cattle and stumbled on one of the old dumps. Following this clue, it was found that the mine had extensive workings. For 90 years people have passed within speaking distance and the *lavaderos*, or gold washers, had a thousand times washed the sand of the little creek that runs at the foot of the hill, a hundred yards away. There are many of these old mines yet to be found, for there is not a village or hamlet but what has a store of traditions of these old mines, but the native is too indolent to look for what he does not see. The mine referred to above is one of the historic mines of the country and was worked by the Church.

The ruins of arrastres in certain localities are numerous. I have found as many as six within a five-minute walk. Wherever these arrastres are found, ore good enough to work in them will generally be found nearby. An old arrastre I know of

had no visible source of ore, but several hundred pounds lying beside it gave the key, and the lode was found, accidentally, a year later and over three miles away, but this was an exception, for the source of the ore is generally nearby. In some instances the arrastre was placed on the dump. I will venture to say that if fifty per cent of the money that has been spent in attempting to placer on the Guayape had been spent in quartz mining, the district would today be better known than the Klondike.

Working Conditions

Olancho is a poor man's country. Everything under the sun can be grown there and at all times of the year. Cattle are cheap, seven to eight dollars for a three or four-year-old with calf; timber is abundant and mainly pine, of which there are four varieties, including the long-leafed yellow; the temperature averages about 70°, and, ignoring solitude, all conditions are ideal, except accessibility for man and burden. Of course, man can ride in, but even as he comes in on muleback, the trip is a long and hard one as well as costly, but for those who undertake it properly and with sufficient capital, it is certain that reward lies in the hills and streams of Olancho.

The natives are, as a rule, friendly to 'gringoes,' but occasionally one encounters a fanatic. I have found the people to be, with few exceptions, honest, obliging, and civil. With them the 'six-shooter' is a badge of gentility and station, and the *eclat* that it gives secures many accommodations and civilities that I have seen denied those who sneered at the 'gun-packer.' I have had my gun rust until it stuck in the holster, and half the time did not know whether I had a cartridge or not. On the whole, the gun is a very useful part of one's kit, sometimes, but the American one occasionally meets there who is always flourishing his gun and trying to make an impression is an object of contempt to the native and pity to his better-balanced countrymen. He is the class of man who makes the rough places in the road for those who follow him.

Americans as a rule have not been very successful in Olancho. A notable exception is Fred Bell. With placer, arrastre, and buying gold from the native washers, he has been extremely successful, while working on a very modest scale. What he has done, others can do, for his operations have been confined to a zone that is not by any means the only good ground in Olancho.

Weight Standards

Troy balances for weighing dust are not accepted in this country, as they only recognize the Spanish ounce, the subdivisions of which are represented by pebbles and coins. They standardize these weights by comparison with some that are reputed to be correct, and as these are generally owned by the local dealer, who makes sure that they do not rob him, everyone is satisfied.

To analyze the cause for failure of Americans in this field would require several reams of paper. The key to the real cause, without individualizing, can be summed up in a few words: ignorance of local conditions, ignorance of mining, graft, and rascality; either, any, or all. The successful men have emphasized the truth of this, and it is hard to believe that a well balanced, competent mining man, speaking the language, knowing the country, people, and conditions, backed by reasonable capital and with an honest desire to do a legitimate business, can fail in this country of opportunities. Every instance of failure that has come to my notice has had ignorance or graft behind it as the primal cause.

One man spent $20,000 on miles of ditch to bring an insufficient water-supply to sluice away 40 ft. of clay overburden, and after completing the work found that he not only did not have sufficient water to do anything, but that, also, he had no tailing ground. Another company spent thousands in bringing water and a fine outfit, to discover, when all was ready, that the entire equipment was valueless owing to plain physical conditions apparent to the most casual and non-technical observer. A dozen companies have gone broke because they tried to bring in machinery that no pack-mule in the country could carry. They evidently knew nothing of the merits of sectionalized machines, and as a result the great pieces of iron lie rusting on the coast, unheeded warnings to many who have come after.

I cannot understand the motive that leads men to believe that it takes less skill and experience to operate in these countries than at home, but it seems to be a popular idea. These men, predestined to failure, seem to have an idea that all that is necessary is to carry into the country a varied assortment of mining machinery, select a place to go to work, and success is certain. The results are natural, and they go away spreading detrimental reports in which they are ably abetted by the unfortunates who financed them.

Natural Advantages

The apparent mineral riches, the amenability of the greater part of the ores to treatment, the cheap water-power that exists within transmitting distance of most points, and a thorough understanding of the governing conditions prompts me in saying that I know of no district where there are greater possibilities for intelligent and properly applied mining effort. It is practically untouched, for the native, as a rule, knows the placer only and the large majority of foreigners have followed his lead. The native's placering is, of course, primitive, and the results he attains are commensurate. He is limited to what he can do with his hands and the batea. As an example, I might describe one outfit out of the many that I have seen. The party consisted of a man and four women. They had come forty miles, from Jutigalpa to the Lavaderas, there erected huts to live in. They were removing a heavy overburden, carrying the pay-dirt to a water-hole in a ravine some 300 yd. distant, and washing it. They did not average over sixty cents per day to the person, but seemed to think they were doing well. As the stranger cannot live on what the native hoards, he quickly pronounces the whole country a farce. Disgustedly he classes the quartz with the placer and leaves the country. There is good

quartz in Olancho, and intelligent prospecting will develop more, for aside from certain restricted areas, no one has left the highways to prospect. The native, as a rule, has no knowledge of hard formations. I met some natives on the Mangualili grinding a soft honeycombed quartz on a *metate*, or between two rocks. The quartz was well filled with coarse gold. They said the vein was about two inches wide; but as to where it might be, I thought it impolitic to ask. Prospecting one day in the valley of the Panal, I came across some mounds of ore, dirt-covered and grass-grown. A little farther on, beside the creek, was a group of *metates*, half buried in the soil, most of them just as the workmen had left them, probably to take part in the revolution for independence from the Spanish oppressor. Just across the stream was an old arrastre.

The Water Question

The water question is an ever-present one in all districts. In most districts of Olancho, water is present in streams sufficiently available for all purposes where capital is to be had to canal it to the workings, but many good placer grounds are too far away from a sufficient supply for operation by men of modest means. There is probably no locality in the department where ample water for milling purposes cannot be had, and there is no locality I know of but that is within reasonable distance of power. I visited one locality where it was reputed no power was available, but a short search proved that there was an available head of 500 ft., ample water for a dozen mines, with not over five miles to transmit the energy. This was an exceptional case, but as a rule, wherever a sufficient volume of water is found, the rapid drop of the valleys quickly makes the head. The eroded channels make numerous, excellent, short-crested dam-sites, with material for construction close at hand. A necessary warning to those contemplating entering the country is that they be sure that the stream they select is one of sufficient volume in the dry season, for many of the streams go almost if not entirely dry at certain seasons. The only way to be sure is by actual observation, for the natives cannot be trusted in this particular. The difference between what is really necessary and their idea of it varies so that absolutely no reliance can be placed on their estimates. Generating power at a point away from the point of consumption and transmitting it in the form of electric energy is far preferable to attempting to put in steam-power at points where water-power is not immediately available. To be sure, there is wood in abundance (the country is covered with forests), but getting in the heavy units required for a steam plant is almost prohibitive.

Exports of iron and steel products from England during the first five months of 1913 amounted to $112,300,000, an increase of $25,270,000 over the same period of 1912.

The Minster-Grenchenberg tunnel being driven under the Jura, in Germany, is giving considerable trouble caused by great pressure in the upper Miocene formation.

The McIntyre-Porcupine Mill

The following description of the 150-ton plant is abstracted from the annual report of the McIntyre-Porcupine Mines, Limited:

The ore is hoisted into an ore-bin. From this it is fed to a 10 by 12-in. Blake crusher, over a grizzly with bars 1¼ in. apart. The undersize joins the broken ore from the crusher and falls into a 12-in. elevator, which raises it to a hopper, from which it is automatically fed to a 16 by 36-in. set of rolls. The rolls discharge the ore to a 12-in. elevator 50 ft. long, and is then hoisted to a 500-ton storage-bin. From there it is fed to a 6-ft. Chilean mill by means of a Challenge feeder. Four tons of cyanide solution, of a strength of 1¼ lb. per ton, is added to the Chilean mill for each ton of ore ground. The Chilean mill discharges the ore through a six-mesh screen to a Colbath classifier, which then discharges all ore over 100 mesh to the tube-mill. Ore finer than 100 mesh flows over the end of the classifier to a 16 by 24-ft. thickener. The tube-mill discharges the ground ore to a Frenier pump, which elevates it to a hydraulic classifier. This returns the free gold that may have passed through the tube-mill, and the sulphides, coarser than 100 mesh, are again returned to the head of the Colbath classifier, which is supposed to retain, in the closed tube-mill circuit, the free gold and the coarse sulphides which contain most of the metal content of the ore.

The overflow from the hydraulic classifier joins the overflow from the Colbath classifier and flows to the thickener mentioned. The proportion of the cyanide solution to the ore, at this point, is five to one; one ton of dilution being added at the Colbath classifier and tube-mill. The thickener discharges, over the top, three tons of clear cyanide solution to each ton of ore fed in. This solution contains about 75% of the total gold in the ore, and is sent to a 12 by 20-ft. clarifying tank, to remove any traces of slime which may escape the thickener. Each ton of ore, with the other two tons of cyanide solution, fed to the thickener, is then discharged at the bottom to a 16 by 24-ft. agitator, which discharges continuously to a 20 by 24-ft. thickener and slime-storage tank. At the bottom of this tank each ton of pulp is discharged with one ton of cyanide solution, which then is elevated to a 16-ton tank at the top of the mill, from which the Burt filters are filled. A cake, ranging from 2 to 5 in. thick, is formed in the filter, which contains about 20% of the gold-bearing solution, and after extracting this the doors of the filters are opened and the cake is discharged. The gold solution from the clarifying tank flows through five 7-compartment zinc-boxes, where the gold is precipitated on zinc shaving and the solution passes into two tanks to be used as barren wash for the Burt filters. The precipitate is cleaned from the zinc shaving and sent to a tank. All solutions go to a 20 by 30-ft. concrete sump under the Burt filters, and from there are returned, by two triplex pumps, to two 16 by 20-ft. cyanide stortage tanks situated at the top of the mill, where they are tested for loss of cyanide.

A Simple Plant for Testing Efficiency

By A. T. Tye

The Cananea Copper Co. maintains a sampling and testing plant at its concentrator at which any new ores may be tested as to concentrating qualities. These tests indicate clearly the relative economy of smelting or of concentration followed by smelting. As any number of carloads can be handled at the sampling plant, a representative sample of a 400 to 600-ton lot can be secured without any additional expense or trouble.

The crude ore crushed to one inch is first sampled by a bucket sampler with a ratio of 35 to 1. This sample is then crushed in 14 by 27-in. rolls and sampled by a second Snyder machine, ratio 5 to 1; crushed in 14 by 27-in. rolls, ground in a sample

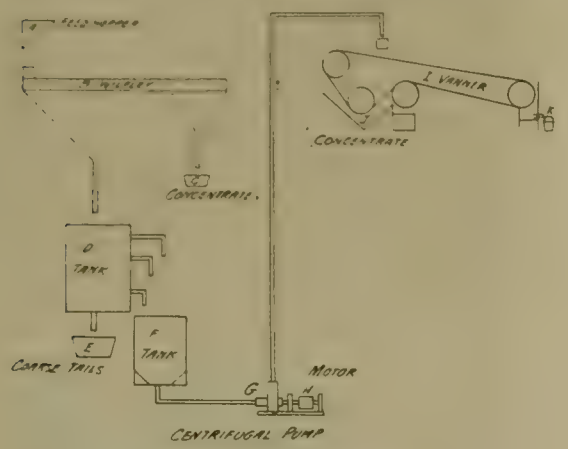


DIAGRAM OF TESTING PLANT.

grinder, and finally sampled by a Vezin sampler, with ratio 12 to 1.

The final reject from the Vezin sampler is used as the basis of the test, and the average assay is secured at once from the lot sample. The largest particle in the reject is about one-eight inch in diameter. For low-grade ore or uniform ores, material of this size would require a sample of about 20 lb. The reject, however, from a 20-car lot will amount to several hundred pounds, which is quartered down and crushed if necessary until a lot of 100 kg. has been obtained for testing.

Testing the Ore

The reject from the sample mill after cutting down, is dried in a steam drier until all moisture has been expelled, and is then ground in a Braun pulverizer to pass 20 mesh. This fine material is carefully riffled down to obtain the general assay sample of the crude ore for analysis. One hundred kilograms of this sample is weighed and deposited in the hopper (A) over the feed-box of the Wilfley table. The ore is fed to the table at about the same rate as in regular mill work, depending on the amount of concentrate to be taken, the rate of feed being slower with a lower ratio of concentration. The coarse concentrate is discharged into tubs (C) and the water and slime from same delivered into tank (F) to be pumped to the vanner (I) together with the Wilfley tailing and slime. The concentrate is run low in silica if the mine is at a great distance from the smelter, or fairly silicious if the concentrate contains considerable iron and sulphur and when the smelter is in close proximity to the concentrators, as at Cananea. In every way, the tests are made to conform to actual milling conditions.

Sand and Slime

The coarse sand and slime are discharged at (B) and are delivered into tank (D), from which the coarse tailing is finally discharged at (E), dried, weighed, and sampled. The slime overflows from (D) into tank (F), from which it is pumped to the vanner (I) by a centrifugal pump (G) run by ½-hp. motor (H). The slime is concentrated on an ordinary mill vanner and the concentrate collected in (J), and dried, weighed, sampled, and assayed. The tailing from the vanner is the only material not weighed directly, and it is determined by difference. All the remainder of the products are carefully dried, weighed, cut down, and assayed in duplicate. The final vanner tailing is carefully sampled every three minutes, as this is a final check on all former weights and assays. Tank (D) is filled with water before starting, so that the coarse sand settles out and slime is at once discharged to the vanner feed.

TABLE I.—COMPOSITE TEST NO. 469

ANALYSIS OF ORE

Cu, 2.22%; SiO_2, 71.2%; Fe, 9%; S, 9.7%; Ag, 1.10 oz.; Au, tr.

Ore passed 20 mesh and run on Wilfley table.

	Pounds.	Cu, %.	Cu, lb.	Ag, oz.	Au, oz.
Feed	2000	2.22	44.40	...	...
Coarse conc.	470	6.20	29.14	3.20	0.03
Coarse tail.	705	0.36	2.53	...	...
Overflow	825	1.54	12.73	...	...

Overflow re-treated on vanner as follows:

	Pounds.	Cu, %.	Cu, lb.	Ag, oz.	Au, oz.
Feed	825	1.54	12.73	...	...
Fine conc.	65	4.96	3.22	3.20	0.03
Vanner tail.	760	1.25	9.51	...	...

	Ratio.	Per cent.
Wilfley	4.25 into 1	Saving 65.60
Vanner	12.60 " 1	" 25.20
General	3.73 " 1	" 72.88

ANALYSIS OF PRODUCTS

Conc.	Cu, %.	SiO_2, %.	Fe, %.	S, %.	Ag, oz.	Au, oz.
Coarse	6.20	19.2	31.8	36.0	3.20	0.03
Fine	4.96	61.0	12.2	13.0	3.20	0.03
General	6.04	...	...	...	3.20	0.03

One ton of this ore made:

	Pounds.	Cu, %.	Cu, lb.	Ag, oz.	Au, oz.
Conc.	535	6.04	32.36	...	...
Tail.	1465	0.82	12.04	...	...

General ratio, 3.73 into 1.
General tailing, 0.82% Cu.
General saving, 72.88%.

	Per cent.
Copper lost in coarse tailing	5.69
Copper lost in fine tailing	21.43
Copper saved	72.88

TABLE II.—COMPARISON OF RESULTS WITH ACTUAL MILLING

CRUDE ORE—A

Test No.	Tailing. Vanner.	Coarse.	General.
394	0.86	0.32	0.53
402	0.80	0.34	0.55
Sections C and D	0.74	0.35	0.53
	0.75	0.37	0.55
Sections A and B	0.85	0.31	0.55
	0.86	0.33	0.56

CRUDE ORE—B

Test No.	Tailing. Vanner.	Coarse.	General.
408	0.40	0.40	0.40
427	0.52	0.32	0.42
439	0.70	0.38	0.53
449	0.70	0.34	0.52
Sections A and B	0.45	0.33	0.44
	0.47	0.39	0.40
	0.60	0.33	0.47
	0.56	0.37	0.45
	0.43	0.35	0.45
	0.52	0.32	0.53
	0.65	0.28	0.44

The tailings represented are from a tonnage of 500 to 1400 per day. At the Cananea concentrators, the ore comes from a great many different orebodies, so that unless treated in a separate section, the feed nearly always contains a mixture of different ores. For this reason it is difficult to obtain tailing in actual ore-dressing, from one ore only. The copper in the feed may vary from a little over 1% to over 3%; the iron from 5 to 20; sulphur from 5 to 20; and insoluble 49 to 83%. But, as shown above, the tailing from entire sections of the concentrators agrees closely with that obtained in the tests, and this holds true for other ores, when they have been concentrated without intermixture.

Separate tests are made on each ore every month to credit the different mines with the amount of copper they have added to production and to determine what grade of ore must be mined to pay all expenses of mining, transportation, concentration, smelting, and losses. Diagrams are constructed which show the actual profit above all expenses, so that the profit can be read off at once for whatever grade of ore is being mined.

Composite Tests

From every sample of crude ore brought to the concentrator, 15 kg. of the final sample is weighed, dried, and pulverized, and deposited in large dust-proof boxes. At the end of the month this ground ore is riffled down until 100 kg. remains, and this serves as the basis of the test of each separate ore.

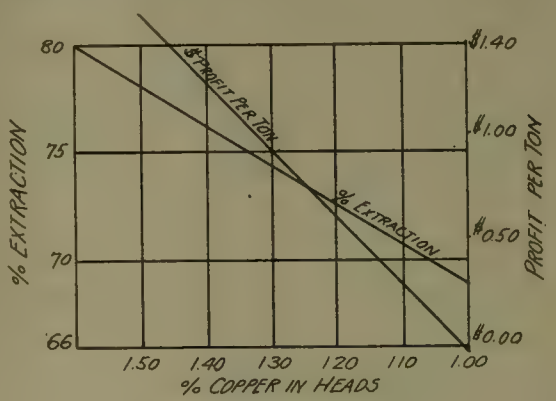
TABLE III.—COMPARISON OF RESULTS FOR JANUARY

	Smelter office, %.	Concentrator office, %.	Composite test, %.
Moisture in concentrate	15.05	13.45	13.70
Cu in ore	2.22	2.22	2.22
Cu in concentrate	6.17	6.27	6.05
Cu in tailing	0.83	0.76	0.82
Extraction	72.31	74.85	72.88
Ratio	3.84	3.77	3.73

Besides these separate tests, a composite mill-test is made of all the ores milled during the month, mixed in the same proportion as milled. This is done for several reasons. It gives a criterion by which to judge the work of the concentrators. The results indicate in concrete form the general tailing, feed, extraction, etc., and show what extraction should be shown by the credits from the smelter receipts of concentrates.

January Results

Results of comparisons for January 1913 are shown in Table II, based upon price of copper 17c. per pound with 96% saved in smelting, or 16.3c. per pound. The cost of smelting, including fuel, power, labor, supplies, repairs, salaries, general expenses, sampling, roasting, converting, fluxes, fettling, amortization, interest, transportation, refining, freight, and selling, is taken at $3.10 per ton. Ratio of concentration, 5.6 into 1. Therefore, the cost of smelting the concentrate per ton of crude ore is $0.55. Cost of concentration, $0.72 per ton. Cost of mining, $1 per ton. Total expenses per ton of crude



PROFIT AND EXTRACTION LINES

ore, $2.27. Crude ore assaying 1.48% Cu gives an extraction of 78.8%, or 23.32 lb. at 16.3c., equal to $3.80 less $2.27 expenses, leaving $1.53 profit per ton. Crude ore assaying 1% Cu gives an extraction of 68.5%, or 13.7 lb. saved at 16.3c. per lb., equaling $2.23, less cost $2.27, leaving a loss of $0.04 per ton. Therefore the critical point between profit and loss is at 1.03% Cu in the feed, as per diagram.

It would require a great part of the time of an office man during the month to tabulate and calculate the tons of wet ore, tons of dry ore, tons of dry concentrate, and similar data from all the mines and concentrators, and to note all the various deductions, to determine the average of the ore, of concentrate, tons of copper in the feed, tailing, and concentrate, and the extraction. The same results can be determined by a monthly composite test requiring less than two hours.

It might appear that close results could not be obtained in this manner, that from only 100 kg. of ore the same results could not be determined as by actually milling 66,000 tons of ore per month. And yet it is the same comparison as between an assay-ton weight of pulp and a thousand tons of ore which it represents. If the ore has been properly cut down and quartered, the assay of the few grams of pulp will indicate accurately the contents of the thousand tons of ore. Likewise the 100 kg. will give the same comparative results as the concentration of thousands of tons in the various sections of the concentrator.

What a concentrator actually recovers is not nec-

essarily the calculated total; it is the tons of copper the smelter actually credits it with. Therefore, comparing the extraction shown by the composite tests over several months with what is actually acknowledged by the smelter, as the tons of copper received as in Table III, shows the accuracy of the composite tests. There is a slight variation from month to month, as all the concentrate produced some months ago may not be shipped and is credited to the following months.

TABLE IV

Month.	Extraction. Composite.	Smelter.
January	75.00	74.69
February	75.50	73.95
March	72.60	71.15
April	76.60	77.50
May	73.80	72.60
Average	75.00	74.00

The composite checks within 1% of the smelter returns, which difference is partly covered by loss in transit and variations in concentrate moisture determinations. This is as close as can be calculated from the crude ores and concentrates with their various assays and moisture determinations. In calculating the results, the percentage of moisture in the concentrates delivered to the smelter is likely to be the most prolific source of error, and the credits to the concentrator vary accordingly. With disseminated porphyry ores, the average concentrate sample per shift or day can be accurately determined, which, with the feed and general tailing, gives the necessary data for calculating the rates and saving. At Cananea, however, with coarse bull-jig and fine concentrate mixed, it is almost impossible to obtain such a sample, and each carload of concentrate is sampled separately.

Standard v. Miniature Machines

Possibly the majority of mining men are of the belief that a concentration test on a new ore cannot be made on a small scale, and if so, that the testing plant must contain miniature jigs, classifiers, tables, and vanners. The difficulty with so many small machines is the error incurred in starting and cleaning-up afterward, and the additional doubt whether, after all, the small machines do duplicate the work of the larger machines in mills. For this reason, at Cananea, the tests are made on a regular full-sized Wilfley table and vanner which at other times are used in everyday work, and in the same state of repair as the general average. With these machines, the test gets under way rapidly and is finished quickly. The greater part of the time the machine is running as in ordinary millwork. The Wilfley acts as a classifier, as also the settling-tanks. The coarse grains of concentrate protect the finer grains, and the latter are saved along with the coarse, thus relieving the vanner of part of the load and making up in part for lack of classification and stage-crushing. The Wilfley and vanner also get more individual attention than in a concentrator, so that, on the whole, there is a series of compensations which about equalizes different conditions. If tests on small lots of ore have not been successful, it is probably on account of carelessness in not securing a really representative sample from the mine, and not the fault of the testing plant.

Conclusions

1. This method of testing has been in use for several years at Cananea.

2. It has been successfully tried out on a great variety of ores.

3. Compared month by month with tonnage up to 66,000 per month, it has given results within 1% of actual smelter returns.

4. The machines used are full-sized standard Wilfley and vanner machines.

5. The machines employed in testing are those used every day in regular mill work and in the average state of repairs.

6. The testing plant can be fitted up at small expense in almost any concentrating plant.

7. New orebodies, or regular ores at greater depths can be tested and their behavior in large concentrators milling thousands of tons may be determined very closely. Even in large units the tailing and other products will vary somewhat from day to day.

8. These tests quickly give accurate data for reports on mining property as to the probable behavior of an ore, and give valuable information which may serve as the basis of experiments in a large testing works.

Thanks are due to F. J. Strachan, superintendent of the Cananea concentrators, for permission to publish the foregoing data.

Kleinfontein and Tube-Mills

The annual report of the Kleinfontein mine for the year 1912 contains some interesting features supplied by the consulting engineer on the results of development and the value of the tube-mill as an adjunct to the stamps. It is stated that the stamp and tube-mill combination introduced as an expediency last year has not been such a success as generally supposed for the reduction of costs, which, since the introduction of tube-mills, have increased from 4s. 2d. per ton with stamps only, to 4s. 5d. per ton with stamps and tube-mills combined, while the percentage of extraction has fallen from 95.79 to 94.60. It need hardly have been pointed out that these unsatisfactory results of the introduction of tube-mills are not the rule on the Rand, for generally the costs are lowered and the extraction percentage is increased by the addition of tube-mills. One group by employing 15 stamps only to one tube-mill can handle the same tonnage as that at New Kleinfontein at a shilling per ton less in cost, and moreover are introducing tube-mills so as to attain this proportion with the direct aim of hanging up stamps because they are less efficient and economical than tube-mills. The Barnato group, too, find that the addition of tube-mills last year added considerably to the efficiency of the mill, using stamps solely, as well as to the extraction.

Expenditures on the Panama canal during the year ended June 30, 1913, amounted to $41,741,000, making a total of $318,229,000.

Searles Lake Potash Deposits

By H. S. Gale

*Searles lake, also known as Borax flat, is a dry lake basin and superficially much like many other desert basins of the Western arid regions. It is a broad somewhat circular valley or depression lying between the Slate and Argus ranges in the extreme northwestern part of San Bernardino county, California, near the corner between that county and Kern and Inyo counties. The camp known as 'The Borax' is about 25 miles by road from Searles postoffice, formerly Garden station, near the Mohave-Owenyo branch of the Southern Pacific railroad. Searles lake at present may be reached by the regular stage that runs from Johannesburg *via* Garden station, or Searles, to Searles lake, and thence on to Ballarat and Skidoo.

Analysis of Brine

The public announcement of Searles lake as a possible source of potash was made as the result of the collection and analysis of a representative set of brine samples from this deposit early in March 1912, by E. E. Free, then of the United States Bureau of Soils, and Hoyt S. Gale, of the United States Geological Survey. A notice was at that time given to the press stating that reports which had been received concerning the unusually high potash content of the brine in the deposit were apparently confirmed by the results of these tests. Analyses of six brine samples taken at considerable depth in old wells at points distributed over the main salt flats showed that an average of 6.78% of the total dissolved salts was potash, quoted in the form of the oxide (10.73% as potassium chloride). The individual results obtained were 7.63, 6.23, 6.89, 6.06, 7.27, and 6.57%. The uniformity of these results was taken to indicate, although of course it did not prove, homogeneity in composition of the brine throughout the salt deposit. Based in part on the logs of the wells that had already been drilled, the statement was also made at that time that "existing data give reasonable assurance that the brine-saturated salt body is at least 60 ft. thick and covers an area of at least 11 square miles. Assuming the salt to contain 25% by volume of the brine, the total amount of potassium oxide available is estimated as over 4,000,000 short tons [equivalent to approximately 6,000,000 tons as potassium chloride]. This estimate is based on incomplete data, but it is believed to be conservative. At any rate it appears that this locality constitutes a very important source of potash in readily available [soluble] commercial form." Whether it will be possible to recover all of this potassium commercially, however, must remain for practical experience to demonstrate. There seems to be good reason for the belief that the commercial operation of this deposit for potash and the other marketable salts that it contains will become a large and important enterprise. Probably the first chemist to suggest that potash might become one of the profitable products of this deposit was Whitman Symmes, a mining engineer of California and Nevada, who in 1898 was superintendent of the California Borax Co., operating at Searles lake.

*From advance chapter on potash in 'Mineral Resources of the United States for 1912,' published by the United States Geological Survey.

Nature of the Deposits

The saline deposit at Searles lake resembles a typical playa, of which examples are common in the desert basin region. The salt-incrusted surface occupies the lowest part of the valley or basin in which it is situated. The drainage basin tributary to it is without outlet, so that if the basin were filled the water would rise to a height of approximately 640 ft. above the level of the present salt flat before it would find an outlet and overflow into the Panamint valley to the south and east. That the valley was thus flooded at some time in the past is attested by the series of shore lines to be seen encircling the basin, the highest clearly marked reaching the elevation of the present lowest divide on the southern margin with successively lower concentric shore lines, marking the recession of the waters as they evaporated and as the lake level subsided. The saline deposit in the lowest part of this basin is the residual product of the evaporation of natural drainage waters.

It appears at this time to be quite clear that the greater part of the water of the former higher level of Searles lake was derived by overflow from Owens lake and hence came chiefly from Owens river. All natural river waters contain some dissolved salts. By long-continued accumulation within a restricted basin from which little or no water is lost by overflow and the water disappears by evaporation alone, the solutions become gradually more and more concentrated with salts, and eventually if the lake approaches complete dryness these salts are deposited as a more or less massive crystalline body. This is evidently what has taken place in the basin of Searles lake. The final evaporation of this large lake is supposed to have resulted from the failure of the principal source of its water supply, when possibly with a general lowering of humidity of climate a slight decrease in the flow of Owens river caused Owens lake to cease to overflow the divide on its south side.

Structure

The physical status of the main saline deposit in the bed of Searles lake today is revealed by a large number of borings that have been put down by private interests in various explorations of the salt beds and by the analyses that have been made from them. So far as has been determined, the main salt body appears to be a bed at least 11 or 12 square miles in extent and having a depth of 60 to 70 ft. A much greater quantity of salts doubtless exists beyond the central area of the more solid salt mass thus defined. This body of salts is chiefly crystalline, in part compact, but in general is be-

lieved to be of cellular or open crystalline structure, being really a body of salts standing in the residual brine from which it has crystallized. Experiments in the wells that have been put down appear to show that this brine is in nearly all parts of the salt bed free to flow and that it stands high in the deposit, approximately at the actual surface of the salts. Thus the brine constitutes the ground-water level of this part of the basin, occasionally after wet periods flooding to a shallow depth over the surface, but generally dispelled by the rapid evaporation of this dry climate until its level sinks below the reflecting white surface of the salt crust. Evaporation at this surface is presumably continuous, the body of the ground water being as continuously replaced by inward seepage from the marginal alluvial slopes. Little sediment other than wind-blown dust is ever spread out upon the main salt plain by the occasional floods, and the salt of the central part of the deposit appears white or tinged with pink and for the most part comparatively clean.

Composition

Many analytical data as to the composition of the mass of crystallized salts of this deposit are in existence. On the salt as distinguished from the brine, which will hereafter be discussed, the Survey has at present no original data, for they could be had only from carefully collected samples obtained during the drilling in the deposits. There is good reason to believe, however, that the salts as well as the brine contain a considerable percentage of potash. Some of the private analyses from this deposit have been made public in a recent article. Several analyses, chiefly of the brine, have been made by the government bureaus and should give accurate data as to the composition of this part of the deposit. The following are the more complete analyses of the brine made from the samples collected at Searles lake March 6, 1912, now published for the first time:

Composition of Brine from Searles Lake, California

(Percentage of ignited residue. Walton Van Winkle, analyst.)

	Austin well U.	Well W9.	Well S.E. No. 8.	Austin well O.	Well S.E. No. 7.	Well S.E. No. 4.	Average.
SiO_2	0.05	0.03	0.00	0.00	0.00	0.03	0.02
As	0.06	0.06	0.05	0.06	0.06	0.08	0.06
Mg	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ca	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Na	33.37	32.57	33.16	33.92	33.23	32.90	33.19
K	6.53	7.27	5.98	5.54	6.29	5.69	6.22
CO_3	7.37	7.95	6.65	6.89	6.85	6.94	7.11
SO_4	12.00	12.49	13.41	11.89	13.79	13.00	12.76
Cl	35.97	35.53	36.50	37.13	36.40	36.79	36.39
B_4O_7	3.07	1.58	1.77	2.03	2.08	4.14	2.45
Total	98.42	97.48	97.52	97.46	98.70	99.57	98.20
Total salts (ignited residue, percentage of original sample)	33.48	33.94	33.30	32.96	33.21	32.88	33.30
Specific gravity	1.3002	1.3045	1.2969	1.2935	1.2959	1.2932	1.2974

Each sample was collected by lowering a stoppered and weighted bottle to a depth of 35 to 40 ft. in the brine and then, by means of a separate cord provided for the purpose, jerking out the stopper and allowing the bottle to fill.

By recalculating the average results of these six analyses to a theoretical or possible combination of salts that might be derived therefrom the following result is obtained. This is the approximate composition of the anhydrous residue which results from the complete desiccation of the brine.

Hypothetical Average Composition of Anhydrous Residue of Brine from Searles Lake Basin

	Per cent.
Sodium chloride (NaCl)	51.61
Sodium sulphate (Na_2SO_4)	19.22
Sodium carbonate (Na_2CO_3)	12.79
Sodium biborate ($Na_2B_4O_7$)	3.23
Potassium chloride (KCl)	12.07
Sodium arsenate (Na_2AsO_4)	0.17
	99.09

The original brine contains a variable percentage of bicarbonate, which is converted to the carbonate form in the anhydrous residue and is so expressed.

As is well known, the theoretical composition of salts in the brine, as shown by the calculations from the analyses, can be accepted as a working basis only with certain reservations. Doubtless most of the salts named in the conventional method of computing the analysis of a solution may be abstracted from the brine somewhat in the proportions given, provided that satisfactory chemical processes can be devised to accomplish the desired result. It is believed that this has already been at least partly accomplished experimentally. But it is also true that no practical process of extraction on a commercial scale will derive all these salts in the amounts shown.

Working Plans

Estimates of other available constituents similar to the estimate of the total available potash in the deposit can be readily computed on the basis of analyses of the salts and the brine. At present the plans for working the deposit contemplate the manufacture of the salts from the brine, which, as a liquid capable of being pumped from place to place, is more readily susceptible of manipulation than the solid salts. Preliminary estimates of quantity of production have been made on the basis of the composition of the brine and on an assured constancy of composition under continued pumping. As to the composition of the brine, the analyses here quoted are now available, and as to the constancy of the brine under pumping, there is opportunity for experimental verification of hypotheses.

It is recognized that, in general composition, desert basin salines are quite distinct from salines that have been produced by the desiccation of marine waters. The Stassfurt salts are similar to the deposits that would be left by the evaporation of normal sea-waters. They contain soluble magnesium salts as an important constituent, especially in conjunction with the potash-rich portions of the deposits. Most of the desert basin salines in the United States are more or less of the Searles lake type—that is, they are composed largely of chlorides, but contain considerable proportions of sulphates and carbonates, chiefly of sodium with some potassium, and little or no soluble magnesium salts. The desert basin salts may be described as salines derived by the direct leaching of continental areas, as distinguished from salts of direct marine origin. Ultimately both classes may be said to have had a common origin.

It is still too early to offer any general summary statement regarding the industrial situation at Searles lake. An immense mass of salts and an equally great volume of saturated residual brine exist in this deposit. The compositions of the salt and brine are fairly well determined. Several of the ingredients which could be extracted have an established value in the chemical markets generally, and some, like sodium sulphate, have potential value.

Withdrawal from Entry

The lands at Searles lake were withdrawn from entry by an order approved February 21, 1913. This withdrawal is not intended to interfere with any valid mining claims that existed prior to the withdrawal, a fact that is made clear in the express wording of the order itself: "This withdrawal is made subject to all rights lawfully initiated under any valid mining locations made upon such lands so long as such rights are maintained in full compliance with the law." In order to relieve the existing uncertainties regarding the validity of 'potash' or general placer locations carrying saline deposits in large area, a draft of a law has been prepared and submitted to the appropriate committee in Congress, which it is believed will provide a satisfactory title basis under which such lands can be worked. It is to be hoped that in the interest of a possible American potash production the matter may receive due consideration and that enactment of a proper measure to this end may be accomplished.

Iron Production for 1912

The iron ore mined in the United States in 1912 amounted to the great total of 55,150,147 long tons, compared with 43,876,552 tons mined in 1911, an increase of 11,273,595 tons, or 25.69%, according to an advance statement by Ernest F. Burchard, of the United States Geological Survey. The production for 1912 was second only to the output of 1910, falling 1,864,759 tons below the record production of that year, which was 57,014,906 long tons.

The Minnesota iron ranges are producing at present considerably more iron ore than is produced in all the rest of the states together, having furnished nearly 62.5% of the total for the United States in all the mines in Minnesota and Michigan and part of those in Wisconsin, mined 46,368,878 tons in 1912, or nearly 84.08% of the total.

The total quantity of ore marketed in 1912, according to reports received by the Survey, was 57,017,614 tons, valued at $107,050,153, compared with 41,092,447 tons, valued at $86,716,575, in 1911. The marketed production, therefore, represents an increase in quantity of 15,925,167 tons, or 38.75%, and in value of $20,333,578, or 23.45%. The average price per ton in 1912, according to these figures, was $1.88, compared with $2.11 in 1911. According to the reports of producers, many of which have been somewhat revised since the report for 1911 was published, the total quantity of iron ore in stock at the mines at the close of 1912 amounted to 10,241,287 tons, compared with 12,206,390 tons at the close of 1911, a reduction of 1,965,103 long tons, or 16.1%, which balances closely with the excess of sales over quantity mined.

Gravel Plant in Nevada

The following is a description of T. Wilson's plant in operation in the main Manhattan gulch, as published in the *Manhattan Post*. The main feature about the hoisting machinery is an endless double-chain elevator with shallow buckets every two feet, the two chains making an elevator about 20 in. wide. This hoists the gravel from a feed-bin of 35-cu. yd. capacity, at the bottom of the shaft, on bedrock, 65 ft. below the collar of the shaft, up to a storage-bin which holds about 25 cu. yd. of gravel, this bin being about 25 ft. above the surface. From the storage-bin the gravel is sluiced whenever sufficient yardage has accumulated. From the chute of the storage-bin, the gravel falls into a revolving trommel made of heavy screen of sufficient mesh to allow rock of 1½ inches in size to fall through, the oversize working out at the lower end into a chute and from there to the waste pile. A steady stream of water is played on the trommel, washing the loose clay from the rocks and gravel which holds the gold. Directly below the trommel is the shaker, a box similar to a sluice-box, but with deep riffles, crosswise, every 2 in. of its 12-ft. length. By means of an ingenious system of pivots, this box is rapidly shaken, with a play of about three inches, endwise, and an inch up and down. At the lip of the shaker three small copper plates are fixed. The gravel falls from the shaker, passes over these plates, and any fine light gold which will not settle readily between the riffles becomes amalgamated with the quicksilver on the plates, and then is soon caught by the lower riffles. Below the plates a line of sluice-boxes, all containing riffles, some cross and some lengthwise with the boxes, extends for about 150 ft. The small percentage of gold which escapes the shaker box is caught in the travel down these boxes. Mr. Wilson estimates that over 90% of the gold is caught by the shaker. The power for the elevator, trommel, and shaker is obtained from a 15-hp. Westinghouse motor. About 15,000 gal. of water is added to the supply each day.

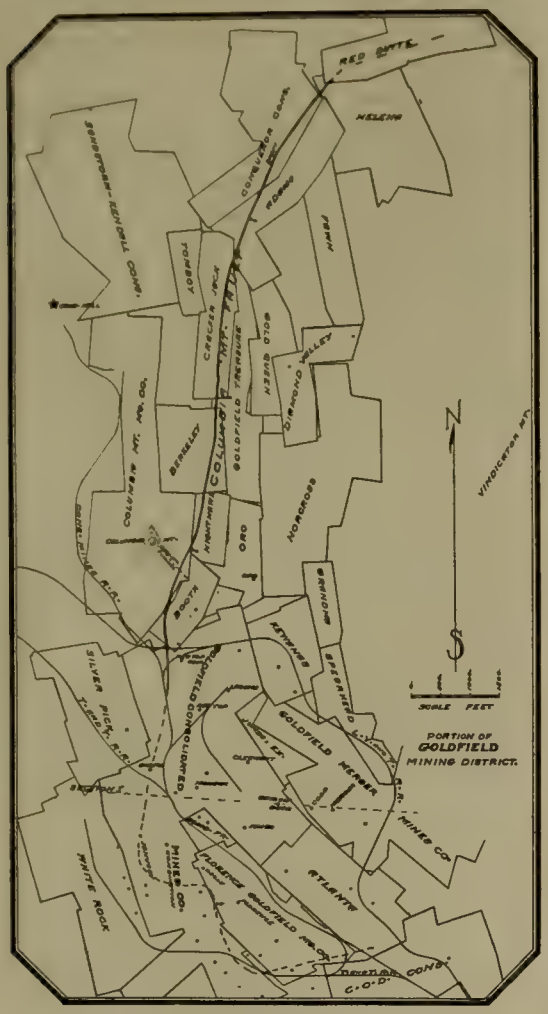
Relation of Faulting and Mineralization in Goldfield

By Corbin Barnes and E. A. Byler

That portion of the Goldfield mining district which has so far proved the most productive, includes the Goldfield Consolidated and Florence mines, and it is here intended to point out the relation existing between the Columbia Mountain fault and this mineralization.

System of Fissuring

F. L. Ransome, in his report on the Goldfield district, suggested a relation between this fault and



GOLDFIELD DISTRICT.

the ore deposits of this portion of the district, but while the extent and character of the fault were well demonstrated, there was not at that time sufficient development in the underground workings to determine its relation to the ore deposits. Later developments have furnished information from which this relation may be deduced, and the general system of mineralization outlined.

This fault, as shown on the plan map, is traceable along the surface from its northern end near the Conqueror mine shaft, south a distance of some two miles to the vicinity of the Red Top, where it disappears beneath the dacite. It may be followed underground from here fairly close to its southern end, by means of the relative positions of the different formations, as disclosed in the underground workings. Its approximate position on the surface south of the Red Top is indicated on the map by a dotted line.

Between the January and the Florence it makes a sharp bend to the east, and then again to the south to its southern extremity, where it ends at an east-west fault. At its northern extremity the manner of its ending has not been disclosed, but it appears here also to end at an east-west fault which probably extends to Diamondfield. The dip of the fault is to the east, all that part north from the January having a regular dip, averaging about 28 degrees. From the Florence south the dip is much steeper to the east, the amount of which has not as yet been determined, but is probably about 60 degrees.

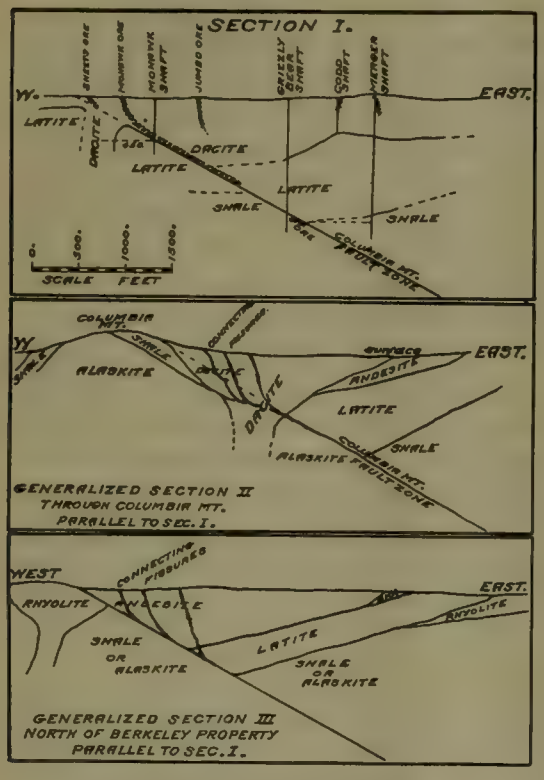
Mr. Ransome has concluded that the main movement of the Columbia Mountain fault was prior to the dacite intrusion, and that it occurred in the andesite and in the underlying rocks. Then came the intrusion of the dacite through the latite, to the fault and across it, and into the latite-andesite contact, lifting up the andesite which has in places since been eroded leaving the dacite at the surface. This conclusion has been disputed by some, but there seems abundance of evidence to support it, and Ransome's idea is now generally accepted.

Situation of Fault Zone

Section I, as shown in the illustration, is through the Mohawk, Grizzly Bear, and Merger Mines Co. shafts. This section furnishes data for a close location of the fault zone on its dip, and work now in progress on the Grizzly Bear and the shaft of the Merger Mines Co. will still further demonstrate it. The fault zone, shown in this section on its dip, is approximately the sloping fault-contacts of dacite with latite, and latite with shale, and at deeper workings probably the fault-contact of shale with alaskite. The downward throw on the east side of the fault has not been sufficient in amount to allow the approximately horizontal layers of latite and shale to entirely pass their corresponding layers on the west side; therefore, the fault zone in places passes through latite upon both sides, and similarly through shale. In consequence of the dacite intrusion across this fault along a portion of its length, which practically obliterated it to a depth of some three hundred feet, it follows that the relative position of the geological formations caused by the fault do not properly show above or at this intrusion, though they do below it.

After the dacite intrusion, there has been a further small movement along this fault zone, and where the intruded dacite lies across the upward extension of the zone, no pre-existing fracture is present; and the movement, while following in general the extension, has been recorded in irregular

fractures extending upward to the surface, having a steeper dip and connecting below with the fault as shown in section I. The mass of eruptives and solidified dacite intrusion has settled irregularly, due to the additional movement of the fault in its original position below, and we consequently find many irregular fractures extending from this fault zone to the surface. These fractures connect below and finally with depth merge with the original fault zone; the foot-wall of which in effect forms the foot-wall of the mineralization.



SECTIONS THROUGH FAULT ZONE.

South of the January, where the fault makes a sharp bend to the east, there seems a probability of the existence of a cross-fault which would account for the difference in dip of the fault north and south of this bend. There is some evidence that this follows the east-west contact between the dacite and andesite. There is, however, no conclusive proof of the existence of this cross-fault, as there are insufficient workings penetrating the latite, in which formation would be recorded the entire movement, while in the dacite above would only be recorded the later small movement subsequent to the dacite intrusion, which may have been distributed in such a way as to make its existence not apparent.

As shown in section I, a cross-cut west from the Mohawk shaft on the 450-ft. level penetrates a body of dacite, the position of which indicates that it is a dike, and while there are not workings enough at proper depth to the north to prove it all, the evidence supports the idea that this is a dike of dacite with a north-south direction with apparently greater width north of the Laguna, which is probably the source of a portion of the dacite intrusion. If this dike is as suggested, and wider to the north of the Laguna, it will be expected that the fault in breaking its way upward through this dacite will show greater irregularity than would otherwise be expected. Generalized section II illustrates this situation and practically represents the conditions existing as far north as the end of the dacite area, in the vicinity of the Berkeley property.

Mineralization

The various orebodies of the Goldfield Consolidated and the Florence mines are directly connected with this Columbia Mountain fault zone; all of them being either in the zone itself or in the irregular fractures extending from it upward. It seems reasonable, therefore, to conclude that this fault has been the connecting channel to the deep seated source of mineralization, and the path for mineralizing solutions.

What is believed to be primary ore has already beeen found on the 1300-ft. level of the Grizzly Bear in this fault zone. The natural tendency, in a fault as flat as this, is a closing of the fracture by compression, and the consequent difficulty of the circulating waters to maintain their open channels. This accounts for the larger size of the orebodies in the upper and more nearly vertical and irregular connecting fissures than in the main channel below. It is reasonable to expect that the deposition of mineral in the channel itself as depth is increased will be of less thickness, while in the steeper intersecting veins it will not be so much restricted.

Relation of Mineralization to Faults

The mineralization appears to depend entirely upon the system of fissuring, and there appears to be no essential relation between the ore deposits and the different kinds of eruptive rock in which they exist, and references to the different kinds of rock are made here for the purpose of exhibiting the system of faulting and fissuring. There has been some cross-faulting both prior to and after the deposition of the ore, which has not been mentioned here, and has to some extent modified the uniformity of the fault and connecting fissures, but has not substantially altered the general scheme.

To the north of the Berkeley property the conditions are somewhat simplified by the absence of the dacite intrusion. This situation is represented in generalized section III. Some ore has been found in the fault zone at the Conqueror mine, which leads to the inference that there are connections along the zone to the source of the mineral solutions, through which they have penetrated this far to the north. There may be a branch from this fault or a connecting fissure extending farther to the west, which has mineralized the area including the Sandstorm and Kendall properties. This system of connected faults and branching fractures is by no means unusual and many notable similar instances are found in mining camps throughout the country. It is not intended here to convey the idea that there are not other sources of mineralization for other portions of this district, or that there may not be many more connecting mineralized fractures extending from this system, which as yet remain undiscovered and which the future will reveal.

The Basic-Lined Converter

By E. P. Mathewson

*In a discussion of a paper on 'The Basic Process as Applied to Copper Smelting,' by Percy C. Gilchrist, read before the Society of Chemical Industry, London, January 5, 1891,† W. C. Roberts-Austen asked Mr. Gilchrist whether he thought that the substitution of a basic lining for acid lining in the Manhès process would afford anything like the service which it had been shown to render in the metallurgy of iron.

Claude Vautin stated that he had experimented for over two years with basic linings for bessemer converters for copper mattes at Cobar, but had given up the attempt on the score of cost. Mr. Gilchrist in his reply stated that he did not believe in applying any system of bessemerizing to copper.

About the time of the presentation of the paper mentioned, Herman Keller, superintendent of the Parrott smelter, in Butte, was experimenting on a large scale with converters lined with magnesite brick. He gave up the idea on account of the cost of linings and because no particular advantage was observed. My belief is that his tuyeres and converters were too small.

Experiments at the Great Falls Plant

A short time afterward, similar experiments were tried at the Great Falls plant of the Boston & Montana company, and at the Old Works of the Anaconda Copper Mining Co. at Anaconda. These were abandoned on the score of cost and the lack of advantages. The same cause of failure, in my opinion, holds here. The Anaconda Copper Mining Co., however, adopted the magnesite brick lining for its tilting casting machines.

E. A. C. Smith, while temporarily in charge of these casting machines, tried the experiment of blowing the copper in the casting machines, but the return of the head of the department put a stop to the experiment, and Mr. Smith put the idea away until a more favorable opportunity presented itself.

About 1903, Baggalley began his experiments of smelting ore in a basic-lined converter at Butte, Montana, at the Pittsmont smelter. He was followed by Knudsen at the Sulitjelma plant in Norway, in 1907. About the year 1905 similar experiments were tried at several smelters, notably the plant of the United States Smelting Co. at Midvale, Utah. Mr. Smith, who was then with the Baltimore Copper Co., found his opportunity to experiment, and his superintendent and manager, Mr. Pierce, gave him all the help in his power, the result being the construction at Baltimore of a basic-lined converter for leady copper mattes, along the lines of the old tilting anode furnaces of Anaconda. The experiment gave promising results, so that the American Smelting & Refining Co. took up the process and introduced it with success on leady copper mattes at its lead refineries at Perth Amboy and Omaha. Then Smith and Pierce persuaded the company to try it on straight copper mattes at the Garfield, Utah, plant.

In the meantime the Anaconda Copper Mining Co., at the Washoe Reduction Works, Anaconda, lined a shell of the standard trough pattern with magnesite brick. The results were excellent, so they gradually replaced all the acid lining with magnesite brick. At Great Falls the same Company's experts developed a large converter along the lines of the upright shell, and, as this type is easier to build and keep in repair, it has become the standard during the past year. Practically all the bessemerizing of copper mattes in the United States is now done in basic-lined converters. The main points to be observed for successful operation of the basic linings are: not to exceed a temperature of 2100°F.; not to have tuyeres smaller than 1¼ in. (1½ in. is the preferred size); to drive in punch rods the full size of the tuyere opening, immediately after pouring the copper; to maintain in the converter as large a mass of matte and slag as possible to prevent sudden changes in temperature and overheating of the lining; to employ slag containing preferably about 25% of silica.

A test was made with a view to finding out whether the cutting action of converter slag on a magnesia brick lining bore any relation to the silica content of the slag. Thirteen slags were selected from the daily samples sent to the laboratory. These varied in silica from 22.4 to 37.8%, and were carefully analyzed for MgO. The results showed no relation between silica and magnesia content.

To Smith and Pierce belongs the credit of taking a long-discarded idea and developing it into a successful process. The great advantages of the process are: decreased cost of lining; the ability to use large units in converting, with consequent economies in labor, power, and repairs; neatness and cleanliness of plant, abolishing the danger, from dust, to the health of the lining crew.

*Abstract from advance copy of paper to be presented at the Butte meeting of the American Institute of Mining Engineers.

†*Journal* of the Society of Chemical Industry, Vol. X, No. 1, pp. 4 to 16 (Jan. 31, 1891).

Improvements at the Old Dominion Mine, Arizona

The steel erecting gang is working on the new sampling mill, adjacent to the big concrete concentrating ore-bins. The main work is almost complete, but some riveting remains to be done. The steel work on the crusher plant has been delayed because of the late arrival of the steel building columns, but these are now at hand and the contractors will go ahead with the erection of the building immediately. All the steel work is being done by the Darbyshire-Harvie Iron & Machine Co., of El Paso. All necessary excavation work in connection with the new concentrator has been completed, and forms are now being put in place to receive the concrete. The foundations for the rolls are already in place. The steel work on the new concentrator will not be started before the crusher plant, sampling mill, and various conveyors are all complete. Plans are being made to double the present capacity of the custom ore-bins, which are above the A shaft, to give more storage room at that point. The

timbering and lining of the pockets at the 1200 and 800 ft. levels has been completed, and a pocket is being cut for the concentrating and smelting ore on the 1600-ft. level, the lowest level of the shaft at the present time. Several changes are being made in various stations near the shaft in connection with the new skip arrangements, and the tracks will be changed later. Ore production and development in the mine continues about normal. The sinking of the K shaft for a sump, below the 1400-ft. level, is finished, and in a few days all timbering will be in place and the shaft will be ready for hoisting ore at any time. It is expected that the raise from the 1200-ft. level of the Old Dominion to connect with the present bottom of the Gray shaft will hole through about July 5, and the shaft will then be timbered with sets down to the 1200-ft. level. A new slime pond has just been completed near Pinal creek on the old Hamm ground, and will be used for settling slime from the concentrator. There are no changes or improvements of note around the smelter.

Portable Electric Mine Lamps

By H. H. Clark

*Portable electric lamps should first of all be safe; that is, they should not be capable of igniting gas, and should not be so poorly constructed that a man will be left in darkness due to failure of any part of the lamp equipment. The lamp should give the proper amount of light for from 10 to 12 hours on one charge of battery. The lamp equipment should be as light as possible, so that the burden of carrying it and working with it may be reduced to a minimum. Some of these qualities are more or less apparent after a brief examination. There are other qualities that are not so easily determined, and I will mention just a few of them:

A most important factor in the usefulness of portable electric lamps is the cost of repairs and upkeep; another is the trouble that is experienced from interruptions of service due to equipments getting out of order. The principal item of upkeep is the expense of replacing the lamp bulbs that have burned out. The life of the lamp is, therefore, an important consideration. The manufacture of miniature lamp bulbs does not seem to be very thoroughly standardized in this country. The lamp bulbs that the Bureau has examined have varied a great deal in their characteristics. These bulbs vary in price from 17c. to over 40c., and it may be supposed that the higher-priced lamps have a longer life, but I cannot give any definite information as to that, although tests are now under way to determine this fact. The candle-power that these bulbs will give is not a fixed quantity, as it varies with the voltage at which the lamps are burned. If a lamp, designed for two-volt service, is burned at less than two volts, it gives less candle-power and has a longer life. If, on the other hand, it is burned at 2¼ volts, its candle-power would be increased and its life proportionately shortened. It is not always a good sign to see a lamp bulb glowing with extreme brilliancy, because it may mean that the lamp is being used at too high a voltage and may last but a few hours at the most.

*Address delivered before the Coal Mining Institute of America on June 18, 1913.

Battery Plates

Another item in the cost of upkeep is the decomposition of the battery plates or elements. This is most noticeable in storage batteries having lead elements. The natural depreciation of the plates is hastened by overcharging, overdischarging, or charging at too high a current. Another trouble that is experienced with the acid batteries is the destruction of the contacts by the acid from the battery. Even in non-spillable batteries and batteries using gelatin electrolites, a certain amount of acid often gets upon the contacts, and rapidly corrodes and destroys them. A good deal of this trouble may be eliminated by properly designing the battery, but it may be prevented even more completely by exercising care to keep the batteries clean and the terminals occasionally wiped off with vaseline or some similar substance. Storage batteries that make use of other electrodes than lead and other electrolites than sulphuric acid are not materially injured by overcharging or overdischarging, and do not have trouble with the corrosion of the contacts. All the batteries that the Bureau has tested, however, have shown a more rapidly decreasing voltage curve than the lead batteries, which means that the candle-power of the lamp when the battery is first charged will be a good deal higher than it will be near the end of the discharge.

Candle-power of Lamps

Another point that I wish to speak of is the matter of candle-power ratings of portable lamps. Up to the present time, so far as I know, no standard candle-power rating of portable electric lamps has been adopted. I want to call your attention to the different meanings that may be given to the word 'candle-power' as applied to portable electric lamps. If a man speaks of his lamp as having five candle-power, he may mean the candle-power of the lamp bulb used in connection with its reflector. In either case he may refer to the candle-power measured at one point or the average of several points. The true candle-power of the lamp is, of course, the average candle-power that it gives over its illuminating range. Some lamps if measured from a point directly in front of their reflectors, will show from 5 to 10 times the candle-power that they would have if their candle-power were measured from a point 30° on either side. An effect of this sort is, of course, to be expected, but the statement as to how the candle-power is measured should always be made, because two lamps that really give the same amount of light have widely different candle-powers when measured 'head-on.'

As an illustration: Two lamps give the same amount of light, but the 'head-on' candle-power of one is more than twelve times that of the other, and the average candle-power is nearly seven times that of the other.

A growth of scrub willow in Alaska is usually an indication that the ground below is not frozen.

Discussion

Readers of the MINING AND SCIENTIFIC PRESS are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment. Insertion of any contribution is determined by its probable interest to the readers of this journal.

The Psychology of Zinc

The Editor:

Sir: There was produced in the United States in 1912 more than 320,000 tons of metallic zinc, worth more than $45,000,000. To produce this amount of metal, over 100,000 little fireclay pots were constantly in use night and day. The average life of these pots is only a few weeks, and when one is broken it must be replaced. As a result, the total number consumed was between one and two millions. For each of these pots in use, a smaller bottle-like vessel of fireclay is required; the life of these smaller vessels is even shorter. The service required of these petty utensils is strenuous, and the handling they receive is necessarily rough, consequently only the best obtainable clays can be used in their construction, and great technical skill is required to make them. A rigorous supervision must be exercised over every stage of their long evolution. They must be dried out gradually during several months, and properly heated afterward, before they can go into a hot furnace to replace those which are broken. They must be handled like crockery, and yet be charged and emptied once every twenty-four hours with heavy iron tools which only a strong man can manipulate. It is a triumph of manual training which makes it possible to use them at all. Yet it is assumed that they are indispensable with a resignation which may be truly Christian or merely fatalistic.

The success in finding suitable clay, the care taken in preparing it, and all the little refinements in manipulation practised, and the slight changes in size and shape of the vessels adopted from time to time for economy, show to what extent the art of making them has been perfected. Most of the ore from which this zinc is smelted is mechanically concentrated out of material which contains less than 4% of zinc as it goes to the mill. From this material a rich concentrate containing between 50 and 60% of zinc must be made before the smelters will look at it. The percentage loss in this mechanical concentration is very high. These two facts, the successful use of fragile vessels on a large scale, and the successful concentrating of lean ores, are taken as evidence of an advanced stage of development in the art of zinc smelting. This 55% concentrate is, however, not yet ready to be put into those precious vessels; it must be roasted to get rid of its sulphur. An incomplete roast will not suffice as in many other branches of metallurgy; practically all of the sulphur must be eliminated. Here comes in another evidence of the success achieved in zinc smelting, for the sulphur is reduced to less than 1%, and this result is announced with pride. Still another evidence of acquired skill is to be found in the drawing and casting of the smelted metal, for each of the little bottles (condensers) attached to the pots (retorts) must be emptied from three to five times a day by scraping its contents into a ladle which holds perhaps twenty pounds. The metal in these ladles, after it is skimmed, is poured into a larger ladle, from which it is poured into the molds, after proper cooling. The skill shown in these operations is admirable.

There is another side to the story outlined above. It is a fact that enormous deposits of mineral containing from 6 to 20% of zinc are easily accessible, some of them opened by shafts and drifts, but they are not available because they are not amenable to the high concentration possible on some leaner ores, or because they cannot be roasted down to less than 1% of sulphur. These masses of rich raw material are a nuisance where they are found, in working mines for other metals, and they are doomed to be irrevocably lost, when these mines are shut down, unless happily rediscovered by posterity and utilized by a new order of zinc smelters.

It might be supposed from the foregoing outline that zinc is connected with some particularly troublesome associates. This is not the case. The elements found with it are those with which every metallurgist is familiar, and has to do with every day. There is little foundation for the suppositions that zinc has properties which make its separation from other metals difficult, or that there is some great difficulty in smelting.

Zinc has indeed two properties which impose special conditions on its metallurgy: the temperature at which it is reduced by carbon is above its boiling point, and consequently as reduced it exists as a gas, in which state it is easily oxidized. Both of these properties belong also to mercury, which is smelted from much leaner ores. On the other hand, zinc has properties which make its smelting very simple. Isolated by volatilization, it is easily separated from its metallic and earthy associates, and it is in fact the only metal which I know of, which is commonly used in the arts just as it comes from the smelting furnace. The temperature needed to reduce it is moderate, that is, about the same as in the simplest lead-smelting process, much less than is required to smelt iron, copper, nickel, or aluminum, or than is constantly employed in working up iron and steel products.

Smelters in other branches of metallurgy show a willingness to discard furnaces and machinery known to be obsolete. They experiment to find something better. They are willing to build furnaces which they know are not perfect, but will have to be discarded or improved later to get the best results or to meet changed conditions. Change does not repel them. But zinc smelters cling to their precious pottery, to their petty charges, and skilled practices of a traditionary art, to their costly but perfected roastings, and they shudder at any suggestion of change. It is said zinc smelting was invented in China several hundred years ago. It has been also said that the zinc industry is a backward one; it is rather a perfected one. I am inclined to think that all of its skill and most of its technical knowledge is to be found with its manual workers. At a consultation held between its family physicians

and one or two outside specialists called in for the sake of appearances, mutterings very much as follows would be heard from the several participants: "One of arrested development—congenitally defective—unsanitary conditions—vocational disease—inherited—incurable—hopeless—will live indefintely—no suffering—happy as a child—inherited wealth—sad case." The consultation will be secret, for everything connected with zinc is done with decorous secrecy. It will be painstaking and detailed, for everything connected with zinc is in perfect detail, and everything is done with pains.

I think there are no zinc smelters on the Pacific coast of this continent, and no friends of the family whose feelings might be hurt by the indiscreet admissions I am making to the *Press*, and China is a long way off from there, whether one goes east or one goes west, and news travels slowly in the zinc world. These are feelings of traditional reverence which everyone should avoid shocking, intentionally or otherwise. I don't want to be thought uncharitable or unkind. There are cases which are sadder than death; they should be spoken of in private, and with hushed voices. I hope my voice is not too loud. Sorrow for the stricken must find a place in every bosom capable of human feeling, but the inevitable must be faced somehow. *Requiescat in pace.*

F. L. Clerc.

Estes Park, Colorado, June 9.

[The statement that zinc metallurgy is backward is frequently made. It is true that the recovery is less than in treatment of copper, gold, and silver, but we believe that this results from real difficulties and is not wholly a matter of tradition. Certainly, the metallurgists that we know, who are working with zinc, are as capable and energetic as any. We hope to see treatment improved. In the meantime our correspondent's semi-serious pen picture will serve as a protest and stimulant.—Editor.]

Oil-Burning in Furnaces

The Editor:

Sir—In my letter on 'Blast-Furnace Smelting with Crude Oil,' published in your issue of February 8 last, I endeavored to emphasize the necessity of thoroughly consuming the oil before the entrance of the mixture of hot gases into the furnace. That such emphasis was needed is shown in a variety of ways. I have heard subsequently of two different attempts to utilize oil as fuel in cupola smelting, which came to naught, apparently by a neglect of this principle. Observation of oil-burning boiler furnaces, so common now, will suffice to show the necessity of a thorough preliminary combustion. The conditions essential to complete combustion—which, by the way, never takes place under steam boilers—are these: There must be enough, but not too much air; the space within which the combustion takes place must remain at the highest possible temperature; the space must be ample; and its form must be such that there be no interference with or between the gaseous currents. The ideal form would be tubular. The best construction would be cylindrical, being composed, let us say, of a sheet-iron tube lined with firebrick of good thickness, and placed horizontally. The diameter should conform to the amount of oil to be consumed, and its length should be such that the gases would be thoroughly burned, and that no smoke, the sign of faulty combustion, should issue from the far end. The temperature at the front (where the air and oil enter) will necessarily be less than at the back, but should be kept as high as possible, by cutting off the direct radiation of heat outwardly by means of baffle-plates. It is contrary to common sense to permit of openings at any point wherein the interior can be seen. The fire-chamber is, of course, connected to the furnace proper, and when thus connected to a blast-furnace would constitute a tuyere. Several of them would be provided for each furnace, spaced regularly about its periphery, and pointing radially inward, or having some inclination downward, according to the fancy of the designer. They must be contracted at the inner end, to increase the velocity of the entering gases and assume the customary effect.

The application of oil-burning to the steam boiler is not scientifically made. The old-fashioned coal or wood-burning firebox is retained and made to do a duty to which it is not well adapted. The interior form of the fire-box is about the worst that could well be devised. Its faults for oil-burning are, first, its many rectangles, which produce conflicting gas currents and prevent the proper mixing which is essential to perfect combustion. Then the large useless space at the front, which cannot be kept hot; but chiefly the presence of the immense bulging boiler immediately over the fire at its incipiency, which effectually keeps down the temperature, which, instead of reaching 3000° or more, as it should, can barely surpass the red heat. I do not mean that all the space is at this low temperature, but that it does not surpass the red heat as an average.

When a liquid or gaseous hydrocarbon burns, the tendency is for the hydrogen to be consumed first, as the carbon, requiring a higher temperature, may escape combustion in part, passing off in solid particles and making a black smoke. A cold object introduced into the path of the burning gases abstracts heat and produces the smoky effect. The bulky boiler, relatively cool, is responsible for the great volume of smoke and soot which often defiles the atmosphere in the neighborhood of steam plants. The remedy is obvious: it is to burn the fuel out of contact with the boiler, and to heat the latter by contact with the fully burned and very hot gases. Smoke is so unnecessary that it is quite a wonder that legislative interference has not been invoked effectively; a proper 'blue-sky' law should be placed on our statute books.

It is in reverberatory smelting that oil-burning has reached its ideal phase. In that furnace the whole interior forms practically a great combustion chamber, kept at a high temperature throughout its entire length (exceeding in some cases 100 ft.), into one end of which the air and atomized oil are introduced, while the fully oxidized gases are with-

drawn from the other. Being surrounded by brickwork, cunningly arranged to prevent the escape of heat by radiation and conduction, the whole interior remains at a dazzling heat, the conditions being perfect for the development of the flame and the complete combustion of the fuel. This condition of affairs should be imitated so far as practicable in the other applications of petroleum as fuel, even if it involved the construction of special combustion chambers. Such constructions are in the way of being realized. Several manufacturers of oil-burning boilers manifest, in their catalogues at least, a tendency to prolong their combustion chambers outwardly, or by extending an arch over the internal combustion space, which comes to the same end, to give the fuel a chance to develop its flame unhampered by the presence of the cold boiler surface.

HERBERT LANG.

Oakland, California, June 6.

The Mother Lode of California

The Editor:

Sir—In your issue of June 21 appears an article on 'The Mother Lode of California,' by J. H. G. Wolf. I consider this an ably written article on the Mother Lode, especially in reference to Amador county, and in fact all other districts mentioned in this article except that part of Calaveras county between the Mokelumne river and the Utica mine at Angels Camp, a distance of about 26 miles on the Central belt of the Mother Lode.

Mr. Wolf intimates that the productiveness of the Lode is lost. He omitted to mention the Gwin mine, about 1½ miles south of the Hardenburg, which property has been a producer of several million dollars and has been worked to the 2600-ft. level. Other mines south along the Lode are, The Hamby and Quaker City, that has produced gold as far as it has been developed; near San Andreas, the Gold Hill, Lookout, and Gottschalk mines have been prospected and from all indications are the making of paying mines, and in all probability as good payers as the Kennedy or any of the Amador properties. They are not unlike the mines of Amador county.

South from San Andreas, and north of Altaville, are other good prospects. They are, the Ford, Fellowcraft, Illinois, Rathgib, Thorpe, and others that have been developed for several hundred feet with good results. The only trouble on this part of the central Mother Lode is the want of capital to develop the mines to the same extent as in Amador county. The Lode did not break its neck at the Mokelumne river. In time it will be found that the Lode south of the Mokelumne river will prove equally as productive as in Amador county or at Angels Camp.

W. T. ROBINSON.

Mokelumne Hill, California, June 25.

The number of productive mines in New Mexico in 1912 was 145, of which 26 were placers, against 105 in 1911, of which 20 were placers, according to the U. S. Geological Survey. The average total recoverable value per ton of ore produced decreased from $11.54 in 1911 to $6.29 in 1912, owing to the large tonnage of low-grade copper ore handled by the Chino Copper Co. A total of 1,352,286 short tons of ore from New Mexico was sold or treated in 1912, an increase over 1911 of 1,119,587 tons. Of this total, 106,198 tons went to amalgamating and cyaniding mills, 1,142,002 tons went to mills for concentrating only, and 104,086 tons went crude to smelters.

Analysis of Black Powder and Dynamite

Bulletin No. 51, recently issued by the United States Bureau of Mines, outlines the methods of analysis that are used by the Bureau of Mines in the examination of certain classes of explosives. The present form of most of these methods has been worked out in the Bureau's explosives laboratory. The methods employed by C. E. Munroe have been taken as a basis, and were elaborated to meet the demands incident to the treatment of complicated mixtures and to the development of the explosives art. This bulletin presents the methods of analysis of 'ordinary' dynamite, and the ammonia, gelatin, low-freezing, and granular dynamites, and the common grades of black gunpowder and black blasting powder. The bulletin is published by the Bureau for the information of all persons interested in explosives and their safe and efficient use in mining work. It may be noted that the standard dynamite used at the Pittsburgh testing station is a good example of the 'ordinary' dynamite known in this country. This testing station dynamite has the following composition:

COMPOSITION OF PITTSBURGH TESTING STATION DYNAMITE

	Per cent.
Nitroglycerin	40
Sodium nitrate	44
Wood pulp	15
Calcium carbonate	1

As most permissible explosives contain only the constituents found generally in the various types of ordinary dynamite, the chemist will usually find it possible to analyze such explosives either wholly or partly by following the general methods of analysis here given for the type of explosive that seems most closely related to the one under examination. The methods of extraction with ether, with water, etc., outlined in the bulletin are general methods which are applied with equal success to all classes of explosives, and therefore by the use of these general methods, following a thorough qualitative examination, little difficulty should be met except with those classes of permissible explosives that contain large amounts of salts holding water of crystallization, such as alum and magnesium sulphate, or those containing an unusual number of uncommon constituents. Even with such explosives, however, if the information desired is principally in regard to the percentages of explosive ingredients (nitroglycerin, ammonium, nitrate, etc.), the methods outlined in this bulletin may be satisfactorily followed.

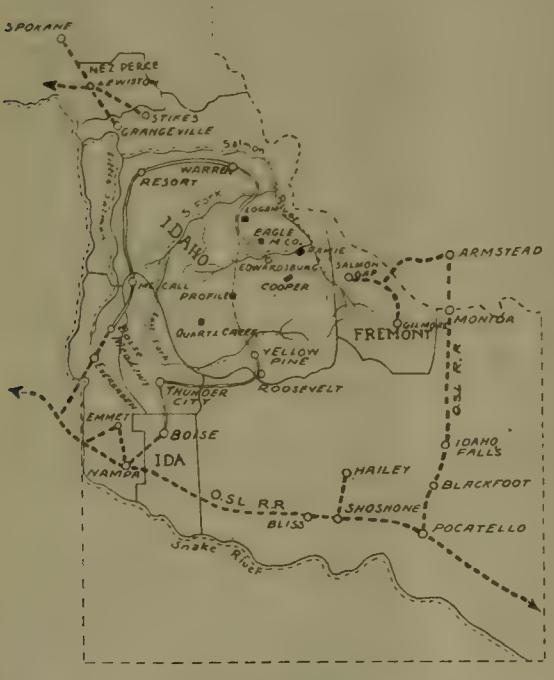
Corporation taxes during the year ended June 30, 1913, yielded the United States government $34,948,870.

Special Correspondence

BOISE, IDAHO

THE PEARL DISTRICT.—CHECKMATE MINE.—LINCOLN.—BLACK PEARL.—WHITMAN.—MISTAKES IN EARLY WORK.—CYANIDATION NEEDED.

In many districts the refractory nature of the ore has been the serious drawback to the successful development of mines. In some respects this is true of the Pearl district, though the principal drawback appears to have been lack of method in determining the true nature of the ore and its adaptability to certain methods of treatment, previous to the erection of milling plants. The valuable minerals consist of gold and silver, intimately associated with pyrite, blende, galena, and small amounts of stibnite and chalcopyrite. In many of the veins the sulphides occur at the surface or within a few feet of it. Some gold occurs 'free', but most of it is in the sulphides in the form of thin flakes deposited along the cleavage-planes of the mineral. The gangue is silicious, carrying a small amount of lime in the oxidized zone and some calcite both in and



MAP OF IDAHO.

below this zone. In general, the ore from all the properties is similar in character, at depth, the principal difference being in the varying quantities of blende and galena associated with the pyrite. The arsenical content varies somewhat in the different mines, and even in different parts of the same mine; this factor appears to have had an influence on the deposition of gold. In the Whitman mine the arsenical ore carries the highest gold and silver content, while in the Checkmate mine the reverse appears to be true. The reason for this apparent inconsistency has never been determined.

During the early period of mining, the Checkmate company erected a mill, including two 5-stamp batteries, vanners, and canvas tables, and this mill was operated almost continuously for more than five years. The orebody developed consisted of three shoots of fair length and width, which came together at depth, forming one shoot nearly 600 ft. long. A portion of this orebody was of shipping grade, the value never falling below $75 and often going as high as $150 per ton. Within the orebody the gold and silver content was consistent and quite uniform, a fact which distinguishes the Checkmate from other properties in the same mineralized area. A fact also worthy of note is the occurrence of galena in appreciable quantities. Invariably, where the amount of galena is high, the gold content is good, and this is true of all the mines. The ore sent to the mill yielded well to amalgamation and produced a good grade of concentrate. Repeated checks on heads, tailing, and the actual recovery in amalgam and concentrate showed an extraction of only 62%. Undoubtedly a large part of the loss was due to sliming the lead sulphide. The mine was developed to the 500-ft. level, but with the destruction of the mill by fire several years ago, operations ceased. Later, lessees worked the upper levels at a profit. The property is credited with a production of between $500,000 and $750,000.

The Lincoln mine has been opened by shaft to a depth of 400 ft. The vein varies in width from 2 to 30 ft., and at the widest point was heavily mineralized. This stope was opened from the inclined shaft before the vertical shaft was sunk, and some ore was taken out. This body of ore was lost, however, because proper precautions were not taken in mining. The full width of the vein was mined and a kind of square-set timbering was used to hold the exceedingly heavy hanging wall. No filling was used. The vein-matter was soft and a six-foot auger hole could easily be made. The men were instructed to be liberal in the use of powder, and they were. The holes were charged to the collar and when blasted not only broke the ore, but the timbers also suffered severely, and as a result the hanging wall fell, taking everything with it. The swelling ground in the drifts caused trouble, and 1200 ft. of the second level, from the incline shaft through which the first work was done, was lost and never recovered.

The treatment of the Lincoln ore was similar to that of the Checkmate, in that amalgamation and concentration were employed. The equipment consisted of a crusher, rolls, Chilean mill, plate, and Wilfley tables. Everything went through the Chilean mill, and as the mine, at times, was in condition to produce a good tonnage of ore, the Chilean was often crowded beyond capacity. Amalgamation followed immediately after grinding, and generally the stream of pulp over the plate was so thick and flowing at such speed that amalgamation was almost useless. An electro-amalgamation device was tried later, but the conditions necessary to good practice were ignored. Concentration on the tables was somewhat more successful than amalgamation, this being due to the fact that the Wilfley table is one of the most easily handled and understood of all concentrating devices. Some of the mill-ore was rich in free gold and at such times there could be observed a streak of the yellow metal traveling down the table above the pyrite. This helped to raise the grade of concentrate, but it certainly did not raise the efficiency in milling. The record of production is not complete, but the books show nearly $240,000 in shipments, of which $50,000 was bullion to the Boise assay office. Considering all the impediments to good work under which the mine and mill labored, the extraction would not exceed 50 per cent.

The Black Pearl mine is also developed by shaft to a depth of 400 ft., and is equipped with a complete mill, consisting of a battery of eight 1250-lb. Nissen stamps, Dorr classifier, Abbé tube-mill, Hendryx agitator, Kelly filter-press, Card concentrators, steam plant for heating solution, zinc precipitation, filter, and zinc press, melting furnace, and the usual tanks. From the standpoint of mechanical efficiency, the mill was up to date, but metallurgical troubles were experienced. Before these were adjusted, the financial resources had been exhausted, and the property was closed. The final plant was not finished until after expensive and time-consuming experiments had been made on other methods of treatment, the first of which was the percolation process. Percolation could not possibly be successful with the heavy sulphide ore, owing to the nature of occurrence of the gold and the tendency of the pulp to pack when charged into tanks.

The Whitman mine was being developed during the time that the other properties mentioned were producing, and should have profited by the experience of the pioneers in

milling. The mine is opened by an adit at a depth of nearly 300 ft., and for a distance of 1400 ft. on the vein. A Hathaway type of mill was built and operated with more or less regularity for two years. The capacity was limited, and the mine production had to be cut to conform with mill capacity. Early in 1910 it was decided to increase the milling capacity, and the Hathaway mill was consigned to the dump. Rolls, jigs, trommels, tables, and vanners were installed in the former mill building, which had been remodeled and enlarged. The equipment was placed in position, and in July milling operations were commenced. No one understood jigs, this being the first installation in the district, but finally, after considerable delay, a millman from the Coeur d'Alene district was secured to start the plant. The millwright had piped the jig water into the air vents of the plungers, and had merely placed the screens on the frame without even one little nail to hold down the cloth. The re-grinding rolls were directly under the trommels and some 12 ft. below, and as a result the product dropped, without a break, to the rolls. The feed-spout from the feeder to the coarse-grinding rolls made a right-angle turn and was flat enough to keep the millman continually poking the ore past the turn. The new millman found his suggestions for a few improvements, which would make the work easier and increase the efficiency, taken with little grace. Also, he found it difficult to satisfactorily explain just why clean concentrate could not be made on the third screen and through the third hutch—the two jigs were three-compartment. The middling was not returned for re-grinding, but was wheeled back and shoveled into the boot of the elevator and returned to the system. More could be given, but these points are enough to illustrate the lack of system in the matter of design and erection, and particularly in the knowledge of the ore and its concentration.

The mill ran several months under very unsatisfactory conditions and milled a fair tonnage. The grade of concentrate was lowered beyond a profitable point by allowing the pyritized wall-rock to go in with the regular ore. In places the hanging wall was well mineralized, but the pyrite contained low gold and silver content. An assayer was employed, but his principal duties consisted in running the crusher, as assays were made about once, and sometimes twice a week. Mine assays were few and far between, and consequently of little value in a vein where the difference between profitable and unprofitable ore could be determined in no other way. A change in management the latter part of the year was followed by a general change in the operating force, as well as in policy, all of which resulted in benefit to the owners.

In 1911 the mistake of attempting cyanidation in the Black Pearl mill, leased for the purpose, cost the owners about $10,000, and resulted in shutting down the property and settling with the crew on a basis of 75% of their wages. The data, on which the cyanide plant was started, consisted of several laboratory experiments, and nothing more. In this work the ore was concentrated in the Whitman mill and the concentrate hauled by wagon to the Black Pearl mill and dumped into a bin erected for the purpose. The equipment at the Black Pearl mill included a tube-mill, agitator, tanks, and zinc-boxes. The mill had been idle more than three years and was in bad condition, so that considerable loss of gold solution as well as barren solution was unavoidable at the beginning. The first mill-runs did not, of course, check with laboratory work, so the entire plant was turned into an experimental mill. To conduct such an experiment and at the same time keep 35 or more men on the payroll is exceedingly costly. The owners had not objected to paying for nearly 5000 ft. of development and the erection of the two mills, but this premature attempt at cyanidation was too much.

While this did not result in commercial success, it was of some value in indicating what could be expected in the matter of treatment. A total of 598 tons of concentrate was treated, the average value of which was $17 per ton. Close concentration was not attempted in the Whitman mill, and for this reason the percentage of silica reduced the value of the material treated. The calculated extraction was 76%, amounting to $7727, and the actual recovery was $6174, which amounts agree fairly well, considering the loss from leakage and other causes. Precipitation with zinc shavings was not very efficient, being only 89.56%. This low extraction was due, in part, to the use of old factory-made shavings and to lack of definite knowledge in the use of lead acetate. The cyanide consumption averaged 4 lb. per ton of ore, and the lime 8 lb. The record of zinc and lead acetate consumption is not complete, nor were other costs kept in shape for tabulation. The entire cost, including all alterations, repairs, supplies, labor, power, etc., amounted to $6.27 per ton. There is no question but that a good plant in charge of a competent metallurgist would reduce this cost to below $5 per ton, and at the same time increase the extraction.

The general conclusion to be drawn from observing conditions in this district is the fact that all companies, aside from the Checkmate, erected mills from hurriedly prepared plans, seemingly under the impression that any mill would answer the purpose. This error seems to be an inherent quality in the conducting of operations among smaller mining companies. The building of a mill marks a critical point in the history of any mine. If the mine has been developed to the producing stage and the mill is not economically adapted to the ore, the final outcome is much the same as if a mill had been built with the expectation of later developing ore in the mine. The mines here have ore, but the general run of ore is not high enough in gold and silver to pay interest on capital invested in equipment necessary for concentration and shipment to smelters. Cyanidation is the logical and inevitable solution of this district's problem, and when the demand for the precious metals becomes more insistent, this district will be a producer.

HIGHLAND, WISCONSIN

ZINC-LEAD PRODUCTION DURING JUNE.—ZINC PRICES.—IRON PYRITE PRODUCTION.—CARBONATE OF ZINC ORES AND THE MINERAL POINT ZINC CO.—ZINC ORE OPENED AT THE CRAWHALL MINE.—PRINCIPAL PRODUCING MINES.—PROSPECTS OF THE DISTRICTS.

June reports at hand for the entire Wisconsin zinc-lead field show shipments to local ore-separating plants and smelters direct consisting of 288 cars of zinc ore, equal to 20,850,000 lb. Of this production, the Mineral Point Zinc Co. secured by purchase and production under company management, 4140 tons; Grasselli Chemical Co., of Cleveland, 2625 tons; National Separating Co., owned and operated by the Vinegar Hill Zinc Co., 990 tons; Illinois Zinc Co., Peru, Illinois, 675 tons; Matthiesen & Hegeler Zinc Co., 580 tons; Empire roasting plant at Platteville, 700 tons; Linden Zinc Separating Co., 450 tons; American Zinc Co., of Hillsboro, Illinois (new smelter), 245 tons; and the Joplin Separating Co., Galena, Illinois, 45 tons. The latter was purchased during the last week of the month and shows that the plant had resumed operation after a shut-down of 60 days.

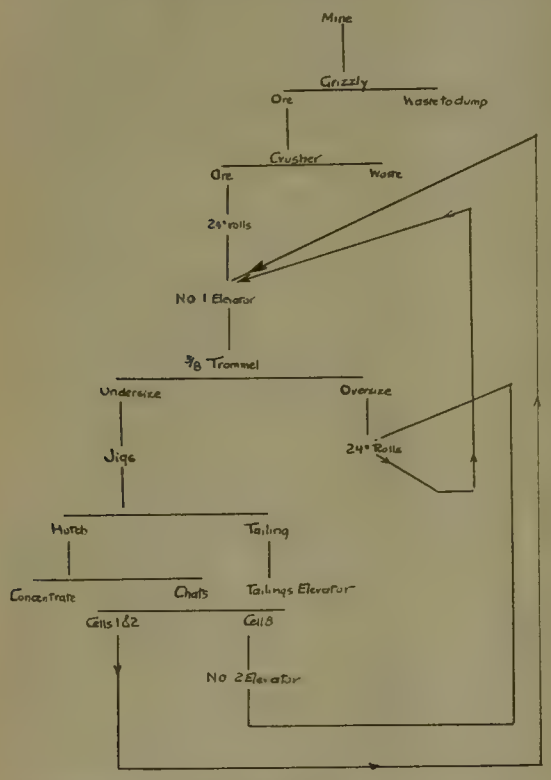
The gross production of zinc from mines during the month totaled 18,000,000 lb., and net to smelters of 13,345,000 lb. Prices averaged from $40 to $43.50 per ton, on a basis of 60% zinc content. The wide latitude between high-grade and low-grade zinc ore in this field makes the intervening markets interesting. The average 30% grades of zinc ore brought $16.50 per ton; 40%, $20 to $24 per ton; and 50%, $26 to $30 per ton.

Iron pyrite fell off considerably as compared with the output for May. The Wilkinson mine, at Benton, shipped 1,486,600 lb. to the General Chemical Co., Hegewisch, Illinois; to Grasselli Chemical Co., East Chicago, Indiana, 1,600,000 lb.; the Linden shipped 500,000 lb., and the National Separating Co. delivered 465,000 lb., a total of nearly 4,000,000 pounds.

Lead ore deliveries were made mostly to the Federal Lead Co., N. H. Snow, buyer, securing six out of seven cars sold during the month. The price remained steady at $52 per ton on a basis of 80% metallic lead. Considerable

lead ore and zinc ore are held in reserve at several points in the field.

Carbonate of zinc ore, locally termed 'dry-bone,' is being delivered at a good rate. The Mineral Point Zinc Co. paid as high as $22 per ton during the last two weeks of the month, a price never before reached in this district. This Company consumes about 200 tons of 'oxide-producing' ores each 24 hours, and is constantly in the market for this material. The carbonate of zinc ores are rich in oxides, and for this reason the Eastern corporation has practically bought up everything in the two northern 'camps,' Centerville and Highland. The Company now owns five mining plants fully equipped and will secure two more. In addition, fee to more than 2000 acres of land has been purchased outright, and all of this is to be prospected and mined. Officials from the head office of the Company, in New York, personally inspected the new holdings in this



FLOW-SHEET OF A 50-TON MILL WITH 8-COMPARTMENT JIG, WISCONSIN.

district during the last week of June, and stated that operations will be started all over the properties. This means that several hundred miners will be employed in the mines already developed; that a great deal of new machinery will be installed, and that several new buildings will be erected at once. These developments are leading to one of the greatest mining booms ever experienced in the northern half of the Wisconsin zincfield.

R. W. Hunt & Co., engineers, for the Fields Mining & Milling Co., recently made one of the best finds of zinc ore, in the Crawhall mine at Shullsburg, which has as yet been reported in this district. The discovery was made on the Thompson land adjoining the Crawhall farm, from which the owner has been drawing $5000 per month royalty. The Company has been paying monthly dividends of $28,500. The ore is declared by officials of the Company to exceed in richness and quantity the deposits proved with drill in the early stages of development on the Crawhall land.

The O. P. David mine was the principal producer in the Montfort district. At Mifflin, the Coker, Ellsworth, Rundel, Peacock, and Lucky Six mines furnished the bulk of the ore. At Linden, Ross Bros., Glanville, Optimo No. 1 and 2, and the Hinkle and Weigle mines were the active producers. The East End mine at Platteville made the best showing; while the Klar-Piquette and Homestead mines both operated steadily, but stored their product in bins holding for better prices. At Cuba, the Burr mine produced 4 cars, and the National Separating Co. shipped 9 cars of roasted ores. At Benton, the Frontier, Fox, Fields, Indian Mound, Rowley, and Temple mines made good outputs. Shullsburg witnessed a heavy production in the Winskill, Rodhams, and Milwaukee-Shullsburg mines. Hazel Green reported its usual fine showing out of the Kennedy and the Cleveland and Scrabble Creek mines. Galena reported heavy deliveries of ore from the Federal, Northwestern, Betsy, Vinegar Hill, and Indianapolis mines. Highland reported light shipments of carbonate of zinc ore, with only 4 cars. A good deal of ore is ready for delivery here and at Centerville. No building is being done on the field, and drilling has lessened considerably since lower prices for zinc ore went into effect. Any improvement in the ore market will be reflected by an almost immediate increase in production.

NEW YORK

COPPER SITUATION AND THE NICHOLS REFINERY.—EARNINGS OF FEDERAL MINING & SMELTING CO. AND BUTTE & SUPERIOR. — CANADIAN NICKEL CORPORATION ORGANIZED IN LONDON.

A holiday on Friday in the summer reduces a New York business week to little more than three days. Early last Thursday the exodus began from the business districts, and on Saturday not even the department stores were open. This was not a matter of moment in the copper metal market, however, for no business had been done for some time before, small lots of copper changing hands at 14⅝ and 14¾c. per pound, and the large sellers holding firm at 15c. without any offers. It is hoped now that buyers will come back into the market after the Copper Producers' Association report is out on Tuesday. Exports during June are given at 27,315 tons, as compared with 26,457 tons during June 1912. The Nichols refinery has been out of the producing list ever since the beginning of the strike there, so that deliveries will be correspondingly decreased for this month. The foreign market, which has been chiefly responsible for the good statistical position of the metal, has struck a snag in the renewal of war in the Balkans, with an even better chance than before that the leading powers may become involved. Aron Hirsch & Sohn began offering September copper in London at lowered prices, though the cables do not give the exact figures. The report has been circulated that a Boston operator has formed a syndicate to engineer a slump in metal prices. The foreign statistics are good, the fortnightly British report showing a decrease of 4,000,000 lb. in stocks. The visible supply in England, France, and afloat thereto was 28,142 tons on July 1, a new low level for recent years, and stocks at Hamburg, Bremen, and Rotterdam shrank to 10,054 tons. But no amount of favorable statistics serves to alter the fact that consumers are not buying and do not seem to care what stocks are.

The shut-down of the Nichols refinery means that about 1,000,000 lb. per day is being kept off the market, and the management has at least room to congratulate itself that its difficulties coincide with a non-existant market, rather than one in which copper is in brisk demand at 16 or 17c. per pound. Exports from the United States for the half year ended June 30 are given as 193,936 tons, a new high record which exceeds the figures for last year by over 21,500 tons.

Net earnings of the Federal M. & S. Co. for its third quarter, ended May 31, are given as $204,000, the earnings for the 9 months being $724,000, or $4000 above the sum required for a full year's dividends on the present 6% basis. Butte & Superior made earnings of over $60,000 in June, according to a report from Butte, where D. C. Jackling is quoted as saying that the mill recovery was slightly over 90% in June and that the second section will be completed soon. Tonopah Belmont reports earnings of $481,831 for the quarter ended May 31, and a total net income of $493,707.

An important new company which has been launched in

Montreal and London is the Canadian Nickel Corporation, Ltd., which has issued $10,000,000 worth of 6% debenture stock and $20,000,000 in common stock. The Company has acquired 17,500 acres of mining property in the Sudbury district, and announces that it will mine 540,000 tons per year at a cost of $6.60 per ton for mining and treatment, extracting an average of 30 lb. of nickel, 12 lb. of copper, and $1 worth of precious metals per ton of ore, thus making a profit of $2,678,400 per year. This all reads very well, but it would be useful to know how many tons of ore are available and how certain are processes of treatment. It has been understood that the Hybinette process was to be employed, but recent reports appear to be adverse to the success of this process, and the International Nickel Co., which has so far controlled the nickel market, does not show any signs of worry as yet.

BOSTON

Butte & Superior and Elm Orlu Extralateral Rights.—Lake Copper Co.—Leaching Nevada-Douglas Ores.—Boston & Corbin Company.

The principals of the Butte & Superior and Elm Orlu properties in the northern part of Butte are trying to avoid litigation over extralateral rights. W. A. Clark has had Walter Harvey Weed, and the Butte & Superior has had J. W. Finch examining the ground, with the view of reaching a basis of settlement. One report stated that the Butte & Superior company would buy the Elm Orlu property, but this was denied by the former interests. It is believed in Boston that, while the feeling between the two parties may not be any too cordial, there is a disposition on both sides to avoid a lawsuit.

Thomas T. Read, associate editor of the *Mining and Scientific Press*, whose offices are in the Woolworth building, New York, has been in Boston during the past few days meeting a number of people connected with the Lake Superior copper mines. Much interest is expressed here in the forthcoming visit of Mr. Read to the Lake district, where he will make a study of conditions. There are persistent rumors of a possible Lake Copper Co. and South Lake Mining Co. merger. Recently, on account of the slump in the former, the two stocks, with the regulation Michigan capitalization of 100,000 shares each, have sold within a fourth of a point of each other. J. R. Finlay, three years ago, gave the Lake mine a valuation of $3 per share, and questioned the prospect of it ever paying a dividend. It is stated that a veteran mining magnate of Utah became so certain of the prospects of Lake when the stock was selling up in the eighties, that he bought $300,000 worth of it. One strong point in the Company's favor is that it still has $22 per share callable on assessments. But this is a bad time to realize on assessments. In the fall of 1910, a banking house here underwrote 1000 shares at a price which netted $26,990. Yet a big fuss was raised about the brokers getting the stock too cheaply. When the Lake Copper Co. was organized 55,000 shares went to the original holders of the land, and 15,000 shares were sold at $3 each. Later, rights to 10,000 shares were awarded to stockholders at $6. Then, in order to continue development work, 2000 shares were sold at $25 each. Two thousand shares were afterward sold at $41, and 1000 shares at $51 to $53. Four years ago conditions at the Lake mine were such that the best Boston authorities were willing to commit themselves incautiously to extravagant statements about its prospects. Less than a year ago the leading financial paper here, in answering a far Western correspondent, said: We believe that purchases of Lake Copper shares around 37 will prove to be profitable, provided that you have patience. The same paper pointed out in March 1910 that Lake had a chance of becoming the largest dividend-payer in Lake Superior, next to Calumet & Hecla.

The neatness and dispatch with which the reorganization of Boston & Corbin has been effected is still the subject of comment in Boston. Notwithstanding dullness and distrust, 89,250 shares were taken over in the reorganization, leaving the underwriters with 10,000 shares.

VANCOUVER ISLAND

Revival of Metal Mining.—Ptarmigan Mine.—Tyee Smelter to Resume Operations.—West Coast Districts.—Coal Mining and Labor Situation.

For the past several years the mining industry on Vancouver island has been confined to coal mines. Previous to 1908 the Tyee, Lenora, and Richard III properties were in active operation at Mount Sicker, and between the years 1900 and the fall of 1907 these three properties had produced about $2,500,000, the ore averaging about $3 gold, 4 oz. silver per ton, and 5% copper.

There are indications now that metalliferous mining will take a new lease of life on the island, and several of the partly developed prospects can and will be reopened by companies having ample capital and managed by mining engineers possessed of the experience and energy necessary. The resumption of work is being shown by the operations at present going on near the head of the Great Central lake on the Ptarmigan mining property, which is the same as that originally located as the Big Interior. When this property was opened in 1899, the facilities for transportation were different from what they are now;

MAP OF BRITISH COLUMBIA.

in fact, a rough prospector's trail about ten miles in length, over which a man had to pack all his supplies on his back, was the only means of approach from the Great Central lake, in the interior of the central portion of Vancouver island. From that point to Alberni, on the west coast, the means of transport were also of the crudest, so that unless the ore had been of an exceptionally high grade, it was impossible at that time to undertake serious development. But today, with a good wagon-road connecting Great Central lake with Alberni, and an aërial tramway connecting the mining property with the head of the lake, warrants opening this property and shipping the ore, even though it be low grade.

At Alberni the shipper has choice of two routes to the smelter, either by water or by the Canadian Pacific railway. H. H. Johnson, manager for the Ptarmigan Mines, Ltd., of Victoria, is at present at the property, and is arranging for the erection of the aërial tramway that served the Tyee Copper Co. in transporting the ore about four miles from the Tyee mine to the siding of the E. & N. railway, which was taken down some time ago.

It is reported on reliable authority that, on the return of W. J. Watson, manager of the Tyee smelter, from England, the plant will be blown in again in the near future. In fact, at the present time workmen are renewing the piling at the smelter's dock, and preparations are

being made in a quiet way to have the plant in readiness for operation. It is proposed that ore from the Ptarmigan mine will form a nucleus for the supply to the smelter, and from reliable information it is figured this property should furnish a large tonnage of ore of medium grade

There are on the west coast of Vancouver island, in the mountains adjacent to Clayoquet, Kyoquot, Nootka, and Quatsino sound, quite a large number of occurrences of copper-bearing ore discovered in 1898 and 1899, that have never been developed beyond the assessment-work stage, sufficient to 'crown grant' the properties. From several of these during that time I obtained samples from outcrops and shallow prospect holes, that carried from 5 to 10% copper. Because of lack of capital and transportation, high smelter rates, and the further fact that, on the Alberni canal, two properties which had considerable capital expended in development, which did not result satisfactorily, that portion of Vancouver island has since been neglected, but really presents an attractive field for further prospecting.

The situation with regard to coal mining for the past seven months has been anything but satisfactory. In the first place, a strike occurred at the mines of the Canadian Collieries (Dunsmuir), Ltd., and about two months ago, when this had become practically settled, and the company was able to mine a normal tonnage from its Cumberland mine with non-union men, the United Mine Workers of America called a strike at Nanaimo in the mines operated by the Western Fuel Co., notwithstanding that the majority of the miners working for the Company were not members of the U. M. W. A., and that they were all working on an agreement with this Company which does not expire until next September. To a disinterested person, it appears that the main result from these labor troubles has been to enable the operators in the state of Washington to work to full capacity in order to furnish the markets heretofore supplied by the Vancouver island collieries, and, besides, to place the miners in a position where they draw strike pay from the union instead of their regular wages from the collieries. Recently members of the Vancouver Board of Trade tendered their good services in an effort to settle the differences between the colliery companies and the miners. This attempt was futile because the Canadian Collieries (Dunsmuir), Ltd., was operating its Cumberland mines to the extent of mining about 2000 tons of coal per day, and, although the Company was not operating at the Extension mines except in a small way, it did not recognize the existence of any strike, while the Western Fuel Co. declined the services of the Vancouver men on the ground that the miners had broken their contract, and so far as the Company was concerned there was nothing to arbitrate. The daily papers announce that the Hon. T. W. Crothers, Minister of Labor in the Dominion Government, is on his way to Vancouver island to investigate the labor conditions, and it is earnestly hoped that his efforts to bring employers and employees together and settle the present difficulties will be successful. There has been almost an entire absence of the scenes and acts of violence which usually accompany labor troubles. In fact, when the strike was first called, opinion generally expressed was against the action of the men, and especially with regard to breaking their contract, when they acknowledged they had no cause for complaints against the Company. Apparently it was purely and simply a case of a small minority who were members of the U. M. W. A. influencing the majority who were non-members by the fear of being called 'scabs.' The latest report is that miners are coming from England, and almost daily new arrivals reach the works on the Canadian Collieries (Dunsmuir), Ltd., and start work. The mines of the Western Fuel Co. at Nanaimo, Pacific Coast Coal Co. at South Wellington, and the Vancouver Nanaimo Coal Co. at the Jingle Pot colliery near Nanaimo, which includes all the collieries in that portion of the island except the Extension, are shut down, owing to the strike, while at the Extension a few men are working. Whether any attempt will be made to operate there with an increased force is not yet known.

KALGOORLIE, WESTERN AUSTRALIA

FEELING AS REGARDS THE MINING INDUSTRY—SONS OF GWALIA AND GREAT FINGALL MINES.—FRASERS GROUP AND DIAMOND-DRILLING.—BULLFINCH AND VICTORIOUS DEVELOPMENTS.

W. J. Loring, head of Bewick, Moreing & Company, has just visited this state after an absence of three years. He was quite optimistic regarding the possibilities of gold-mining, and said that he could not understand why so many people were the reverse. He was enthusiastic regarding the deep developments on the Sons of Gwalia and the Great Fingall Consols. At the former property he stated that, in addition to the $75,000 expended on new plant during 1912, another $50,000 would be spent during 1913 and 1914. Wood-burning suction-gas generators had proved so economical at the Queen of the Hills at Meekatharra that his firm would gradually supersede steam-engines for driving treatment plants on all its mines. Developments at the Sons of Gwalia were highly satisfactory, and production and dividends could be maintained at their present rate for 3½ years, while the alterations were being made. With regard to the Great Fingall, the equipment of the internal shaft at No. 13 level would be completed by September, when ore down to No. 18 level would be available for the mill. The new ore-shoot at No. 17 and 18 levels has been proved for a length of 400 ft. to be worth $10 to $12.50 per ton, averaging 8 ft. wide. Referring to the volatilization process of gold saving introduced on the Gwalia Consols by Ben Howe, Mr. Loring was satisfied that it would solve the difficulty of treatment of refractory ore containing arsenical pyrite and antimony, which has been the bugbear of the Gwalia Consols, Lancefield, and Transvaal mines, which have not been satisfactory for several years.

While at Southern Cross, Mr. Loring took an option on the Frasers group of mines, which have been practically at a standstill for a dozen years. On the strong recommendation of the government geologist, Harry P. Woodward, backed by the Government mining engineer, A. Montgomery, the Minister for Mines, P. Collier, offered to subsidize any local syndicate and supply a diamond-drilling plant and a supervisor to test the line of lode by a series of 10 bores to depths down to 1000 ft. This work was started in January, and the first bore has been completed. The cores from 538 to 542 ft. assayed $21 per ton, and from 958 to 976 ft. cut a second lode which showed visible gold at 968 ft., but assays have not yet been published. Mr. Collier has promised Mr. Loring that if the latter can raise the money to sink a shaft and develop at 1000 ft., the Government will subsidize the venture to the extent of $30,000. The mines have already produced $3,625,000 from 325,000 tons, and the deepest workings are only 366 ft. deep, and little work has been done at that depth. There are three lodes in the property, but only one has so far been developed. The ore-shoot has yielded ore for a length of 4000 ft. and a width up to 20 ft. This seems to be a most promising venture, and may lead to this state being more exploited by capitalists in the future than in the past.

Detectives have failed to find any clue to the robbers who stole $15,000 worth of retorted gold from the smelting-room of the Bullfinch mine. The carelessness of the management may be gauged from the fact that with nearly $75,000 of gold amalgam and precipitate to be treated, the three men held up by the robbers only earned $2.70 per day each. The mine is looking well, and development is being done on five different lodes, stoping covering a width of 15 to 60 ft. The plant is being increased by an additional 5 stamps and a tube-mill. Fred Morgan, the manager, states that he could easily provide ore for double the capacity of the mill. When the present plant is complete, 6000 tons per month will be treated, and a minimum profit of $50,000 per month will be made. The winze in the Associated Northern-Victorious leases at Ora Banda are now down as follows: No. 1, to 45 ft., averaging $10.25; No. 3, to 49 ft., averaging $34; and No. 4, to 55 ft., averaging $33 per ton. At a depth of 25 to 30 ft., telluride was showing in both No. 3 and No. 4 winzes at the junction of the oxidized and sulphide zones, but did not continue.

General Mining News

ALASKA

JUNEAU

Though the chief object of the Alaska Gold Mines Co. is to prepare the mine for production, the work has disclosed some interesting developments. It will be recalled that the Alexander level is being continued east at an average depth of about 1500 ft. Cross-cuts from this, through the orebody, which are being driven every 200 ft., continue to show that the Company will develop from a point about 2000 ft. east of the cross-cut, and for a distance of at least several hundred feet, a body of ore, averaging higher in grade than the estimated average of the mine. Even a small body of ore of such a grade as indicated in these cross-cuts, that is assaying over $3 per ton, as against the estimated average of $1.50 for the whole mine, would do much to 'sweeten' the average of the whole. General construction work in all departments continues at a satisfactory rate. The cement for the dam is arriving by this time; the cement work-house above the dam is practically built, and plans for the upper power-house are almost finished. On the Sheep creek division, work continues on the re-location of the railroad; bunk and mess-houses are practically completed; the tunnel, which, it will be recalled, cuts the deposit about 700 ft. below the Alexander level, and will be the main extraction way, keeps up its rapid driving of over 500 ft. per month.

NOME

A new dredge of 1¼-cu. ft. capacity close-connected buckets is being installed at the mouth of Peluk creek. It will be equipped with certain improvements adapting it for beach dredging, and is the second to be erected here by the American Dredge Building & Construction Co. Probably a dredge will be erected this season on Hastings creek, above Saunders creek, and another on Sunset creek. A new interest is being awakened in this branch of mining.

ARIZONA

COCHISE COUNTY

At the Calumet & Arizona smelter the total production for June was 4,400,000 lb. of copper, a decline of more than 500,000 lb. During the latter part of the month the old smelter plant was entirely shut down and the second of the new blast-furnaces blown in. Both the furnaces are handling about 1400 tons of ore daily. Three converters are in use in the new plant. The work of clearing the ground around the old plant, preparatory to dismantling it, has been started.

GILA COUNTY

(Special Correspondence.)—The men employed on the transmission line between the Roosevelt dam and Superior by way of Miami, consisting of about 25 white men and 75 Indians, are now at the head of Queen creek box cañon, a mile from Superior. As the concrete foundations for the towers are laid, a road gang makes a four-foot trail at a wagon grade, and slight widening of the trail in the future will transform it into an excellent wagon-road. This will fill in the gap between Iron's ranch and the town of Superior, thus placing Globe, Miami, Superior, Florence, and all the intermediate towns and mining camps on a direct line of communication, besides bringing Ray and vicinity into closer relation with the Miami mining district. When the electric transmission line reaches Superior, it may be considered feasible to build a branch line to the Calumet & Arizona property 2½ miles south, whence a transmission line leads to Winkleman, where the power is generated. With such an arrangement, temporary disability at either the Government plant at Roosevelt, or the Ray Consolidated power-plant at Winkleman, could be relieved at the other end. A recent report of a discovery of great richness in Powers gulch seems not to be borne out by subsequent investigation. Beaudelaire, who brought the ore to Globe, where assays showed 1700 oz. silver and $200 gold per ton, did not claim, as reported, that he had any quantity of the ore, which was a small picked sample.

Miami, June 30.

PIMA COUNTY

The Calumet & Arizona Mining Co. has purchased the Cornelia mine, which will probably be worked by steam-shovels.

YAVAPAI COUNTY

At the Arkansas & Arizona mine, in the Jerome district, three new 150-hp. boilers and a hoist with 2000-ft. capacity are being installed. The cross-cut on the 800-ft. level of the United Verde is near the point where it will be cut by the new shaft. Good orebodies have been opened recently in the Copper Basin mine, near Prescott. This is controlled by Phelps, Dodge & Co. New machinery is being erected for the mill at the Y-P mines, near Senator, and stamps are now ready to begin work. The 800-ft. tramway from the dump to the plant is nearing completion. About 10,000 tons of ore accumulated from former operations will be treated.

CALIFORNIA

AMADOR COUNTY

At the Argonaut mine, a drift from the 3900-ft. level has been extended 300 ft. into rich quartz. The May clean-up was about $50,000. The Wildman-Mahoney property will probably be sold to an Eastern syndicate.

BUTTE COUNTY

The Drexler dredge is doing good work near John Adams, and the White ranch is to be dredged shortly. A shaft is being sunk to open gravel at the old Hendricks property at Thompson's Flat, near Oroville. A 15-hp. gasoline hoist has been installed.

CALAVERAS COUNTY

Rich ore has been opened in the Tanner mine, and attention is being directed to the east side gold belt near Murphy's. The 60-stamp mill of the Lightner company is being overhauled.

NEVADA COUNTY

F. M. Spaulding, of Los Angeles, has completed arrangements for reopening the old Richlan gravel mine on Wet hill. The lease of the old company has been taken over by the Major Gold Mining Co. A new shaft will be sunk to open the channel, and it is estimated that it will have to be sunk about 150 ft. to reach the gravel. The new shaft will be near the old Empire shaft on the Ragon place through which $300,000 was taken out. The new company owns about 7000 ft. along the Manzanita channel.

PLACER COUNTY

Representatives of the Guggenheim interests have men at work at Poverty Bar, near Butcher ranch, to ascertain whether the gravel is sufficiently rich to warrant the purchase of the property. They have an option until August 1. The company owning the property has stopped work on the gold dredge for the present.

SANTA CLARA COUNTY

(Special Correspondence.)—It is expected that changes in management of the Quicksilver Mining Co. will lead to a vigorous attempt to rejuvenate the famous old New Almaden mines. C. A. Nones, who as president has been in control for several years, has been removed and W. H. Landers has been appointed manager. The Company has paid no dividends for some time, and it is now reported that it was kept going by sale of farm lands. A serious shortage in accounts is alleged against the old management. In the meantime, Mr. Nones has been declared bankrupt. Some months since, the stockholders formed an insurgent committee and, acting for them, a careful report upon the property was made by Mr. Landers, assisted by Clifford G. Dennis. The old mine has been worked to a depth of 2400 ft. and has yielded handsomely, though of recent years the grade has been extremely low; roughly ½%. While extensive tracts of mineral-bearing land are owned, there has been little effort to develop new orebodies, and there is practically no ore in sight. About 4½ miles north are old workings from which at one time quicksilver to the value of $60,000 was won, and in the ground be-

tween them are abundant evidences of mineralization, and many small abandoned workings. Mr. Landers has recommended that serious efforts be made to reopen some of this ground. When the old workings were abandoned, 1½% constituted the lower workable limit of ore, and it would certainly seem probable that since ½% ore has paid a profit for some years, it is worth an effort to reopen the ground. One curious and exasperating difficulty is the presence of carbon dioxide, but it is expected that means will be found for meeting this difficulty and the mine will again become an important producer.

San Jose, July 7.

SHASTA COUNTY

The Noble Electric Steel Co. is employing 50 men, and the furnace is producing 25 to 30 tons of iron per day. Coke is now being used instead of charcoal.

SIERRA COUNTY

Since the vein was cut in the North Fork mine, it has widened from 2 to 13 ft., and is all payable. The drift will soon be under the rich shoot opened many years ago. At the Tightner, a shaft is to be sunk from the lower adit, on one of the rich ore-shoots. Active development is under way at the Wisconsin gravel property near Forest City.

SISKIYOU COUNTY

It is stated that the Blue Ledge copper-gold property, near the Oregon line, has been sold to New York people. The Osgood quartz claims and the Nigger Boy mine, on Ash creek, have been acquired by Oregon and Ohio people.

TRINITY COUNTY

The Trinity Consolidated Hydraulic Mining Co. is operating a large force of men at both the Union Hill and Hupp hydraulic mines.

YUBA COUNTY

The Elks Gold Mining & Milling Co. has secured a two years' lease of the properties of the Red Ravine Mining Co., near Indian ranch. New machinery is to be installed and active work will commence early in August.

COLORADO

PUEBLO COUNTY

The Colorado Fuel & Iron Co. will increase its equipment of electrical apparatus by the addition of 200-kw. and 300-kw. rotary converters, a 50-hp. motor, three 110-kva. and three 150-kva. transformers, and switchboard panels and accessories. The apparatus will be furnished by the General Electric Company.

TELLER COUNTY (CRIPPLE CREEK)

According to local statistics, the gold production was as follows:

	Tons.	Av. val.	Gross val.
Golden Cycle, Colorado City	34,000	$20.00	$ 680,000
Portland, Colorado City	9,950	22.00	218,900
Smelters, Pueblo and Denver	3,850	65.00	250,250
Portland, Cripple Creek	13,600	3.00	30,800
Stratton's Independence	11,800	2.36	27,848
Colburn Ajax	4,245	2.59	11,674
Gaylord Dante	1,800	3.00	5,400
Kavanaugh-Jo Dandy	1,500	2.30	3,450
Wild Horse	1,300	3.20	4,160
Isabella	625	2.00	1,250
Total	82,670		$1,233,732

El Paso company and lessees shipped 100 and 48 cars of ore, respectively. The Cresson mine, on Raven hill, produced about 4000 tons. Eight sacks of ore, valued at $1000, were stolen from a freight car between Cripple Creek and Colorado Springs. Lessees at the Deadwood, Sitting Bull, Rising Sun, Vindicator, and W. P. H. properties are doing fairly well. An experimental cyanide plant is being erected at the Vindicator to treat dump ore. The flow of water from the Roosevelt tunnel is now 6735 gal. per minute. The recession during June was about 72 in., and water-level is 30 ft. below No. 11 level of the Gold Coin shaft.

THE SAN JUAN

Ore and concentrate shipments from Ouray during June were as follows: Camp Bird, 650 tons; Wanakah, 650; Atlas, 325; Bachelor district, 168; Jumbo, 24; Haagsma-Hall, 25; Revenue, Lannon lease, 48; and American Nettie, 23; making a total of 2011 tons.

Shipments from Silverton were as follows: (1) concentrate, Sunnyside, 318 tons; Iowa Tiger, 282; Vinyard & Co., 159; Frisco Tunnel, 232; and Gold King, 217; a total of 1708 tons; (2) crude ore, Gold Tunnel, 125; Celtic Leasing Co., 25; Dives, 132; So. Expl. & Mining Co., 306; Allerton, 65; Scotia, 44; Frank Hough, 40; Boston, 22; and Bazanella, 20; a total of 779 tons.

LOOKING TOWARD OURAY FROM CAMP BIRD MILL.

IDAHO

BLAINE COUNTY

Good ore has been opened in the Plughoff & Reed claims at Glendale. At one place it was cut after driving through 40 ft. of soft ground, and shows 7 ft. of silver-lead ore. Sixty feet west a shaft has opened more ore of a similar character. The vein is well defined, and so far is continuous for 70 ft., in granite country.

BONNER COUNTY

Nearly 100 men are employed now by the Idaho-Continental Mining Co. and work of preparing the ground for the concentrator at the mine and the power-plant, 14 miles beyond Porthill, is being rushed as rapidly as possible.

SHOSHONE COUNTY

(Special Correspondence.)—The worst mine cave-in ever experienced in the Coeur d'Alene has resulted in an almost complete shut-down of the Hercules. The collapse of the galleries took place on June 4, closing all the workings above the No. 4 adit. An effort is being made to resume operations in the levels from the winze, and some ore is being removed.

Operations at the mill of the Idora Hill Mining Co., on Sunset peak, in the Coeur d'Alene region, have begun. The mill is designed to handle 50 tons per day, but it is believed that the capacity will approach 100 tons when it is in full working order. The plant, and the tramway connecting the mill and the mine, are operated by electricity. Arrangements are under way for the consolidation of the Reindeer Copper & Gold Mining Co. and the Copper Queen

Mining & Milling Co., Ltd., whose respective properties adjoin, in the Coeur d'Alene. It is proposed to organize a new corporation with a capitalization of 2,000,000 shares.

Spokane, Washington, July 3

Fred T. Greene, an engineer for the Amalgamated Copper Co., of Butte, Montana, has made a report on the National copper mine, near Mullan. The report is as follows: Below present adit level, partly developed, 883,990 tons, valued at $910,066; probable ore, 875,400 tons, valued at $2,074,698; possible ore, 1,830,620 tons, valued at $4,338,569; total, $7,323,333. Above adit level, partly developed, 247,890 tons, valued at $587,499; possible ore, 207,520 tons, valued at $491,823; total, $1,079,321. This makes a total value of $8,417,890. A contract has been let for a 600-ft. raise from the adit, and should be completed by the time the mill is ready next February. A boarding and bunk house of 200 men capacity is being built. Charles McKinnis is general manager.

Early on July 4, somebody dynamited the flume of the Bunker Hill & Sullivan mill, tearing a hole 10 ft. wide on one side and causing a great loss of water. After an hour the water was shut off at the intake. No arrests have been made. The Snowstorm Mining Co. paid a dividend amounting to $22,500 on July 10, making a total of $1,169,617 to date.

MISSOURI

Lawrence County

The Grasselli Chemical Co. has awarded contracts for drilling 300 acres of its land near Statts City. At one time this property produced a good deal of ore from shallow depths, and now the deeper levels will be prospected.

MONTANA

Jefferson County

(Special Correspondence.)—A report is to hand that lessees at the Ruby mine, near Basin, have shipped four carloads of ore valued at $120,000. This was mined by driving a short drift in new ground from old workings. This mine formerly was a good gold producer, and was bonded to P. H. Dowling by W. A. Clark about six years ago. The former soon paid off the bond of $75,000, and recently leased the property to some Butte miners, who opened this rich ore.

Basin, July 5.

Silverbow County

(Special Correspondence.)—The usual quarterly dividend of the Tuolumne Copper Mining Co. was not declared, as profits were not sufficient to justify paying out $80,000. The property is a small one, but is surrounded by good mines. At a meeting of the directors the superintendent stated that a rich shoot had been opened on the 2200-ft. level. It is 8 ft. wide and assays 7 to 12% copper. In the southeastern part of the district about 1100 acres of ground have been acquired by one of the leading companies at a cost of over $1,000,000.

Butte, July 5.

NEVADA

Churchill County

During May the Nevada Hills mill treated 4260 tons of ore averaging $12.45 per ton, with a residue loss of $1.56 per ton. The total recovery was $46,403, at a cost of $28,345, leaving a profit of $18,057. There is $30,000 owing to the bank, while cash, supplies, concentrate, and absorption in plant are valued at $110,000.

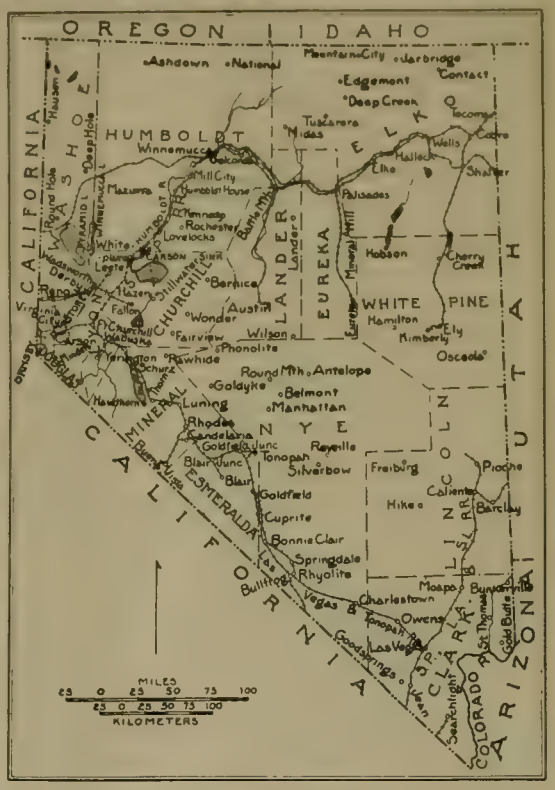
Elko County

(Special Correspondence.)—At the Bluster mine, timbering heavy ground has been completed, and development is again under way. At a point in the vein 225 ft. south of the main cross-cut adit the drift was driven on what was supposed to be the foot-wall. It was opened at this point and ore averaged $30 per ton across 3 ft. About 3300 ft. of work has been done in the mine. At the Flaxie a drift from a depth of 53 ft. in the winze is out 30 ft. in good ore. Specimen ore has been opened in the Buckeye. Fair developments are reported from the True Fissure and Stormy groups.

Jarbidge, July 8.

Lyon County

(Special Correspondence.)—Reports from the superintendent of the Nevada-Douglas mine continue to be encouraging. The 700-ft. level in the south end of the Ludwig has been driven for the last 50 ft. in ore which averages about 15% copper, and some specimens of metallic copper are being obtained at this point. On the sixth level a big tonnage of high-grade ore is being stoped, and it is hoped to open an extensive orebody at this point. On the 100-ft. level the drift which is being driven to the north beneath the wide gossan outcrop is looking favorable; the last 20 ft. has been driven through leached gossan which widens out as the breast advances. There is every probability of finding a good-sized body of ore of a secondary nature below. A small force of men has been put to work in the Casting Copper adit, and shipments from there will be resumed. The proposal to build a smelter for the Nevada-Douglas has been definitely abandoned, as the experiments with leaching



MAP OF NEVADA.

made by the staff have resulted so favorably that W. L. Austin was engaged to study the problem, as well as similar work elsewhere. Mr. Austin has reported that while mechanical difficulties are being experienced in leaching work at the Bullwhacker and Butte-Duluth, there is every probability that they will be successfully overcome and that leaching by means of sulphuric acid can be done on these ores at a cost not to exceed 10c. per pound. The ore, crushed to 16 mesh, will be leached with a 12% solution of sulphuric acid, giving a 90% extraction, the copper being precipitated from the solution by electrolysis. It is the intention of the management to proceed with the construction of a leaching plant, and the ore in the Douglas Hill group will be treated in this way.

Mason, July 3.

During the week ended June 2, the Mason Valley smelter treated 4422 tons of ore, and shipped seven cars of matte. The Oakland Copper Bell has opened 5 ft. of ore. Ore on the dump averages 7% copper, 5 oz. silver, and $2.50 gold per ton. At the Yerington mountain, the shaft to connect No. 3 and 4 adits is down 600 ft. Regular shipments are made to the smelter. A gasoline hoist has been installed at the Blue Jay.

Nye County

The *Tonopah Miner*, which is now in its twelfth year of publication and has always been optimistic about Tonopah mines, states that the gross production of the district for the first half of 1913 was $1,210,889. During the week ended July 5 the output of eight mines was 11,715 tons valued at $259,345. On the 750-ft. level of the new shaft the Tonopah Extension has opened a new vein in the north cross-cut. So far it is of a low-grade character. The south cross-cut on the Montana-Tonopah 55-ft. level went through 12 ft. of quartz, showing good ore in places, and is thought to be a faulted portion of the south vein. The Halifax 1000-ft. level has cut some rich veins of sulphide ore. On the 1166-ft. level of the Belmont, the north cross-cut opened the western extension of the shaft vein 375 ft. west of the other shoot being developed on this level.

At Manhattan the Big Four is producing about 100 tons per day, but this will be increased when the conveyor is installed to handle the reject from a trommel working below the crusher. This will act as a sorting station and prevent waste going to the stamp-mill. The lessees at the White Caps are still shipping high-grade ore to Tonopah. The Earl claim of the Brady leases is improving on the 350-ft. level.

Storey County

It is probable that a 50-ton plant consisting of Kinkead crushers, amalgamating plates, and concentrating tables will be erected on Cedar Hill to treat ore from the Sierra Nevada property. Walter Techow, of the Kinkead Milling Co. and Ophir cyanide plant, will be in charge.

White Pine County

One round of shots in the Morris and Bunker Hill mines of the Giroux company, at Ely, is said to have broken down 30,000 tons of ore. As a result the operating force was reduced by laying off about 125 men. Until now, it is stated that while the mines have been producing 1000 to 1200 tons of ore per day, much of it has been taken out in further developing the ore deposit. Now the development has reached the stage where the best features of the caving system can be followed and cost of mining will be greatly reduced.

NEW MEXICO

The output of coal in New Mexico in 1912 was the largest ever made, according to the U. S. Geological Survey. The production increased from 3,148,158 short tons in 1911, valued at $4,525,925, to 3,536,824 tons in 1912, valued at $5,037,051, a gain of 12.3% in quantity and of 11.3% in value. In the Raton field, 11 mines produced over 100,000 tons each, two producing over 400,000 tons. The San Juan River field, in the northwest, has an area of 13,000 square miles.

Grant County

The Chino Copper Co. recently made an experimental shot in one of its open-cut mines at Santa Rita and the result was, it is said, entirely satisfactory. Three adits, some 10 or 15 ft. apart, were driven into the mine a distance of 45 ft., each connected at the ends by a drift about 50 ft. long. In this drift, near the end of each adit, 53,000 lb. of high-grade powder was packed. The blast was fired by electricity. This method cost between $7000 and $8000, but is expected to simplify mining there, where 90% of the ore can be moved by steam-shovel work.

OREGON

Jackson County

(Special Correspondence.)—A 20-ton mill is being erected at the Nellie Wright mine, in the Gold Hill district. It will be driven by electric power. The ore is worth from $9 to $18 per ton. The Blossom mine, in the same district, is opening well. The Cinnabar has been opened by two adits, driven to depths of 320 and 180 ft., respectively. Drifts from these have opened a large orebody, assaying high in mercury. The property is being examined by two engineers. After an idleness of 30 years the old Alice mine, on Kanes creek, is being reworked.

Philomath, July 4.

UTAH

Beaver County

The Majestic Mines Co. owns, near Milford, 25 claims containing copper and silver-lead ores. Monthly profits range from $3000 to $5700. The deepest shaft is down 600 ft., and has opened silver-lead ore 100 ft. below water-level. The shoot of copper ore in the Old Hickory is fairly extensive and contains about 75,000 tons. Shipments total 75 tons per day.

Juab County

For several months the Tintic Standard 1000-ft. level has been driven on a contact between quartz and lime, which was of an encouraging nature. Ore was cut, but gas drove the men out. The ore was rich in lead and silver. Similar ore has also been opened in a drift from a winze below the 1350-ft. level of the Eagle & Blue Bell mine. Work is to be resumed at the United Tintic, as the last assessment has been paid off the Company's debt, leaving a surplus for further work.

Salt Lake County

During the half-year ended June 30, 1913, the Salt Lake Stock Exchange dealt with 3,499,979 shares, representing a value of $833,763. These included 62 listed and 22 unlisted stocks.

High-grade silver-lead ore has been opened in the Graham lease of the West Toledo mine at Alta. A cave had been driven into 175 ft. from the mouth of an adit, and six inches of ore was exposed, which is figured to be an extension of the Toledo vein.

The Utah Consolidated Mining Co. has paid a dividend of 50c. per share, amounting to $150,000. The mine is opening well, and several new shoots of copper have been discovered. One is in the porphyry dike which divides a portion of the Highland Boy limestone. It is small but parts carry 10 to 15% copper. On No. 12 level, 2.4 to 3.4% copper ore is being mined. This mine is the largest lead producer in Utah, and lead ore shipments average 250 tons per day. The shoots, especially in Yampa limestone, are showing well.

Summit County

The Silver King Coalition Mines Co., Park City, will place in operation in its mines new 2½-ton and 3-ton electric locomotives and a 35-kw. motor-generator set ordered from the General Electric Co. The report of Frank Anderson, engineer conducting surveys for the Silver King Consolidated through the Silver King Coalition's workings, to ascertain if the latter Company has trespassed on the former property, has been returned to the federal district court. The engineer says that, to the best of his knowledge, the Coalition's workings do not enter the Consolidated's ground. This report is believed to be the ending of the present $750,000 trespass suit. The Consolidated officials say that they will go further down into their own ground and try to discover if there is evidence of trespass there. This work will take many months, as about 1800 ft. will have to be driven.

During the first half of 1913, the Park City district porduced 41,095 tons of ore valued at $1,643,800. Eight roasting furnaces are working at the Ontario mill, and 150 to 160 tons are being treated daily.

WASHINGTON

Stevens County

The president of the Chewelah Copper King Co., S. P. Domer, has denied that the mine has been sold for $350,000, but stated that negotiations are under way with the Granby company, of British Columbia. A recent shipment of ore to the Grand Forks smelter returned 8.65% copper and 41.6 oz. silver per ton. Electric power for the mine and mill of the United Copper Co., near Chewelah, will be available in about two weeks. At present, 100 men are employed. The adit being driven to cut the vein at a depth of 1000 ft., at a distance of one mile, is being pushed forward steadily. It is in 2500 ft., and 130 ft. was driven in June. The shaft is down 600 ft. An engineer for the Guggenheims has been examining the property.

MEXICO

COAHUILA

(Special Correspondence.) The condition of the northeastern states of Mexico, especially Coahuila, Tamaulipas, and Nuevo Leon, is as bad as could be. The federal troops are only holding the large towns and are trying to keep open a part of the railroads, meeting with indifferent success. A large percentage of the population of these states, especially the middle and lower classes, is against the present government of Mexico. Mining is almost at a standstill. The Mazapil Copper Co., operating the Coahuila & Zacatecas railway from Saltillo to Concepcion del Oro, in the state of Zacatecas, has been shut down since May 1. This includes mines, two smelters, and railway, throwing out of employment between 3000 and 4000 men. Conditions are steadily growing worse.

Saltillo, June 17.

SONORA

Mine shipments from Sonora during June came well up to the average, there being more than ₱2,000,000 worth of ore shipped into Arizona and Texas from various properties. As shown by the statement of the collector of customs at Agua Prieta, the June shipments were: Nacozari, 10,560 tons; Churunibabi, 1522; El Tigre, 92; Panama, 41; San Ygnacio, 21; Vaquero, 41; Sonora, 47; El Temblor, 22; and Alice, 27; making a total of 12,373 tons. El Tigre shipped 71 bars of bullion. Estimated values are as follows: Gold, ₱295,800; silver, ₱587,300; and copper, ₱1,168,900; a total of ₱2,052,000.

The wet and dry mills of the Calumet & Sonora mine are working two shifts. Ore is mined on the 400 and 500-ft. levels. The new crusher and sorting belt are working well. About 160 men are employed.

PERU

(Special Correspondence.)—Ferrobamba is shut down for the present. In the Department of Arequipa, many mining properties are of doubtful value, and difficulties in transport, labor, and laws are against good work. As far as the southern portion of Peru is concerned, a promising enterprise is the investigation of the great belt of Silurian slates, which extend from the west side of the main Andean range, to the north and east, in the direction of the Inambarri and Paucartambo rivers, where there are gold deposits of a good character.

Casilla, Arequipa, June 14.

The Borax Consolidated, Ltd., of London, England, has petitioned the Peruvian government for certain concessions in the Republic, in return for which the Company agrees to do the following: (1) Construct a railroad or aërial tramway from the borax and salt mines in the province of Moquegua, department of Arequipa, to the city of Arequipa; (2) install near the city or mines a plant to produce 40,000 tons of borax and over, as the demand increases; (3) transport from the mines to Arequipa 1200 tons of salt annually, and return with supplies for the employees of the Compañia Salinera del Peru; (4) erect telephone lines to the mines; (5) employ only Peruvians at their works; and (6) will spend £200,000 on the concession on these works. In return for these proposals, the Company asks that no export duty be placed on borax from the port of Mollendo for 18 years after work commences, all equipment to be imported duty free, and that the towns near the concession will not tax borax production for 18 years.

Schools and Societies

A number of students from the KANSAS SCHOOL OF MINES AND METALLURGY, accompanied by B. L. Wolfe, E. C. O'Keefe, and A. W. Young, inspected the mines, smelters, and mills in the mining district around Joplin, Missouri, and in southeastern Kansas during the first week in July.

The COLORADO SCHOOL OF MINES summer classes open on July 14 and will finish on August 23. There will be four instructors, and subjects include seven grades of mathematics, civil and mechanical engineering, chemistry, and metallurgy. Fees range from $4 to $15 per subject. It is proposed during the coming fall to have a short course in coal mining.

Personal

Professional men are invited to send news of their engagements and travels. Such news is interesting to friends.

WALTER OREM is in New York.

JAMES G. BERRYHILL was in New York recently.

STEPHEN BIRCH is at the Midas property near Valdez.

GRANT H. TOD is on his way to Seattle from Alaska.

A. K. MCDANIEL is making examinations in Alaska.

B. B. THAYER will leave New York for Butte on July 15.

F. W. BRADLEY left Juneau for San Francisco on July 10.

H. F. FAY has returned to Boston from the Lake Superior district.

H. ROBINSON PLATE is making a professional visit to Juneau.

LEVI HOLBROOK is ill with pneumonia at Cambridge, Massachusetts.

F. G. CLAPP sailed for Europe on June 24 for professional work in Hungary.

KIRBY THOMAS has returned from a professional visit to the Cobalt district.

JOHN A. THOMSON will leave Saltillo, Coahuila, Mexico, by way of Tampico, for the United States.

JOHN BAGLEY has been appointed by Governor Lister inspector of mines for the state of Washington.

E. J. VALLENTINE is on a six months vacation and expects to arrive in San Francisco on July 21, on his way from the Malay States to England.

C. H. FULTON and J. BURNS READ, of the Case School of Applied Science, who have been visiting the West, were in San Francisco last Monday.

H. H. ARMSTEAD, president of the Mexican United Co., has gone to Mexico to make an inspection of the Company's properties in Guanajuato, Jalisco, and Tepic.

C. M. EYE has been appointed superintendent of the American Girl mine, at Ogilby, California. Until further notice his professional address will continue to be at Ocean Park.

H. C. RAY, assistant professor of metallurgy at the University of Pittsburgh, Pennsylvania, is with the Butte & Superior Copper Co. of Butte, Montana, for the summer, in the experimental department.

J. B. LIPPINCOTT announces the opening of engineering offices in the Central building of Los Angeles. With Mr. Lippincott will be associated EDWARD R. BOWEN, who will specialize in steel and concrete structures.

E. T. CORKILL, chief inspector of mines for Ontario, has resigned his position to accept an appointment as safety engineer with the Canadian Copper Co., at Copper Cliff, Ontario. He is succeeded by T. F. SUTHERLAND, assistant inspector of mines.

Obituary

ROBERT PETTIGREW, one of the best known mining men in the state of Washington, died at his home at Roslyn on July 8.

JOHN A. KIRBY, one of the pioneer mining men of Utah and Nevada, died at Providence, Rhode Island, recently. Mr. Kirby was one of the best known mining engineers of the West, having been superintendent of the old Bullion-Beck mine at Eureka, Utah; also of the Daly West mine at Park City and of the Montana-Tonopah at Tonopah. He was one of the original owners of the Nevada Hills property and was one of the directors of this Company at the time of his death.

The Metal Markets

LOCAL METAL PRICES

San Francisco, July 10.

Antimony	12—12½c	Quicksilver (flask)	$41
Electrolytic Copper	16—16½c	Tin	50—51¢c
Pig Lead	4.60—5.55c	Spelter	7—7½c

Zinc dust, 1400 lb. casks, per 100 lb., small lots $9.50—9.75; large $7.50—8.50

EASTERN METAL MARKET.

(By wire from New York.)

NEW YORK, July 10.—Copper is weak and in little demand. Sales reported are of little importance. The greatly decreased stock reported by the Copper Producers' has had no immediate effect upon market conditions. Lead remains unchanged and but little business is being transacted. Spelter continues dull with no change in the market. On July 9, cables from London report copper as easy with spot at £62 10s. and futures £62 15s. Lead is quoted at £15 7s. 6d. and spelter at £20 7s. 6d. The tin market is easy with spot at £177 5s. and futures £178 5s.

SILVER

Below are given the average New York quotations, in cents per ounce, of fine silver.

Date.		Average week ending			
July	3	58.25	May	28	60.08
"	4 Holiday		June	4	59.99
"	5	58.25	"	11	59.75
"	6 Sunday		"	18	59.08
"	7	58.50	"	25	58.12
"	8	58.12	July	2	58.20
"	9	58.37	"	9	58.29

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	56.25	63.01	July	60.67	....
Feb.	59.06	61.25	Aug.	61.32	....
Mch.	58.37	57.87	Sept.	62.95	....
Apr.	59.20	59.26	Oct.	63.16	....
May	60.88	60.21	Nov.	62.73	....
June	61.29	59.03	Dec.	63.38	....

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.		Average week ending			
July	3	4.33	May	28	4.33
"	4 Holiday		June	4	4.33
"	5	4.33	"	11	4.33
"	4 Holiday		"	18	4.33
"	7	4.33	"	25	4.33
"	8	4.33	July	2	4.33
"	9	4.33	"	9	4.33

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	4.43	4.28	July	4.71	....
Feb.	4.03	4.33	Aug.	4.54	....
Mch.	4.07	4.32	Sept.	5.00	....
Apr.	4.20	4.36	Oct.	5.08	....
May	4.20	4.34	Nov.	4.91	....
June	4.40	4.33	Dec.	4.20	....

ZINC

Zinc is quoted as spelter, standard Western brands, St. Louis delivery, in cents per pound.

Date.		Average week ending			
July	3	5.10	May	28	5.19
"	4 Holiday		June	4	5.11
"	5	5.10	"	11	4.94
"	6 Sunday		"	18	4.90
"	7	5.10	"	25	4.97
"	8	5.10	July	2	5.07
"	9	5.10	"	9	5.10

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	6.42	6.33	July	7.12	....
Feb.	6.50	6.13	Aug.	6.96	....
Mch.	6.57	5.94	Sept.	7.45	....
Apr.	6.63	5.52	Oct.	7.36	....
May	6.68	5.23	Nov.	7.23	....
June	6.88	5.00	Dec.	7.09	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California, being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending					
June	12	41	June	26	41
"	19	41	July	3	41
			"	10	41

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	43.75	39.37	July	43.00	....
Feb.	46.00	41.00	Aug.	42.50	....
Mch.	46.00	40.20	Sept.	42.12	....
Apr.	42.25	41.00	Oct.	41.50	....
May	41.75	40.25	Nov.	41.50	....
June	41.30	41.00	Dec.	39.75	....

COPPER

Quotations on copper as published in this column represent average wholesale transactions on the New York market and refer to electrolytic copper. Lake copper commands normally from 1-5 to 1-4c. per lb. more. Prices are in cents per pound.

Date.			Average week ending		
July	3	14.35	May	28	15.43
"	4 Holiday		June	4	15.18
"	5	14.23	"	11	14.79
"	6 Sunday		"	18	14.70
"	7	14.23	"	25	14.47
"	8	14.23	July	2	14.43
"	9	14.23	"	9	14.25

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	14.09	16.54	July	17.19	....
Feb.	14.08	14.93	Aug.	17.49	....
Mch.	14.68	14.72	Sept.	17.56	....
Apr.	15.74	15.22	Oct.	17.32	....
May	16.03	15.42	Nov.	17.31	....
June	17.23	14.71	Dec.	17.37	....

COPPER SURPLUS

Figures showing the visible supply of copper at the beginning of each month are now widely available. Below are given the amounts, in pounds, known to be available at the first of each of certain months. The figures are those of the Copper Producers' Association supplemented by Merton's figures of foreign surplus.

		U. S.	European.
July	1912	44,335,004	107,817,920
August	"	50,281,280	113,285,760
September	"	46,701,376	112,743,680
October	"	63,065,587	107,396,800
November	"	76,744,967	103,803,840
December	"	86,164,059	96,949,440
January	1913	105,311,360	96,859,840
February	"	123,198,352	100,067,520
March	"	122,302,198	95,542,720
April	"	104,269,270	106,565,760
May	"	75,549,108	102,654,720
June	"	67,474,225	93,378,880
July	"	52,904,606	85,565,760

UNITED STATES PRODUCTION AND CONSUMPTION

		Production.	Domestic deliveries.	Exports.
May	1912	126,737,836	72,702,237	69,485,945
June	"	122,315,240	66,146,229	61,449,650
July	"	137,161,920	71,093,120	60,121,600
August	"	145,628,521	78,722,418	70,485,150
September	"	140,089,819	63,460,810	60,264,796
October	"	145,405,453	84,104,734	47,621,342
November	"	134,695,440	69,369,795	55,906,550
December	"	143,353,280	58,490,880	65,712,640
January	1913	143,479,625	65,210,030	60,383,845
February	"	130,948,881	59,676,402	72,168,623
March	"	136,251,849	76,585,471	77,699,306
April	"	135,333,402	78,158,837	85,894,727
May	"	141,319,416	81,158,800	68,286,007
June	"	121,860,853	68,452,572	68,067,901

The fortnightly statistics of copper show that the European stocks, including Hamburg and Rotterdam, on June 30 decreased 1727 tons, while copper supplies afloat decreased 50 tons, making a total decrease in the visible supply of 1777 tons to 38,199 tons, as compared with 39,976 tons on June 14 last.

TIN

New York prices control in the American market for tin, since the metal is almost entirely imported. San Francisco quotations average about 5c. per lb. higher. Below are given average monthly New York quotations, in cents per pound:

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	42.53	50.45	July	44.25	....
Feb.	42.96	49.07	Aug.	45.80	....
Mch.	42.58	46.95	Sept.	48.64	....
Apr.	43.92	49.00	Oct.	50.01	....
May	46.05	49.10	Nov.	49.92	....
June	45.76	45.10	Dec.	49.80	....

The Stock Markets

SAN FRANCISCO STOCKS AND BONDS.

(San Francisco Stock and Bond Exchange.)

BONDS.

Listed.	Closing prices, July 9	Unlisted.	Closing prices, July 9.
Associated Oil 6s	98½	Natomas Dev. 6s	94
E. I. du Pont 4½s	83½	Pacific Port. Cement 6s	90
Natomas Con. 6s	90	Riverside Cement 6s	77
Unlisted.		Standard Cement 6s	91½
Associated Oil 1st ref	80	Santa Cruz Cement 6s	80
General Petroleum 6s	89	So. Cal. Cement	70

STOCKS.

Listed.	Closing prices, July 9.	Unlisted.	Closing prices, July 9.
Associated Oil	38½	Mascot Copper	1½
Amalgamated Oil	—	Noble Electric Steel	3
E. I. du Pont Powder pfd	—	Natomas Consolidated	—
Pacific Coast Borax, pfd	90½	Pacific Coast Borax, old	—
do com	—	Pacific Portland Cement	59
Pacific Crude Oil	35c	Riverside Cement	45
Sterling O. & D.	1.05	Standard Cement	17
Union Oil of Cal	73½	Standard Oil of Cal	—
West Coast Oil, pfd	90	Santa Cruz Cement	37½

NEVADA STOCKS

(By courtesy of San Francisco Stock Exchange.)

San Francisco, July 10.

Atlanta	$ .15	Mizpah Extension	$ .46
Belmont	6.07	Montana-Tonopah	1.02
Big Four	.40	Nevada Hills	.92
Buckhorn	1.30	North Star	.95
Con. Virginia	.10	Ophir	.16
Florence	.34	Pittsburg Silver Peak	.45
Goldfield Con	1.70	Round Mountain	.48
Goldfield Oro	.11	Sierra Nevada	.14
Halifax	1.40	Tonopah Extension	2.30
Jim Butler	.68	Tonopah Merger	.58
Jumbo Extension	.11	Tonopah of Nevada	4.80
MacNamara	.17	Union	.08
Mexican	.72	West End	1.25
Midway	.41	Yellow Jacket	.25

COPPER SHARES—BOSTON

(By courtesy of J. C. Wilson, Mills Building.)

	July 10. Bid	Ask		July 10. Bid	Ask
Adventure	$ 1½	1¾	Mohawk	$ 42	—
Alloues	31½	32	North Butte	24½	24¾
Calumet & Arizona	59½	60	Old Dominion	43½	44½
Calumet & Hecla	415	420	Osceola	74½	76
Centennial	11	12	Quincy	56¾	58
Copper Range	39	39½	Shannon	6	6¼
East Butte	10	10¼	Superior & Boston	2⅛	2⅜
Franklin	5	5½	Tamarack	28½	29
Granby	54½	54¾	U. S. Smelting	35	35½
Greene Cananea	5¾	[illegible]	Utah Con	9	9½
Hancock	15	16	Victoria	1	—
Isle-Royale	18½	19	Winona	1½	1¾
Mass Copper	2½	3	Wolverine	44	45

NEW YORK QUOTATIONS

(By courtesy of E. F. Hutton & Co., Kohl Building.)

July 10.

	Bid.	Ask.		Bid.	Ask.
Alaska Mexican	8⅞	9¼	Mason Valley	5½	6
Alaska Tread	37	39	McKinley-Dar.	1⅝	1¾
Alaska United	17⅝	18⅝	Miami 6s	163	170
Alaska G. M.	17	17¼	Mines Co. Am.	2⅜	2⅝
Braden Copper	6½	6¾	Nipissing	8⅜	8⅝
B. C. Copper	2⅛	2⅜	Ohio Copper	⅝	¾
Davis-Daly	1⅞	2¼	San Toy	18	20
Dolores	2	4	Sioux Con.	2	4
El Rayo	1	2	S. W. Miami	5	7
Ely Con.	[illegible]	10	So. Utah	¼	⅝
First Nat.	1⅝	1⅞	S. O. Calif.	169	171
Giroux	1⅜	1⅛	Tri Bullion	⅛	¼
Green Can.	5⅞	6	Tuolumne	1	1⅛
Hollinger	16	17	United Copper	..	⅛
Kerr Lake	3⅛	3¼	Wettlaufer	12	14
La Rose	2¼	2½	Yukon Gold	2¼	2½

TIN STATISTICS

Statistics cabled from Europe show decreased visible supplies ranging from 1600 to 1800 tons, according to L. Vogelstein & Co.'s report of July 1. The New York Metal Exchange makes the decrease 2609 tons. The difference is due largely to the exclusion of Europe (other than Holland) from the Exchange figures, all tin going there (which in June amounted to 985 tons) being left out of consideration by the Exchange. It deducts shipments to the Continent from the total shipments, and the effect is tantamount to enlarging deliveries correspondingly. The net result of the Exchange figures should harmonize closely with foreign statistics, for the former shows supplies, exclusive of Straits' shipments to the Continent, of 4855 tons, and deliveries of 6782 tons, an apparent decrease of 1927 tons in the visible, instead of 2609 tons.

From whatever point of view considered, however, the position is not unfavorable. Doubtless the market would have made a better response were it not for many present uncertainties and the rather dubious future. To date, Straits' shipments are 2000 tons in excess of last year, and those for July are expected to increase this about 1000 tons. Also, while the falling off in American deliveries at the end of June amounted to only 550 tons compared with last year, the decrease at the end of July will amount to about 1500 tons, by which time also the decrease in Europe, now 734 tons, will amount to fully 1000 tons. These increased shipments on the one hand, and decreased deliveries on the other, are having a demoralizing effect, but, price and position considered, much that was unsound in the situation has undoubtedly been discounted.

On June 30 the visible supply was 11,101 tons, having a spot value in London and New York of £193 15s. per ton and 42.625c. per lb., respectively.

COPPER PRODUCERS' ASSOCIATION REPORT

The Copper Producers' Association statement, July 8, shows a decreased surplus. The details are as follows:

	Pounds.
Stock of marketable copper of all kinds on hand at all points in the United States, June 1, 1913	67,474,225
Production of marketable copper in the United States from all domestic and foreign sources during June	121,860,853
Deliveries for consumption, June	68,452,572
Deliveries for export, June	68,067,901
Stock of marketable copper of all kinds on hand and at all points in the U. S., July 1	52,904,606

Recent changes in surplus have been as follows, in pounds:

	Increase.	Decrease.
June 1912	.....	5,280,639
July	5,945,416	.....
August	.....	3,579,046
September	16,364,213	.....
October	13,679,380	.....
November	9,419,095	.....
December	19,148,523	.....
January 1913	17,885,770	.....
February	.....	896,134
March	.....	18,032,928
April	.....	28,720,162
May	.....	8,074,883
June	.....	14,569,619

JUNE COPPER PRODUCTION

	Pounds.
Anaconda group	21,500,000
Anaconda group (half-year's total)	136,050,000
Baltic	1,814,000
Braden (68,127 tons ore)	1,300,000
Chino	3,094,286
Copper Queen	6,292,480
Copper Queen smelter	10,900,000
Calumet & Arizona	4,400,000
Champion	2,640,000
Detroit	1,750,601
Franklin	290,000
Granby, from 104,508 tons of ore smelted	1,789,000
Miami	2,612,600
Moctezuma	3,438,793
Mohawk	1,164,000
Phelps-Dodge total	12,661,328
Quincy	2,336,000
Shannon	924,000
Trimountain	992,000
Wolverine	856,000

Australian Copper Production

The following is from L. Vogelstein & Co.'s copper statistics for 1912:

PRODUCTION OF THE VARIOUS STATES IN TONS

	1911.	1912.
Queensland	20,521	23,157
New South Wales	9,351	8,981
South Australia	6,140	6,505
Tasmania	6,042	5,370
Western Australia	2,473	1,274
Miscellaneous	128	181
	44,655	45,468

PRODUCTION OF THE MOST IMPORTANT MINES IN TONS

	1911.	1912.
Mt. Morgan	7061	8990
Great Cobar	6466	6650
Mt. Elliott	5983	6692
Wallaroo	6079	6290
Mt. Lyell	5992	5058

Mt. Lyell's normal production has been over 8000 tons; a strike in 1911 and a fire in the mine in 1912 explain the lower production in these two years. The production of the Wallaroo mine is shipped to Europe as refined ingot copper. Of the remaining production, about 17,500 tons are refined electrolytically in Port Kembla, and the balance is shipped to Europe and the United States in the form of blister, matte, and ores. The estimate of refined copper produced in Australia shows that about 1000 tons remain in the country. England exported to Australia in copper manufactures, excluding brass, 3500 tons in 1911 and 4161 tons in 1912. During recent years a large proportion of the Australian production has been refined in Australia and comes on the European market in the form of electrolytic copper. This enhances appreciably the importance of Australia as a copper-producing country, on the list of which she stands fifth.

Metal Production in Arizona

The total value of the mine output of gold, silver, copper, lead, and zinc in Arizona in 1912, according to V. C. Heikes, of the United States Geological Survey, was $67,050,784, against $44,157,223 in 1911. This large increase in value was due mainly to the increase in the production of copper.

The production of gold in Arizona in 1912 was 181,996.90 oz., valued at $3,762,310, an increase in value of $331,807. Of this output, 2082.35 oz. came from placers, 112,067.77 oz. from dry or silicious ore, and 57,507.86 oz. from copper ore. From bullion recovered in gold and silver mills, 102,244.72 oz. was produced, concentrate yielded 10,276.48 oz., and crude ore sent to smelters contained 67,086.88 oz. The largest production of gold was from Mohave county—$1,899,131 in 1912, against $1,547,663 in 1911.

Arizona's silver production in 1912 was 3,490,387 oz., valued at $2,146,588, against 3,276,571 oz., valued at $1,736,583, in 1911. Of this output, 2,378,593 oz. came from copper ore, 373,255 oz. from silicious ore, and 599,110 oz. from lead ore. Bullion produced at gold and silver mills yielded 45,660 oz. of silver in 1912, concentrate produced 387,159 oz., and crude ore sent to smelters contained 2,932,049 oz. Cochise county mines produced 1,962,644 oz. of silver in 1912, against 1,946,319 oz. in 1911, and Yavapai county produced 748,872 oz. in 1912, against 764,744 oz. in 1911.

Copper production increased in Arizona from 306,141,538 lb., valued at $38,267,692, in 1911, to 365,038,649 lb., valued at $60,231,377 in 1912. Arizona continued to rank first among the copper-producing states in 1912. Concentrate produced 135,666,375 lb. of the output, and crude ore sent to smelters produced 224,141,378 lb. Cochise county, which includes the great Warren or Bisbee district, produced 147,654,661 lb. of copper, against 132,290,007 lb. in 1911. Greenlee county, embracing the Copper Mountain and Greenlee districts of the Clifton-Morenci region, produced 76,848,299 lb. of copper, against 70,926,330 lb. in 1911. Yavapai county, including the Verde district, produced 34,043,005 lb. of copper, against 36,103,649 lb. in 1911, and 40,824,556 lb. in 1910. Gila county, including the Globe district, produced 63,969,423 lb. of copper in 1912, against 49,226,341 lb. in 1911. In Pinal and Gila counties the so-called low-grade schist and porphyry ores yielded 76,848,299 lb. of copper, against 30,666,515 lb. in 1911. The copper output of Greenlee county is largely from the same class of deposits.

The production of lead in Arizona in 1912 was 6,806,443 lb., valued at $306,290, against 10,274,552 lb., valued at $462,355, in 1911. Cochise county is credited with 3,776,867 lb., valued at $169,959, the largest part of which was derived from the copper mines in the Warren district. Mohave county followed with 1,937,031 lb. Increased output was made in 1912 from Yavapai county, but there was a decrease in Santa Cruz county. Concentrate yielded 1,731,242 lb. of lead in Arizona in 1912, and 5,075,201 lb. was contained in crude ore sent to smelters.

The spelter production of Arizona was 8,758,243 lb., valued at $604,319, in 1912, against 4,562,984 lb., valued at $260,090, in 1911. Mohave county produced mainly from the Union Pass and Chloride camps, 8,304,462 lb. of spelter in 1912, against 4,476,552 lb. in 1911. Productions of zinc were also recorded in Yavapai, Pima, Santa Cruz, and Cochise counties.

There were 444 mines producing gold, silver, copper, lead, or zinc in Arizona in 1912, against 397 in 1911, and the total quantity of ore sold and treated was 6,840,082 short tons, an increase of 2,272,943 tons.

Metal Output of the Central States

The value of the output of silver, copper, lead, and zinc in the states of Arkansas, Kansas, Michigan, Missouri, Oklahoma, Wisconsin, and northern Illinois in 1912 was $79,675,814, an increase of $15,156,370 over the value for 1911 and of $23,349,111 over that for 1908, according to the U. S. Geological Survey. The total value of the production of these metals for the years 1908 to 1912, inclusive, was $327,385,994, of which $151,830,008 was for copper, $98,188,656 for zinc, $76,217,618 for lead, and $1,150,512 for silver.

RECEIPTS at the San Francisco Mint in June were as follows:

	Fine oz.
Alaska	9,323.131
Arizona	10,615.523
California	20,182.746
Colorado	1.089
Idaho	37.282
Nevada	3,848.297
New Mexico	297.673
Oregon	335.297
Utah	26.376
Philippine Islands	2,214.697
Washington	5.353
Refineries, Government offices, etc.	177,648.121
Mutilated United States coin	81.390
Foreign coin	9,643.655
Jewelry	849.337
Mexico	70.258
Northwest Territory	7.368
Total receipts	235,187.593

Value of gold, $4,861,759.03.

THE special meeting of the Tuolumne Copper Co. stockholders on August 18, is to increase the stock from 800,000 shares to 1,500,000 shares, par value $1, to take over the mines of the Butte Main Range Mining Co. in the East Butte district. The promoters are trying to get Pilot Butte to join the combination, and there is also a possibility of the Colusa-Leonard coming in later.

IMPORTS of copper into Russia continue to grow smaller as the domestic production increases. The only copper imported in 1912 was electrolytic, of which the domestic production does not yet come up to requirements.

Philippine Mineral Production

The following statistics of mineral production in the Philippine Islands for the year 1913 have been compiled by the division of mines, Bureau of Science.

	1911		1912		(+) Increase. (−) Decrease.	
Metallic:	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Iron, metric tons	73	₱ 29,159	141	₱ 49,272	+ 68	+₱ 20,113
Silver, fine ounces	3,383	3,606	7,121	8,664	+ 3,738	+ 5,058
Gold, fine ounces	9,190	379,906	27,582	1,140,424	+18,392	+ 760,518
Copper, kilograms	1,100	600	.....	.....	− 1,100	− 600
Non-metallic:						
Coal, metric tons	20,000	130,000	2,720	20,200	−17,280	− 109,800
Clay products	.....	450,000	.....	453,000	.....	+ 3,000
Lime	.....	90,000	.....	92,026	.....	+ 2,026
Sand and gravel	.....	477,344	.....	468,750	.....	− 8,594
Stone	.....	655,795	.....	651,049	.....	− 4,746
Salt, metric tons	18,333	550,000	19,147	574,511	+ 814	+ 24,511
Mineral waters, litres	300,000	60,000	264,871	55,849	−35,129	− 4,151
Total		₱2,826,410		3,513,745		.....

One peso Philippine currency is equal to 50c. United States currency.

Mineral Production of Peru in 1911

According to the *Boletin* 78, del Cuerpo de Ingenieros de Minas del Peru, the mineral output was as follows:

Mineral.	Quantity, metric tons.	Value, Lp.
Coal	324,000	194,155
Petroleum	195,276	785,071
Gold, fine	.....	101,152
Silver, fine	.....	926,713
Copper, fine	27,734	1,411,416
Lead, fine	2,209	12,541
Vanadium, ore	2,251	215,000
Bismuth, fine	24.5	7,329
Tungsten, ore	48.5	4,326
Mercury	0.55	123
Borax	1,923	16,922
Salt	24,867	24,867

Total value, 3,699,615 Lp., equal to $17,760,000.

New Zealand Mines under the control of the Consolidated Goldfields of New Zealand, at Reefton, South Island, produced as follows in May:

	Tons.	Yield.	Profit.	Working costs.
Wealth of Nations	1,996	$16,000	$5,000	$3.98
Progress	2,725	10,500	.....	4.32
Blackwater	3,991	36,000	11,000	4.46

At a meeting of directors of the Tuolumne Copper Co. on June 30, it was decided, after a lengthy discussion, to postpone ordering the payment of the quarterly dividend. The Company has only $50,000 in the treasury. A report presented by the mine's superintendent stated that the company has just opened a fine body of ore on the 2200-ft. level.

Application has been made for the appointment of a receiver for the Butte & Ely Copper Co. A restraining order has also been asked for enjoining the Company from transferring shares of stock held by one Heilbronner to organize the Consolidated Copper Mines Co. A hearing will be given on July 26.

The Consolidated Copper Mines Co. has extended the time for the exchange of the stock of the Giroux Consolidated Mining Co., Butte Ely Copper Co., and the Chairman Consolidated Copper Co. until July 5. Certificates have been deposited with the Guaranty Trust Co. by noon of July 2.

Imports of chromate and bi-chromate of potash into the United States in 1912, were 32,913 lb. valued at $3085.

Ore Reserves of Rand Mines

The tables compiled by the *South African Mining Journal* classify the ore reserves of the mines according to the various controlling houses or groups, and deal with only 'payable,' fully exposed, and fully valued tonnages, except in one or two special instances. The group aggregates are as follows:

Group.	No. of mines.	Tons.
Central Mining & Investment Corporation	15	38,563,916
Consolidated Gold Fields of S. Africa	5	8,655,403
East Rand Proprietary Mines	1	6,013,000
Anglo-French Exploration Co.	1	1,687,101
Consolidated Mines Selection	1	2,457,000
Randfontein-Langlaagte	2	8,970,639
General Mining & Finance Corporation	7	6,808,889
Johannesburg Consolidated Invest. Co.	8	6,740,909
S. Neumann & Co.	5	4,268,634
A. Goerz & Co.	4	2,721,500
Independent Company	1	500,471
	50	87,387,462

The Mt. Ross mine, New England district, New South Wales, produces tin and diamonds, a peculiar combination. The wash containing tin is sometimes thin, but the dolerite overburden is often 36 in. thick, and contains the diamonds. A six-day run in May resulted in the treatment of 64 loads of wash, yielding 280 lb. black tin, and 201 carats of diamonds worth $4.80 per carat.

The following is the gold production of Rhodesian mines in May, 1912:

	Tons.	Value.	Profit.
Eldorado	7633	$ 88,300	$ 48,000
Globe & Phoenix	6420	207,000	139,000
Lonely Reef	4900	83,000	.....

Diamonds worth $1475 were mined in the United States in 1912. They are mostly found in Arkansas. The Ozark Diamond Mines Corporation has erected a plant capable of washing 100 'loads' of 16 cu. ft. daily, according to the U. S. Geological Survey.

The principal gems mined in the United States in 1912 were the sapphires from Fergus county, Montana. These were worth about $195,505, while the value of about 40 various gems and stones, was $319,722.

Chromic-iron ore production in the United States during 1912 was 201 long tons valued at $2753. This came from a mine near Dunsmuir, Siskiyou county, California. Imports were 53,929 tons valued at $499,818.

Cost of mining the deep leads of Victoria, Australia, averages about $10.35 per fathom of wash. This yields $16 per fathom at the Great Southern, Rutherglen, and $11.20 at the Duke Consols, Maryborough.

Company Reports

TRONOH MINES, LTD.

The report of this Company, owning the premier tin mine of the Malay Peninsula, shows that 496,495 cu. yd. of ground was washed, yielding 2776 tons of concentrate, which sold for $1,680,000. The average yield was 12.5 lb. per cubic yard. During 1911, the output was 3856 tons of concentrate, worth $2,110,000, the yield yer yard being 21 lb. For several reasons, the 1911 output was abnormal. The accounts show a profit of $758,000, out of which $576,000 was distributed as dividend, being at the rate of 75%, and $144,000 was written off the property account. Mr. Griffiths has recommended the adoption of bucket-dredging for a portion of the ground, and A. C. Perkins has confirmed his view. This ground is too irregular in content to be suitable for the present methods used in the richer parts of the Company's property.

LAHAT MINES, LTD.

This Company is nearly allied to the Tronoh, and was formed in 1906 to acquire tin-bearing ground at Lahat, in the Kinta district of Perak, Federated Malay States. The capital is $576,000, and dividends at the rate of 2½, 10, 15, and 17½% have been paid for the years 1909 to 1912, respectively. The report for 1912 shows that 270,927 cu. yd. of karang was treated, and 441 tons of cassiterite concentrate recovered. This sold for $264,000, the price received averaging $6096 per ton. The ground let on tribute brought an income of $23,000. The mining cost was $149,000, and after the payment of London expenses and income tax, and allowing for depreciation, a balance of $115,000 remained. Out of this, $112,800 was distributed as dividend, being at the rate of 17½%. Additional property has been acquired connecting the old property with the granite hills to the west. O. S. Dawbarn is the manager.

YUKON GOLD COMPANY

The balance sheet of this company, as shown by the report for the year that ended on December 31, 1912, was as follows:

Assets:	
Property and investments	$12,026,120.72
Equipment	6,935,801.29
Deferred charges (including stripping)	441,279.15
Advanced royalties	340,604.44
Supplies and materials	879,292.04
Accounts collectable	502,965.16
Cash	97,350.98
	$21,223,413.78
Liabilities:	
Capital stock	$17,500,000.00
Guggenheim Exploration Co.	2,524,972.21
Bills and accounts payable	202,272.45
Depreciation	586,893.45
Surplus	409,275.67
	$21,223,413.78

Details regarding the operations of the year were given June 28. Since the report was issued it has been announced that the Company has leased important dredging grounds on the American river in California and will at once place in operation there a 7½-ft. Bucyrus dredge. This, with the new work at Iditarod, adds materially to the probable profits of the concern.

OURO PRETO GOLD MINES OF BRAZIL, LTD.

This Company was formed by John Taylor & Sons in 1834 to acquire the Passagem gold mine, Minas Geraes, Brazil. Arthur J. Bensusan is superintendent. The report for the year 1912 shows that 68,486 tons of ore was treated, yielding gold worth $508,000. The working cost was $432,000, and royalty $17,700; $43,000 was allowed for depreciation and $17,700 was distributed among preference shareholders, being at the rate of 10%. The 100,000 ordinary shares received no dividend; in fact, only $1 per $4.80 ordinary share has so far been paid. Labor shortage continues to be one of the troubles at this mine, and efforts are being made to obtain workmen from Europe and elsewhere. Development during the year has not given good results, and the ore reserve has decreased 30,000 tons, and on December 31 were approximately 2½ years' supply. The lode is flat and has hitherto been worked by incline shafts. A main vertical shaft was started two years ago, calculated to cut the lode at 2000 ft. on the dip. Owing to the water troubles, sinking has been delayed.

LONELY REEF GOLD MINING COMPANY, LTD.

This Company has a capital of 325,000 £1 shares, of which 271,007 have been issued, and 53,993 are in reserve. The property consists of 234 claims, water rights, etc., in the Bubi district of Rhodesia, 50 miles north of Bulawayo The report of the general manager, Francis Drake, covers the year ended December 31, 1912. Mr. Drake, till recently consulting engineer, is now manager, and A. W. Allen is metallurgist.

Development in the mine covered 3701 ft., besides 1459 cu. yd. of stations, winze chambers, and sumps. The main shaft is 1050 ft. deep. Stoping has been done at several points between the No. 2 and No. 7 levels. More ore was broken than was milled, the excess amounting to 11,544 tons, and the total quantity lying in the stopes at the end of the year was calculated to be 13,074 tons. Almost all of this is in shrinkage stopes, which are the most economical to work in certain portions of the mine. Another advantage of this method of stoping is that the mine is independent of fluctuations in the supply of native labor. Two additional levels, the eighth and the ninth, were opened during the year at depths of 895 and 1020 ft., respectively. On No. 8 level, 626 ft. was driven, of which 604 ft. was in ore; and 398 ft. was driven on No. 9 level, of which 166 ft. was in ore. These levels have not yet been extended to the full length of the ore-shoot, and driving is being continued in pay-ore. Shaft-sinking was suspended toward the end of the year, owing to the fact that the ore-shoot showed signs of trending again to the south, as it does in the upper levels of the mine. To determine this trend, a winze has been sunk from No. 9 level. This is now down 104 ft. in rich ore, without having reached the northern limit of the ore-shoot. The length sampled in this winze is 73 ft. Of this, the first 23 ft. averages 12.16 dwt. over 48.83 in., the next 25 ft. averages 29.31 dwt. over 50.25 in., and the last 25 ft. averages 37.36 dwt. over 36.8 in., the reef not having been fully exposed in places. This winze is the deepest point yet reached in the mine, being now 1124 ft. from the surface. Arrangements have now been made for the sinking of an incline shaft below the No. 9 level for the development of the deep ground in the mine. The new hoisting station and ore-bins for this inclined shaft are being prepared, and sinking will be started as soon as possible. The additional plant required for the purpose has been ordered.

The ore reserves at December 31 last were estimated at 174,529 tons, of an average assay value of 22.40 dwt. They show an increase, after deducting the 37,655 tons sent to the mill, of 24,185 tons compared with the estimate of 140,344 tons at December 31, 1911. The present reserves represent approximately a 3½ years' supply of ore for the reduction plant, calculated on a working capacity of 4000 tons per month. The average assay value of the reserves is slightly less than that shown in the previous year, owing to the inclusion of some blocks of lower-grade ore at the southern end of the ore-shoot. The results of operations were as follows:

Ore treated, tons	37,655
Old slime treated, tons	6,331
Total gold production	$768,000
Mining, milling, treatment, etc.	245,000
General, office, directors, taxes, etc.	139,000
Profit	384,000
Dividends paid	259,000
Capital expenditure, development, equipment	134,000

Book Reviews

COLORADO GEOLOGICAL SURVEY, BULLETIN No 6. By R. D. George. P. 196. Maps, diagrams, index.

The main purpose of the bulletin is to describe the commoner minerals and rocks, and furnish the means of recognizing them and of knowing their use. Many valuable geological materials lie unused for lack of knowledge of what they are and how they may be used. It is hoped that this work may stimulate an interest in and a search for the valuable geological products. In this book the author has endeavored to present a handbook of rocks in a form which will be comprehended by everyone interested in the important facts regarding the materials of geology. Emphasis has been given to the important minerals and rocks, unimportant species being described only where their intimate relationship to the more important types has made it necessary, or where the possibilities of economic uses have made it desirable. The work includes a discourse on crystallography, showing with illustrations the various crystal forms as found in nature. It also discusses cleavage, fracture, hardness, specific gravity, color, lustre, streak, and other physical features by which the various minerals may be recognized. It then describes in detail the rock-making minerals, non-metallic minerals, gem minerals, and the metallic minerals, giving the various characteristics of each and the method by which they may be recognized. The characteristic reactions of the important elements are given. The common rocks are described under the heads of igneous and sedimentary, and the subject of metamorphism and the metamorphic rocks is also included. Building stones, the materials of cements, limes, and plasters are also covered by this work. A glossary of geological terms is included.

THE MEN WHO BLAZE THE TRAIL. By S. C. Dunham. P. 126. Barse & Hopkins, New York.

This little book of verse is one of the charming by-products of mining in the Far North. In it Mr. Dunham voices the thoughts and feelings of the Alaska 'sour-dough' as Mr. Service has done for his brothers in the Yukon. The modest little volume is intensely photographic; the verses are word pictures of things as they are, or at least as they were in the early years at Nome. Incidentally, Mr. Dunham has phrased, and excellently, the feeling of helplessness and hopelessness that has come to the sturdy, self-reliant pioneers of the North who face new conditions that they neither approve nor understand. Thus:

"We're too slow for the new breed of miners,
Embracing all classes of men,
Who locate by power of attorney
And prospect their claims with a pen—
Who do all of their fine work through agents,
And loaf around town with the sports,
On intimate terms with the lawyers,
On similar terms with the courts."

Mr. Dunham has caught the brooding spirit of the North, but he also knows the desert, and his later poems, in which he depicts life in Nevada, are equally interesting. Thus he sums up the campaign of 'Lem Allen of Churchill' for the position of lieutenant-governor in 1903:

"And if Lem keeps on talking and treating
In the extra dry way he's begun,
He will turn down the traitors to Silver
By a ratio of sixteen to one."

PSYCHOLOGY AND INDUSTRIAL EFFICIENCY. By Hugo Münsterberg. Pp. 321. Index. Houghton, Mifflin Co., Boston. For sale by the *Mining and Scientific Press*. Price $1.50, postpaid.

Some one has said that lately no publisher has considered his list complete unless it contained at least one book upon scientific management or efficiency engineering. That may be only another way of saying that far too many books have been written upon this new but really important science. The book under review does not come under the heading of those which were written as a sop to the vanity of the author or as an advertisement of his professional qualifications. It is, on the other hand, a real contribution to the science, and one that will go a long way toward clearing up much of the general distrust of so-called scientific management methods. It is written in a simple and readable style, free from unusual technical terms. After a general introduction on 'Applied Psychology,' the author discusses 'The Best Possible Man,' 'The Best Work,' and 'The Best Possible Effect.' A few of the chapter headings, selected at random, will give a good general idea of the contents: Vocation and Fitness. Scientific Vocational Guidance. Experiments in the Interest of Electric Railway Service. The Adjustment of Technical to Psychical Conditions. The Economy of Movement. Experiments on the Effects of Advertisements. Buying and Selling. The Future Development of Economic Psychology.

"The book has a message for everyone interested in either industrial or human efficiency, even though its human efficiency message may chiefly concern one's own self."

Recent Publications

ESTADISTICA MINERA DEL PERU EN 1911. By Carlos P. Jimenez. Boletin del Cuerpo de Ingenieros de Minas del Peru. P. 80. Lima, 1913.

MAGNETIC IRON SANDS OF NATASHKWAN, QUEBEC. By Geo. C. Mackenzie. Department of Mines Bulletin. P. 57. Ill. maps, charts. Ottawa, 1912.

BIENNIAL REPORT OF THE STATE GEOLOGIST. North Carolina Geological and Economic Survey. Joseph Hyde Pratt, geologist. P. 118. Raleigh, 1913.

WOOD-USING INDUSTRIES OF VIRGINIA. Compiled by Roger E. Simmons. Department of Agriculture and Immigration. P. 88. Ill. Washington, 1912.

PUBLICATIONS. This is a catalogue of publications issued by the Bureau of Science, Manila, Philippine Islands. The papers listed cover a wide variety of subjects connected with this territory.

WEST VIRGINIA GEOLOGICAL SURVEY. Part I, 'The Living Flora of West Virginia,' by C. F. Millspaugh; and Part II, 'The Fossil Flora of West Virginia,' by David White. I. C. White, state geologist. P. 491. Ill., index.

CONTRIBUTION A L'ÉTUDE GEOLOGIQUE DE LA PARTIE CENTRALE DU CONGO BELGE. By Sydney H. Ball and Millard K. Shaler. Extrait des *Annales* de la Société géologique de Belgique. P. 51. Map. Liege, Belgium, 1913.

THE MINING INDUSTRY IN NORTHERN ONTARIO SERVED BY THE ONTARIO GOVERNMENT RAILWAY. By Arthur A. Cole. Temiskaming and Northern Ontario Railway Commission publication. P. 78. Ill., plans, index. Toronto, 1913.

University of Illinois publications. Urbana, 1913:

THE PROPERTIES OF SATURATED AND SUPERHEATED AMMONIA VAPOR. By G. A. Goodenough and Wm. Earl Mosher. Bulletin 66. P. 94. Ill., charts, tables, bibliography.

PRELIMINARY REPORT ON ORGANIZATION AND METHOD OF INVESTIGATIONS. Coal-mine investigations by the State Geological Survey, University of Illinois, and the U. S. Bureau of Mines. P. 71. Ill., maps, charts.

POTASH SALTS, SUMMARY FOR 1912. Compiled by W. C. Phalen. Advance chapter from 'Mineral Resources of the United States, 1912.' U. S. Geological Survey. P. 36. Mr. Phalen has brought together in this little pamphlet, not only the statistics of consumption and imports, but such data as are available bearing on the problem of possible local production. He has given a brief summary of the investigations now being conducted by the U. S. Geological Survey and the Bureau of Soils, and indicates several promising fields. Mr. Gale's statement regarding the Searles lake deposits is quoted elsewhere. In it important data supplementary to the brief announcements made by the Survey last year are published.

Concentrates

Most of these are in reply to questions received by mail. Our readers are invited to ask questions and give information dealing with the practice of mining, milling, and smelting.

IDLE RAILWAY CARS in the United States in May totaled 50,294. There were 10,000 new cars bought during the month.

CONCENTRATION of 390,473 tons of ore, by 14 mills, at Cobalt during 1912, resulted in 10,527 tons of concentrate, a ratio of 37 to 1.

STANDARD rack and pinion ore-bin gates are of the following sizes: 18 by 24, 20 by 28, 24 by 30, and 30 by 36 in., with their respective weights of 225, 250, 275, and 325 pounds.

SHIPPING through the Suez canal in 1912 totaled 5373 ships of 20,275,120 net tons. Receipts were $27,005,068, and dividends paid $16,847,540. This should be something to compare with the Panama canal when in full operation.

HORSE-POWER of turbines on the German steamer *Imperator*, the largest in the world, totals 60,000 hp. Her dimensions are: length, 919 ft., and beam, 98 ft., 9 decks above water-line, 36 water-tight compartments, and 50,000 tons.

'TIMBERING' in the main shaft of the Lonely Reef mine, Rhodesia, has been done with wood to 795-ft. depth, and with steel sets the remaining 255 ft. Although more expensive in first cost than the wooden timbers, the steel is practically indestructible.

CRUSHING EQUIPMENT at the Miami mill, Arizona, is being increased by the installation of two sets of 16 by 42-in. Miami heavy-type rolls of Traylor make, and two sets of screens. This increase of plant will produce ½-in. size of ore for further treatment.

TREATMENT of the Lonely Reef mine, Rhodesia, consists of twenty 1250-lb. stamps each; two tube-mills 5 by 14 ft., and one 5½ by 16 ft.; four 20-ft. diam. Dorr thickeners; four 8 by 32-ft. Pachuca agitators; and three Dehne filter-presses, with 50 chambers 40 in. spuare.

GOLD AND SILVER EXPORTS from New York from January 1 to June 21, 1913, totaled gold, $60,179,782, and silver, $25,016,845, against $22,483,762 and $24,984,679, respectively, in 1912. Imports totaled gold, $8,516,135, and silver, $4,450,675, against $10,248,474 and $5,245,674 in 1912.

TOBIN BRONZE is a composition containing between 59 and 63% copper, 0.5 and 1.5% tin, and a small percentage of zinc. It has a bright golden color, specific gravity of 8.4, melting point of 1600°F., weighs 0.303 lb. per cubic inch, and can be welded by electric or oxy-acetylene processes.

DIAMOND-CUTTING is mostly done in Europe, at Amsterdam and Antwerp, 23,000 persons being engaged in the industry, and the cost being about $24,000,000 per year. It is now proposed to do a lot of this work in South Africa, which, last year, exported uncut diamonds worth $57,600,000.

MINING COSTS at the Calumet & Hecla properties during 1912 were as follows, according to the *Houghton Mining Gazette*: Ahmeek, $1.39; Allouez, $1.61; Calumet & Hecla, $1.91; Centennial, $1.92; Isle Royale, $1.54; Osceola, $1.23; Superior, $2.33; and Tamarack, $2.23; an average of $1.77 per ton.

TREATMENT of mixed sand and slime, or slime alone, by upward displacement is attracting some attention in the United States, and good results are said to have been secured. There are difficulties in getting uniform results, and everything must be in extremely nice adjustment. Upward displacement was tried at the Westralia Mt. Morgan's mill, and a slime plant at Kalgoorlie for treating old dumps, several years ago, but results were hopeless.

IN AGITATING SLIME with barren solution, it is difficult in many cases to find an ore which will allow sufficient decantation to take place to furnish enough solution for agitation purposes. On clayey ores the upward current of the solution through the decanting zone carries slime particles with it in every case, and under all conditions.

UNCONSUMED GASES in boiler flues are liable to cause explosions. Recently, at a mine in Western Australia, a boiler fireman shut the damper down and stopped the fan to 'blow down' the boiler. After doing this, he opened the damper. and flames from the wood fuel exploded the accumulated unconsumed gases, blowing out a quantity of brickwork.

THE flame blow-in of a Case gasoline melting furnace is placed so that the flame enters the furnace on a tangent and does not hit the crucible until there is complete combustion. The hot gases circle around the crucible, thereby preventing the loss of crucibles by cracking, and saving their wear and tear to such an extent that their life is lengthened several melts. This furnace is made in three sections, or practically divides in the centre, so when the upper ring is lifted off it leaves the upper portion of the crucible so exposed that it can be removed with basket tongs.

RAILROAD TUNNELS through the European Alps are the Mont Cenis, St. Gothard, Arlberg, Simplon, and Lötschberg. The latter is about 9¼ miles long, the St. Gothard 9½ miles, and the Simplon 12¼ miles. After nearly two years' work in the Löetschberg 'headings', an accident occurred. It was supposed by the engineers that the detritus forming the floor of the Gastern valley ended well above the line of the tunnel, which in consequence would be driven in solid rock. This supposition was wrong, as there was a rush of sand, gravel, and water, amounting to 250,000 cu. ft., filling the heading for nearly a mile and killing 25 Italian miners. Later on, a new heading was started, and work was completed on March 31, 1911.

CLEAN-UP BARRELS, as used at Kalgoorlie for treating the amalgam, rich concentrate, and chippings from grinding pans, or sundry material from the clean-up room, are simply of cast iron, 2 in. thick, with a 3-in. shaft fitted through the centre and extending outside for bearings and driving gear. They are best driven by gearing at about 20 r.p.m. One side of the barrel has a heavy door about 10 by 18 in., well fitted in a hole, and is clamped down The machine is charged with the material to be ground, enough water added to make a thick pulp, and enough quicksilver to collect all gold and amalgam. Lime or soda is added to clean the mercury. About four rollers, say 4 by 12 in., are also added for grinding, which occupies about 12 hours. After this time, the barrel is opened, the pulp run into a box or vat, thinned with water, and then run over riffles. The residue is rich and is caught in a box, and returned to the pans. The barrel does good work and may be securely locked.

QUICKSILVER occurs in nature principally as sulphide, namely, cinnabar. The deposits in the United States are found generally in simple fissure fillings, frequently irregular and linking together larger fillings; in compound fracture zones; along bedding planes or other contacts; and disseminated in the adjoining rocks. The ore-shoots are often very irregular and sometimes lenticular. They are found in many kinds of igneous, sedimentary, and metamorphic rocks of various ages, such as granitic, quartz porphyritic, rhyolitic, andesitic, diabasic, and basaltic igneous rocks, limestones, sandstones, shales, serpentines, slates, and quartzites. Cinnabar, the principal ore, has a formula of HgS, and contains up to 86.2% mercury. It has a beautiful red color, and is found in crystalline incrustations, intergrowths, and impregnations, also granular, massive, and earthy. Its hardness is 2 to 2½, and specific gravity 8 to 8.2. When scratched, it gives a scarlet streak. The ordinary variety is crystallized, massive, and earthy, and bright red to reddish brown in color.

High-Voltage Direct-Current Locomotives

The electrification of the Butte, Anaconda & Pacific railway is of exceptional interest because it represents one of the largest installations of electrical equipment for steam railroad service and is the first in this country where direct-current locomotives, operating on as high a potential as 2400 volts, will be employed. Construction work necessary to effect the change from steam to electric equipment is now practically completed.

The adoption of the 2400-volt, direct-current system for this railway was determined after a comprehensive study of local conditions and requirements. The traffic demands are unusually severe, and consist principally of hauling long trains of copper ore over heavy mountain grades. In comparison with other existing systems, the 2400-volt, direct-current system was considered best suited for exacting service of this character; for its adoption presented an opportunity to realize unusual economies, both in initial expenditure and the cost of operation.

The part of the road that has been equipped lies between Butte and Anaconda, Montana. It comprises 30 miles of main line single track, numerous sidings, yards, and smelter tracks, aggregating a total of about 90 miles on a single track basis. The haulage of copper ore from the Butte mines to the smelters at Anaconda, together with all mine supplies, lumber, etc., moving in both directions, amounts to practically 5,000,000 tons of freight per year. Complete freight trains weighing 3400 tons are made up of 50 loaded steel ore-cars and will be operated over a ruling grade of 0.3% by a locomotive consisting of two of the units illustrated. Single units will be used for making up trains in the yards and for spotting cars.

The initial equipment consists of seventeen locomotive units, type 0440-E-160-4 GE 229A; fifteen for freight and two for passenger service. Each unit weighs approximately 80 tons. The two units for forming the freight locomotives in each case will be coupled together and operated in multiple unit. The combination freight locomotives will haul the usual trains of 3400 tons at a maximum speed of 15 miles per hour against the ruling grade, and at 21 miles per hour on level tangent track. The passenger locomotives are the same design as the freight locomotives, except that they are geared for a maximum speed of 45 miles per hour on level tangent track. A schedule of eight passenger trains per day, four each way, is maintained. The average train is composed of a locomotive and three standard steam-road passenger coaches. All the locomotive equipment, as well as the sub-station apparatus and overhead line material, was designed and built by the General Electric Company.

The principal data and dimensions applying to the locomotives are the following:

Length inside of knuckles	37 ft. 4 in.
Length over cab	31 ft.
Height over cab	12 ft. 10 in.
Height with trolley down	15 ft. 6 in.
Width over all	10 ft.
Total wheel base	26 ft.
Rigid wheel base	8 ft. 8 in.
Track gage	4 ft. 8½ in.
Total weight	160,000 lb.
Weight per axle	40,000 lb.
Wheels, steel tired	46 in.
Journals	6 by 13 in.

DIRECT-CURRENT LOCOMOTIVE, 2400-VOLT.

Gears, forged rims, freight locomotives	87 teeth
Gears, forged rims, passenger locomotives	80 teeth
Pinions, forged, freight locomotives	18 teeth
Pinions, forged, passenger locomotives	25 teeth
Tractive effort at 30% coefficient	48,000 lb.
Tractive effort at one hour rating	30,000 lb.
Tractive effort at continuous rating	25,000 lb.

The locomotives are the articulated double-truck type, with all weight on the drivers. The cab, containing an engineer's compartment in each end, and a central compartment for the control apparatus, is carried by the two truck frames on centre pins. The cab is box type, extending the entire length of the locomotive, and is provided with end and side doors. On each axle is mounted a motor of the twin-geared type. The friction draft gear mounted on the outer end frame of each truck transmits the hauling and buffing stresses directly through the truck frame, diverting these strains from the centre pins and underframe.

The trucks are built of heavy steel castings. The side frames are of a truss pattern with heavy top and bottom members and pedestal tie bars. They are connected by end frames and a cast steel centre transom. The entire weight is carried on semi-elliptic springs suitably equalized. The cab underframe consists of two 12-in. longitudinal steel channels on either side of the centre and two 6 by 6-in. steel angles along the outer edges. The central channels are enclosed and form a distributing air-duct

for forced ventilation. Air is conducted through the centre pins, which are hollow, into the truck transoms and thence to the motors.

The engineer's compartment, at either end of the cab, contains the operator's seat, controller, air-brake valves, bell and whistle ropes, ammeter, air gauges, sanders, and other control apparatus that should be within immediate reach of the engineer. These compartments are comfortably heated by electric heaters. In the central section is grouped the control apparatus. The contactors, reverser, and rheostats are mounted in two banks running lengthwise of the compartment, and are arranged with ample space between them to afford convenient access for cleaning, inspection, and repair. All parts and circuits carrying 2400 volts are thoroughly protected from accidental contact. A dynamotor is employed to furnish 600 volts for the operation of the contactors, lights, and air-compressor.

The motors are the GE-229A commutating-pole type, wound for 1200 volts and insulated for 2400 volts. A forged pinion is mounted on each end of the armature shaft and meshes into a corresponding gear mounted on the wheel hub. The gear reduction is 4.84 on the freight locomotives and 3.2 on the passenger locomotives.

The GE-229A motor is designed especially for locomotive service, is enclosed, and is provided with forced ventilation. Air is circulated over the armature and field coils, over and through the commutator, through longitudinal holes in the armature core, and thence exhausted through openings in the bearing head. This method of ventilation circulates effectively a large volume of cool air throughout the motor and keeps all parts at a uniform temperature, eliminating the possibility of 'hot spots.'

The continuous capacity of each motor is 190 amperes on 1200 volts under forced ventilation, and 225 amperes on 1200 volts for the one-hour rating. For the double unit 160-ton locomotive, this is equivalent to a continuously sustained output of 2100 horse-power.

The control equipment on the locomotive is the well known Sprague-General Electric, type M, multiple-unit control, and is designed to operate the four motors in series and series-parallel. The pairs of motors with their respective resistances are all connected in series on the first point of the controller. The resistance is varied through nine points on the controller and finally short-circuited on the tenth or running point. The pairs of motors are then operated similarly in series-parallel and all resistance is cut out on the nineteenth point, which is the full-speed running point. This provides a control with ten steps in series and nine steps in series-parallel.

The transition between series and series-parallel is effected without opening the motor circuit, and there is no appreciable reduction in tractive effort during the change. The smooth transition between control points permits acceleration close to the slipping point of the wheels. A switch is provided having manually-operated handles for cutting out either part of motors, so that the locomotive can then be operated with one pair of motors in the usual way.

The contactors are actuated by the 600-volt circuit obtained from the dynamotor and are of a design similar to that employed in the standard type M control. The principal variations are embodied in the method of insulating for the higher voltage. The arm between the operating armature magnet and the arc chute mechanism consists of a treated wood spacer insulator; and the contacts and magnetic blow-out, which make and break on the 2400-volt circuit, are mounted on mica and porcelain insulators.

The main switch is provided with a powerful blow-out, so that heavy currents can be opened. The three smaller switches, one for each of the two heaters and one for the dynamotor circuits, are designed specially for 2400 volts. The blade is controlled by a lever attached to the grounded part of the locomotive frame and insulated from the live parts of the switch by a rod of treated wood.

There is one main fuse for the trolley circuit and two fuses for the motor circuits. They are all of the copper ribbon type and are fitted with hinged covers to facilitate fuse renewals. The boxes are placed as near as possible to the overhead trolley in order to protect the wiring circuits near the source of supply. There is also an auxiliary circuit fuse for protecting locally the dynamotor and heater circuits. The main, motor, and auxiliary fuse boxes are provided with powerful magnetic blow-outs, energized by current passing through the fuse, to insure proper rupture of the arc.

An ammeter is placed at each engineer's position and indicates the current in the circuit of one pair of motors. The ammeter and air-gauges are illuminated by a gauge light connected in the headlight circuit, so that the headlight switch turns on simultaneously the headlight and gauge light at the same end of the locomotive.

The main motor rheostats are formed of cast-iron grids assembled in a frame and insulated by mica. Twenty resistance units are provided for each passenger locomotive, and twenty-six resistance units for each freight unit. The rheostat boxes are mounted in an enclosed compartment above the banks of contactors.

Current is collected by overhead trolleys of the pantograph type. They are pneumatically operated and can be put into service from either engineer's compartment by a hand-operated valve. Each passenger locomotive is equipped with two collectors, and each freight unit with one collector. A 2400-volt insulated bus line, connected direct to the pantographs, is run along the centre on the roof of the cab. The bus lines are connected by couplers between the two units of the freight locomotives, so that current is obtained from both collectors or from a single collector. The collectors and bus lines are adequately guarded by railings.

The locomotives are equipped with arc headlights. The interior illumination of the cab is provided by ten incandescent lamps arranged in two circuits, one lamp being placed in each engineer's cab and the balance in the central compartment. In each lamp circuit is a portable lamp with an extension cord. One lamp switch is in each engineer's cab, so that one lamp circuit can be controlled from each end of the locomotive. A 600-volt bus line is provided on the passenger locomotives for lighting and a 2400-volt bus line for heating the passenger coaches.

The air-brakes are the combined straight and automatic type. The air-compressor, of the CP-26 type, is two-stage, motor-driven, and has a piston displacement of 100 cu. ft. of air per minute when pumping against a tank pressure of 135 lb. per square inch. Air is taken from the interior of the central compartment through a screen, which prevents the entrance of particles of dust. The compressed air in passing from the low-pressure to the high-pressure cylinder is conducted through radiating pipes on the roof of the cab. This reduces the temperature of the air and allows condensation of moisture before entering the high-pressure cylinder. From the high-pressure cylinder it is delivered into four air-reservoirs, each 12 by 164 in. They are placed under the floor of the cab and connected in series, which affords a further opportunity for radiation and condensation.

Pneumatic sanders are provided. The sander valves are placed within convenient reach of the engineer's seat, and valves and boxes are arranged for sanding the track in front of the leading wheels when running in either direction. The couplers are M.C.B. standard. The bells are fitted with automatic bell ringers, and the whistles are air-operated. All wiring is drawn through conduits and carefully protected from possible mechanical injury.

HUMPHREY PUMPS, as described in this journal of June 28, will lift water the same as an ordinary pump by suction and deliver to heads up to 250 ft. They will operate on kerosene, distillate, gasoline, benzol, or any form of gas available.

H. N. LAWRIE has opened an office in the Yeon building at Portland, Oregon, for microscopic study of ores and rocks and for general mining engineering work.

COKE production of the United States averages about 400,000 tons per week.

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EDITORIAL

WATER and large corporations are frequently associated in the mind of the public, but the conjunction is sometimes a profitable one. The Niagara Falls Power Company reports a net income of $928,000, or 16.1 per cent, last year as compared with 11.92 for the preceding year.

COALFIELDS in Routt county, Colorado, are to be developed upon a large scale, if the Yampa Fuel & Iron Company is successful in placing a bond issue in Europe. Representatives of the French and Belgian interests who are negotiating for the sale of $28,000,000 worth of bonds have recently been studying the situation in Colorado, and if the outcome is successful, a railway will be built from Hayden, Colorado, to Casper, Wyoming, and the exploitation of the coal deposits undertaken.

EXTRALATERAL rights are discussed in a clear and informing way by Mr. John B. Clayberg in the *California Law Review* for May. While many difficult points are made clear, it is perhaps significant of the inevitable legal maze that results from granting any such right, that even so experienced a practitioner confesses to doubt as to how the courts would rule on numerous important points. Possibly by the time all existing extralateral rights are adjudicated, the public will be educated to the point of abolishing them for the future.

DUMMY directors will have a hard time of it in the future, if the ruling made by the Supreme Court of New York State holds good. A shareholder in White, Van Glahn & Company sued Mr. H. K. White, alleging that Mr. White, though knowing the company to be insolvent, became a director (thereby facilitating the sale of stock through his reputation for wealth and business success), but allowed the affairs of the Company to be managed by others, with the result that a few months later it became bankrupt. The opinion of the court, concurred in by all the justices, was that Mr. White was liable for the $50,000 lost by the shareholder who invested in the Company under the belief that it was being actively managed by Mr. White. This is a new ruling, but one that seems eminently sound. It is all too common that well known men allow their names to be used as bait to catch the unwary, and it is to be hoped that the establishing of legal responsibility for losses may act as an effective deterrent. All too often, however, those who are so unwise have little beyond their reputations to lose in the ensuing maelstrom.

Underestimating the Cost of Milling Plants—I

By A. Sydney Additon

Among the remarks commonly heard when several persons are discussing some new milling plant are: "I guess it is a good plant, but it cost about twice what they expected it to cost," "Yes, the plant is finished, but they will have to spend a lot more money on it before it is efficient," "Plants always cost twice what they are estimated to cost." Or at a directors' meeting, when a contemplated structure is under discussion and an estimate has been submitted, some one will say: "Add 75% to that amount and you will come close to the actual cost, is my experience."

Causes of Underestimating

Why is this and why are such ideas prevalent? Often, of course, persons making such remarks are speaking without knowledge, but too often the observations are true. Why should it ever happen that a plant estimated to cost $100,000 should cost $150,000? Misrepresentation, bad management, incompetency, ignorance, lack of technical advice, crooked business, and graft, are given as the reasons, and some or all of these may be assumed to cover the case. What is meant by such reasons, and how each of them acts to the end, is not as a rule clearly understood, as they are given off-hand, with but seldom any inquiry beyond. They are general reasons and, as general reasons, are largely true. They would be reasons for failure in any business enterprise. Exactly what happens to cause the cost of a given structure to exceed original estimate is not commonly clear.

For elucidating this point and supplying data which may aid engineers and managers to escape falling into the clutches of the underestimated cost bugaboo, I have studied the matter in considerable detail, and some of the results of this investigation follow. The discussion is confined wholly to mills and milling operations, and it is assumed that the mine work in each case is satisfactory and in no way affects the topic under discussion. At one property I visited, a new stamp-mill and cyanide plant had recently been constructed and were running smoothly and giving satisfactory results. The arrangement of certain parts of the equipment being peculiar and differing from the usual practice, led me to inquire the reason. This question brought out the history of the construction of this plant, which had cost 41% more than the original estimate submitted to the directors of the company at the time they voted to build. This history, while by no means unusual, throws much light on our inquiry.

History of One Undertaking

To begin at the beginning, this property was owned by a group of clever, conservative, well-to-do business and professional men, all of whom believed in doing well and thoroughly everything they undertook to do. They all realized that it cost money to develop and equip a mine, and were ready to meet contingencies. They were the right sort; men for whom an engineer or other employee would do his best. They had purchased the property in an undeveloped state, and immediately started to find a competent reliable man to develop it for them either into a producing mine or to the point of abandoning the venture. They took their time in making a selection of the engineer, realizing the importance of this first step, and finally succeeded in securing the services of just the man needed. This done, they supplied the funds and told him that it was up to him to make a mine or advise them to quit. He had their entire confidence and was given a free hand.

Under these favorable conditions the development of the property was rapid, the vein was well opened and ore found to be of workable grade was blocked as fast as developed. The superintendent cautioned the company against thinking of a milling plant too soon. But after a couple of seasons of this well directed development, the time came when the superintendent advised the construction of a plant, reporting at the same time the exact condition of the mine and ore reserves. All of this was most pleasing to the directors, and much deserved praise was given the superintendent. They then instructed him to submit to them estimates of the cost of such a plant as he considered advisable.

Machinery Houses

The superintendent immediately took up the matter with three well known machinery dealers, whose representatives visited the mine, and, in due course of time, each house submitted to him plans, specifications, and estimates of cost of the plant that the representative decided was best suited to the requirements. These plans and estimates were gone over carefully by the superintendent and some of the officials of the company. After many consultations and, needless to say, many visits from machinery house representatives, lunches at the club, and so on, a selection was made, and contracts signed. The elation due to the knowledge that they had a good, proved mine, well developed, with quantities of ore, together with their confidence in the superintendent, and the clear understanding the 'representative' seemed to have of their needs, shut from the view of the officials of the company the vision of anything but a successful plant. The machinery house furnished working drawings and an estimate of the cost of construction. Everything was most satisfactory to all concerned. The superintendent rushed the preliminary work, machinery was delivered, money paid, and construction soon under way. Exit joy, enter gloom.

In carrying on the construction, according to plans, it was found that the labor costs at each stage of the work were considerably in excess of the estimate given by the machinery house, due to conditions, such as the kind of labor available, which were not important factors in making the

estimate. The amount of material that had to be purchased during the construction was also surprising; not equipment, but all sorts of miscellaneous items, such as iron, lumber, nails, hose, wheelbarrows, track, and tools, besides material and equipment for an incline with which to handle the machinery to its proper site. All of these things made quite an additional amount of money necessary. As the plant neared completion, a metallurgist was employed to be its superintendent, and a crew was selected. All was ready and started, everything seemed to go smoothly, and all hands were jubilant. The added cost for labor and material during construction was forgotten. The next day the local newspaper announced that "The new up-to-date milling plant of the * * * Mining Company was put into commission yesterday, and its operation was found to be perfect from the start. This plant has a capacity * * *," etc. I might here note that the metallurgist who had been employed as mill superintendent was not entirely satisfied with certain parts of the plant, but said nothing, as he needed the job and knew that it would work itself out.

Ore-Bin Difficulties

At the end of the second day the mine foreman reported that he could not put the amount of ore into the bin that he was instructed to deliver each day. The mill superintendent was questioned, and during the succeeding days he tried in every way possible to increase the capacity. Finally, at the end of two weeks, it was decided that the maximum had been reached, 30% less than what the plant was designed to do. The first blockade was at the regrinding mill, after the battery. The machinery house was appealed to and sent a man up to investigate, one who was able to sell machinery. First an attempt was made to make a second classification below the battery, so as to send a portion of the oversize to the tube-mill direct, with the idea of relieving the regrinding machine. This meant telegraphing for another cone to be sent by express. (Yes, it happened that there was sufficient height to get this in.)

Changes in the Mill

After the necessary tearing out of frames, and making of launder and plumbing connections, the cone was tried, but proved of but little help, and the amount of water added to the pulp in trying to separate a product for the tube-mill from the flow that should have gone to the regrinder was not small. It was clearly 'up to' the regrinder, and the man was forced to admit, not that the machine was not doing work up to its rated capacity, but that a much larger amount of pulp was going to it than was expected when the plant was designed. The ore was harder than had been realized, and too small an amount was crushed fine in the battery. Nothing for it but another regrinder. "Too bad, but one cannot always tell how ore is going to crush." The regrinder was ordered at once by wire from the East. Meanwhile, the plant was to be operated at the limited capacity. The crew must necessarily remain the same, hence the cost of milling was increased 43%, amounting to $1827 per month, or $4575 for the 75 days before this new mill could be received and installed.

Fortunately, the superintendent inquired about the power necessary for this new mill and found that the motor which was driving the present regrinder, and some other equipment, was already fully loaded. Either a separate motor must be put in for the new mill, or the present one taken out and a larger one put in its place. The latter course was adopted, and by the time the new mill arrived, the new motor was installed on a new foundation with new transmission arrangements. The only place that this new regrinder could be placed was outside of the building, so it was necessary to remove a portion of the wall, make an excavation, build a lean-to addition to the building, put in foundation, and increase and alter the water service. On account of the distance that this placed the mill from the discharge of cones, the launders had to be reconstructed and the second cone thrown out.

Tank Changes

While running at the reduced capacity, waiting for the new regrinder, something went wrong with the vacuum pump, and it became necessary to stop the filter for a day to repair the pump. When the filter stopped, everything had to be shut down, all the way to the top of the mill, as no pulp-storage tanks had been provided. To provide against such delays in the future, two pulp-storage tanks, fitted with agitation appliances, were ordered at once and installed. In placing these tanks after the agitators, there was, of course, insufficient head room between the discharge of the agitator and the top of the settlers, hence it was necessary to provide a centrifugal pump to lift the stored pulp to the required height. There being no room in the building, or on the grades, for these large tanks, it was necessary to make a special excavation beside the building and build a retaining wall and foundation. This work was not foreseen at the time the material for the alterations to accommodate the new regrinder were ordered, consequently another less-than-carload order of cement and lumber was placed. A new motor for the agitators, alterations in plumbing, electric wiring for power and lighting, gangways, steps, and walks were all necessary.

Additional Equipment

When the new regrinder was installed, the capacity was run up to that originally proposed without difficulty. The classifier was the next point of trouble. It had not been handling the product quite as satisfactorily as desired, but now that the added load was put upon it, it became literally buried. It was not suited to the work and had not sufficient capacity. The question of adding another or throwing it out and putting in one of different design was decided in favor of the latter. This was ordered and installed. Meantime the plant was again being operated at limited capacity. The new installation involved, of course, another lot of alterations to power, lighting, water, and launder service. At this time the metallurgist in charge of the

mill determined that a good extraction could not be maintained if the time of agitation were shortened. With the capacity of the plant increased, this would be necessary, unless another agitator was added to those in use. (Note that the metallurgist had been employed at the time the plant was ready to run, but had been given no chance to determine such points in advance.) So in order to avoid further disappointment and delay, an additional agitator was wired for. This required an additional amount of air, which the compressor could not deliver. A new compressor was therefore ordered, with a new motor to drive it. All of this called for a deep excavation for the new agitator, additions to the building, a retaining wall and foundations for agitator, compressor, and motor, and also alterations in the air, water, and lighting service, and in gangways and walks. More less-than-carload freight shipments, and an additional 30 days' operation of the mill at limited capacity were necessary.

Precipitation Department

The precipitation department was nearly efficient. Clarifying tanks had been installed to save the cost of a clarifying press, and the results secured were, however, more or less unsatisfactory. This led to the purchase and installation of a press for the purpose. I understand that the metallurgical company that supplied this precipitating plant will not now guarantee satisfactory results unless a clarifying press is used. This is good, and will save added costs in this department. The amount of solution to be handled in the plant had been greatly underestimated, if estimated at all, and when the plant was brought up to its capacity this was keenly felt. In fact, it so handicapped the cyanide department that four additional tanks were installed to give sufficient storage capacity. This also necessitated another pump and a pipe-line to storage tanks at top of plant, and called for additional alterations in the power service and circulating system.

After all these alterations had been made, the increased tax upon the power service necessitated the purchase of a transformer. Other smaller items that had also to be supplied were: laboratory equipment, report and testing-room fittings and tools, and utensils and appliances for use of the crew. All of this was not done as easily and simply as it reads, as the reader will know from experience, but days were spent trying to make parts do their duty, scheming to overcome troubles, telegraphing for prices, and placing the stock. Also much loss of time, grief during the making of alterations, and losses of material which cannot be easily estimated. After four and a half months—which, by the way, was a short time, considering the various troubles, the plant was at last ready to handle its estimated capacity in an efficient manner. The additional cost over and above the original estimate was $49,519. This total was made up of the following items:

Additional labor for construction made as per plans.	$6,732
Additional cost of material as per plans.....	5,270
Additional freight and hauling of this material.....	904
Cost of supplies used during construction.....	2,240
Equipment, material, and labor for necessary accessories	2,185
Equipment, material, and labor for surface incline..	1,373
Purchase and installation of cone classifier, with its attendant costs, and subsequent tearing out of same	180
Purchase and installation of new re-grinder, including excavations, building, foundations, and alterations	3,690
Purchase and installation of new motor, on account of additional power required for re-grinder, foundations, and alterations	620
Purchase and installation of pulp-storage tanks, including pump, motor, pipe and fittings, excavations, building, foundations, and alterations....	2,420
Purchase and installation of new classifier, including removal of old one, foundations, and alterations	980
Purchase and installation of new compressor and excavations, building, foundations, and alterations	1,010
Purchase and installation of new compressor and motor, including foundations and alterations...	1,440
Purchase and installation of clarifying press, including foundations and alterations.....	2,860
Purchase and installation of additional solution tanks, pump, and pipe-line, including excavations	680
Purchase and installation of new transformer.....	720
Purchase and installation of laboratory equipment, tools, and appliances	600
Freight and hauling on above new equipment and material	3,615
Added cost of operating expense for 4½ months, due to limited capacity.....	8,540
	$45,959

The difference between this amount and the actual added cost, as noted above, or $3560, was made up of miscellaneous items of which no detailed account was kept, such as: telegraphing, express charges, traveling expenses, added office expenses, and experimenting. There should also be added the loss of the use of the money not produced, due to the 30% curtailment of the output for the four months and a half.

Total Cost

The total cost, then, was about 41% greater than the original estimate. This does not necessarily mean that the plant cost 41% more than it should have cost, but 41% more than the amount of money the company was advised it would cost and had arranged to have on hand to pay. It is quite annoying for a board of directors to be obliged to notify the stockholders every 30 days that more money is needed for construction work and at the end to realize that they have spent 41% more than they said they would. In this particular case there was no further embarrassment after the first call for additional money, as the profits from the operations at limited capacity amply covered the added cost. This good fortune does not, however, alter the seriousness of the underestimate, as many times this would not be the case. It may be added that where the excess cost is paid out of profits made during the operation of the inefficient plant, less attention is paid to the fact that excess cost was incurred, thus helping to keep it from public notice. But at the same time it indicates the underlying reason for the remark of a director, given above: "Add 75% to that amount and you will come close to actual cost, is my experience."

Cause of the Trouble

Having gone over the chief details of the history of this plant, the question at once presents itself, where did 'gloom' first enter? What was the cause of all this trouble? The answer is easy, and I only fear my inability to state it strongly enough to make the facts clearly understood and appreciated. The first error was made when the superintendent went to machinery dealers to buy a plant, instead of taking to them a complete set of specifications of what was wanted and asking them for bids. The point is this: When a buyer goes to a machinery house and tells them that he wants a first-class milling plant, of a certain daily capacity, giving them all the details possible of treatment required, the machinery dealer will prepare a set of plans and specifications, including as little equipment as will assemble to the appearance of a plant of the capacity desired. The buyer generally expects the dealer to put in every sort of thing possible in order to make the sale greater. As a matter of fact, they cut out everything they can possibly omit in order to quote as low a price as possible so as to get the order. You might buy the plant somewhere else, or not at all, if the price seems too high, but once you buy and install what they have specified, you will have to buy what the plant lacks later; their whole aim being to 'land' your order. They have no responsibility in the matter beyond supplying first-class specified equipment. They are not selling you a plant guaranteed to handle so many tons of your ore per day, making a certain percentage of recovery or profit, but they are simply selling a specified list of equipment. All efficiency and capacity statements are made by 'selling' engineers, or trade catalogues, and the firm's authorized signature will not be found signed to anything in the way of a guarantee, except the contract to sell certain specified machinery (of first-class workmanship and design) at a certain price and upon certain terms. Their principal concern is to leave out enough items to enable them to make their price lower than the other bidders, and at the same time specify enough to make the proposal look like complete equipment to the purchaser. There is a happy medium here which must be struck, and the expertness with which a machine salesman can do this measures his worth to his firm.

Position of Machinery Houses

It might be thought that the machinery business would be injured by such methods, but they all do it, and, no matter how conscientious a firm desires to be, they know that other firms will proceed in this way, and therefore they must, or not expect to secure the business. In the second place, it is easy enough to slide out of any responsibility not really assumed, cover their designs or intentions, and actually make the purchaser their friend by ready and willing assistance in securing the additional equipment needed. Persons who buy plants in this way rarely buy more than one, in any case. In the case under consideration, when it was found that the regrinding mill had not sufficient capacity, the claim that the ore did not crush as easily as expected seemed plausible as well as probable.

Placing the Blame

Was it the fault of the superintendent? No, not exactly. When this man was employed, he was secured as the best man obtainable to develop the mine. He was not supposed to be a metallurgical engineer, and his knowledge along this line was superficial. He had not spent his life in designing and constructing milling plants, but in finding and developing ore. When it came time to build the plant, everyone was jubilant over success; this man had made good. The building of the mill did not appear to be anything to 'stump' him, especially when all the machinery houses were ready to help with advice and experience. The fault was with the directors of the company in not being as careful in beginning the milling business as they had been in starting the mining business. Had they had plans, specifications, and estimates carefully prepared by an experienced metallurgical engineer, no such annoyance would have occurred, no time would have been lost after installation, and the completed plant would have cost much less than the excess cost of the present one.

Conclusion

Some of my readers will doubtless think I am trying to score the machinery dealers, but this is not the case. Machinery dealers are the friends of mining operators and especially of metallurgical engineers; from them the engineer secures quantities of data and much assistance. Were they not friendly with each other, and did they not work together, supplying each other with information based on experience and practice, it would be indeed difficult to prepare a correct estimate of a piece of work. I have merely given the history of this particular mill as an example of one way in which excess cost occurs, and have stated the reasons given because they are true and, if personally understood, reflect in no way upon machinery dealers. I do not wish to be understood as blaming the machinery houses for methods they are plainly forced to adopt, but I certainly would be glad to see conditions changed so that such methods need not be pursued. Machinery houses much prefer to tender a bid on a full set of specifications rather than to deal with buyers as in the above case. When specifications are prepared, really competitive bids can be secured, the machinery houses are saved much unnecessary expense, and everybody is better pleased. A machinery dealer prefers to stick to his own business, that of manufacturing and selling machinery. Going to a machinery house to buy a milling plant, as in the case cited, is like going to a sawmill to buy a house. Submit specifications to the dealer and ask him his price in either case, thus doing away with the conditions which force him to do business in the manner described above. I suppose the time for this will never come, but if every machinery house would refuse to bid on a milling plant without having the buyer's own specifications to go by, this cause for excess cost would be eliminated.

The Symmes Agitator

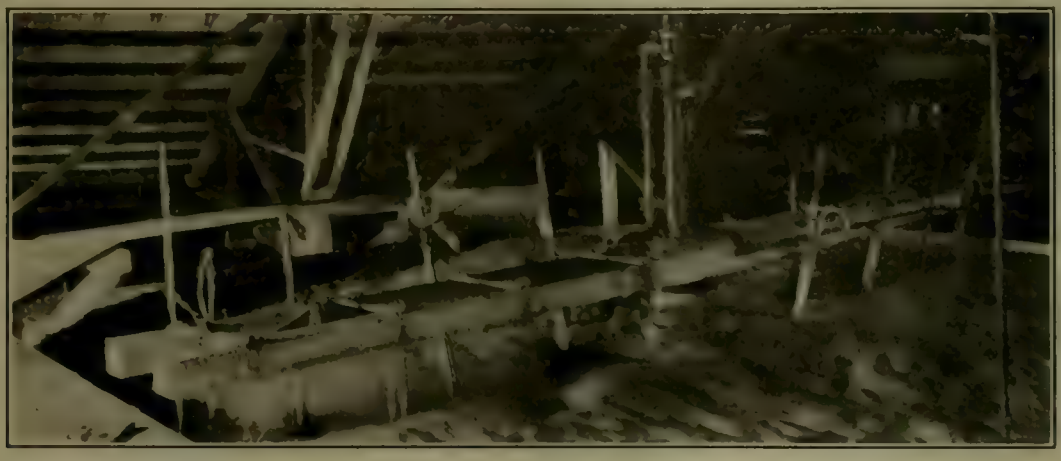
By Whitman Symmes

In sequence of the article by Jay C. Carpenter in the *Mining and Scientific Press* of May 3, it may be of further interest to metallurgists to have a description of my solution of the flat-bottom agitator problem. The results which Mr. Carpenter obtained are excellent, and quite remarkable. But in the operation of the Trent agitators at the West End mill, he was dealing with a much simpler ore than that being cyanided in the Mexican mill. This ore contains heavy lead, zinc, and iron sulphides, and treating without concentration, a much stronger agitation than that described by Mr. Carpenter is required, both for the solution of the silver and gold, and keeping the ore in suspension. For example, when Trent agitators were in the Mexican mill, it was impossible to start them, when they got stuck, by the simple expedient of forcibly reversing the arms, as described by Mr. Carpenter. Indeed, the ore packed so solidly in the bottom of the vat, that the arms could not be made to clear themselves, even when the vat was emptied to within a few feet of the bottom, and men took hold of the arms and attempted to move them. Collars were always fixed to prevent the arms from rising, and consequently there was no trouble from that source such as Mr. Carpenter describes. At first there were steam coils in the vats, but scales of baked clay, from the crust formed on the pipes, would choke the nozzles, and consequently live steam had to be substituted for heating. I do not think that anyone could have given the Trent agitators a fairer trial for continuous agitation of the Mexican ore, than they received under the supervision of the mill superintendent, Charles R. Morris. Mr. Carpenter does not refer to any device, or to any method which was not tried there. The time lost in the mill, due to the Trent agitators, was in hours as follows: March, 1912, 28.6; April, 57.5; and May, 46.8.

In the Mexican mill it was necessary to change solution during the cyanide process, on account of the high tenor and baseness of the pulp being treated. An arrangement of Pachuca agitators, transferring to the Dorr thickeners, and receiving pulp from them, would have been inconvenient, because of the different elevations of the agitators and thickeners respectively. Therefore, it was desired to retain the flat-bottom vats, for metallurgical reasons as well as for economy in the alterations. At that time, the Dorr agitator was not upon the market. I knew of no agitator which would meet our requirements; and so it became necessary to devise one.

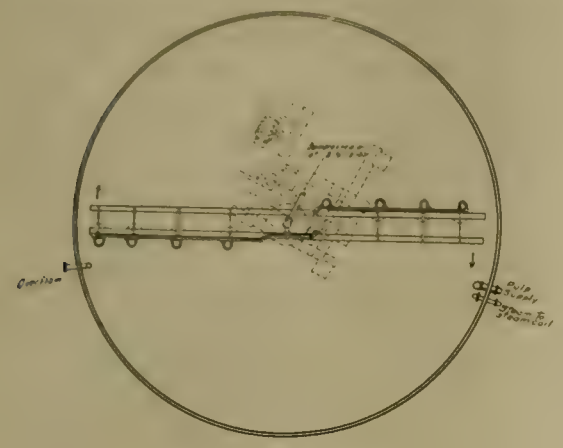
A Perfect Agitator

A perfect agitator should be capable of giving as strong or as weak agitation and aeration as any pulp requires; it should have no wearing parts in the pulp itself; it should not be subject to interference or injury by settlement or packing of the pulp; and all parts should be readily accessible from the outside of the vat. To meet these conditions for a flat-bottom vat, I devised a machine consisting of a number of air-lifts, flexibly suspended from a horizontal revolving arm. In the Mexican mill these are supported from an arm on a standard, fixed immovably in the centre of the vat, and on account of the space available beneath each vat, the driving gear was placed there. The revolving arm could just as easily be suspended and driven from above, if the vats had been resting on the ground, and designed for operating by that method, if required. The agitator can be easily understood from the illustrations. The only parts beneath the pulp that require any attention are the air nozzles. These are protected with rubber sleeves, as in a Pachuca, to prevent a flow of pulp into the air-pipe, when the air-supply is interrupted. The air-lift tubes hang from the revolving arm by means of chains, and are so balanced as to remain vertical when the arm revolves, which in the Mexican mill is at the rate of 1.5 r.p.m. Air is supplied to each tube by a hose, connected with a pipe-union above the pulp. In the



VIEW SHOWING TOP OF VAT FITTED WITH SYMMES AGITATOR.

event that the pulp becomes packed on the bottom of the vat, the air-lifts will drag, and cut their way down through it. A rod, rising from each tube, indicates whether the tube is in a vertical position, or is dragging. If power should be off for a long time, the air-lift tubes can be raised by means of the chains, and then, by being lowered a few links at a time, will cut their way down to their normal position near the bottom of the vat. For agitating a vat while it is being filled or discharged, when the air-lifts are unable to operate, a second air-pipe can be carried down alongside of each air-lift, and air



PLAN OF SYMMES AGITATOR.

may thus be blown into the partly filled vat, but in the Mexican mill the continuous system of agitation is in use, and these extra pipes are not needed. The amount of compressed air used by each air-lift is regulated by means of a needle-valve above the connection, and for this purpose the attendant can walk along the trussed beam while it is revolving. The suspended air-lifts can be easily lifted out of the vat for inspection, by merely disconnecting the air hose at the union, and then lifting the chains off the hooks. There are no flange connections below the level of the pulp, to be cut by action of the moving pulp, and thus made to leak, as in the Trent and some other types of agitators. There are no valves necessary to hold the pulp in the vat, while making repairs to pumps or pipe-lines, and which valves, having been cut by the moving pulp, are generally found to leak badly. There are no pumps to pack and to repair.

The Agitator at the Mexican Mill

The first agitator of the above description started operation in the Mexican mill on August 30, and the second and third were started on November 20, 1912. They are still in operation, and the crushing and grinding department of the mill has never lost any time on their account. They have never been shut down except when the power was off, or when the air-lifts have been lifted out to inspect the condition of the rubber sleeves, which is done about once a month. They have never required any repairs whatsoever, excepting new rubber sleeves. When the first agitator was substituted for the Trent, its superior agitating power was at once apparent. No. 1 Trent had been filled with pulp sampling about $12, and discharging it at $6 per ton. The new agitator took the pulp at $12, and discharged it at $4. The following figures show the improved extraction, other conditions being the same in both cases.

TRENT AGITATORS

		Tailing.	Further extraction possible by agitation.
June	1912	$1.58	$0.23
July	1912	2.01	0.26
August	1912	1.64	0.20

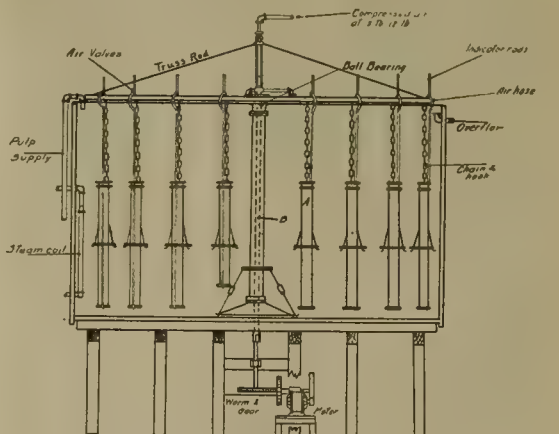
SYMMES AGITATORS

		Tailing.	Further extraction possible by agitation.
March	1913	$1.67	$0.03
April	1913	1.01	0.02
May	1913	1.30	0.04

The undissolved metal of value is practically all silver.

Details of the Agitator

The agitator tanks are 24 ft. diam. by 14 ft. deep. The power consumed by each of the three Trent agitators, for the pumps alone, averaged 6.31 hp. The power consumed in turning the revolving arms of each of the new agitators is less than 0.5 hp., and the compressed air used is equivalent to about 4.5 hp. at the motor which drives the compressor. The latter is a Sullivan, 18 in. diam. by 12-in. stroks, built without a water-jacket, and supplying air at 12 lb. pressure. It is operated at a speed of 93 r.p.m., and supplies all the compressed air used in the mill, for operating three air-lifts, a 16-ft. Oliver filter, the three new agitators, and a No. 525 Steel-Harvey crucible furnace. The compressed air consumed by the agitators, measured by an Excelsior air meter, is



SECTIONAL ELEVATION OF SYMMES AGITATOR.

as follows: pulp, 1 ore to 2 solution, with air 8, 12, and 15 lb. pressure, consumed 29, 80, and 94 cu. ft. respectively, while with 1 ore to 2½ solution, with same air pressure, consumed 30, 74, and 89 cu. ft. respectively. The agitators are ordinarily working with air at 12 lb. pressure or less, and their average consumption is 60 to 70 cu. ft. of free air per minute. The amount of air required depends upon the violence of the agitation which the pulp demands, in order to obtain a complete extraction, and does not depend upon the agitator itself. In one test the

pulp was thinned to 1 ore to 3½ solution, and agitated with only 17 cu. ft. of free air per minute at 8 lb. pressure, without there being any settlement of the pulp to the bottom of the vat. No difference was noticed in the operation of the agitator when the melting furnace was drawing upon the air supply, and probably they could be operated with less air than at present. The agitators require less attention than any other machinery in the Mexican mill, and except for a slight alteration of the piping, which has since been devised, they appear to be as near perfect as it is worth while trying to get. The power has been off for 5 hr. 40 min., and they started without any trouble. It has never as yet been necessary to raise or lower the air-lifts in order to have them cut their way back to the bottom of the vat, and as the indicating rods have not been of any particular use, it is doubtful if they are really necessary. After stoppage, the air-lifts seem to start the agitation by dragging and by cutting their way by means of the induced flow. They appear to be better than the Dorr agitator, in that they have no rakes to be buried in the pulp. I infer this from the similarity of the Dorr agitator to the Dorr thickener, and know that, in the latter, the spider can be broken by settlement of the pulp, owing to lack of attention. Furthermore, our agitators make use of the full capacity of the vat. I believe that they are in every way as good as Pachucas, with the additional advantages of a less first cost, of an absolute freedom from interruptions of the agitation, and the possibility of a cheaper and more convenient arrangement in connection with the now almost universally used Dorr thickeners.

Section 10 of the Mines Act of 1907, of Victoria, Australia, provides that any water or sludge produced from or consequent to any mining operations, and discharged into any watercourse, lake, or reservoir, shall be deemed to pollute or injure the same if such water or sludge, at the point where it leaves any claim or any land comprised in a lease, or any land used in connection with any such mining operations, by or in any respect under the control of the person carrying on the same—(*a*) contains any poisonous matter in the total proportion of more than 50 gr. to 1 gal., or any noxious matter in such quantity as to be injurious or detrimental to the public health; or, (*b*) holds in suspension or solution any earth or mineral, or any earthy or mineral substance in the total proportion of more than 800 gr. to 1 gal. A watercourse includes river, stream, watercourse, waterway, creek, or gulch, and in each case whether water flows therein perennially or intermittently.

The Buffalo Star dredge, Bright district, Victoria, Australia, handled 377,519 cu. yd. of gravel in 1912 yielding about $42,000 in gold. This was from a depth of 33½ ft. The company has re-soiled about 2330 sq. yd., about ½ acre of dredged ground, by carting soil from ahead of the dredge and spreading it from 15 to 18 in. deep on the tailing from the dredge. In December last the oat crop was 4 ft. high, cutting equal to two tons of hay per acre, or 60 bushels if thrashed.

Diamonds and Other Gems Mined in the United States

Gems and precious stones were produced in the United States in 1912 to the value of $319,722, according to Douglas B. Sterrett, of the United States Geological Survey. The kinds of precious stones found in the United States are many, ranging from diamonds of fine quality to low-grade stones such as agates, but, as is seen from the total value of the output, there are no really large operations.

The principal gem mineral mined in the United States during 1912 was Montana sapphire, of which there was a large output for use both as gems and in mechanical applications. The greater part of the gem sapphires came from the mines in Fergus county, where they occur in a rock matrix. The majority of these stones have the true sapphire-blue color. The bulk of the sapphire for mechanical use came from the placer deposits in Granite and Deer Lodge counties and consists of varicolored stones.

The development of the opal deposits of Humboldt county, Nevada, was attended with much success, and a quantity of magnificent gem material was obtained. The opal is of an unusual type, consisting of dark translucent mineral with a variety of rich colors. The deposits promise to supply a gem equal if not superior in beauty to the opal from Australia.

Prospecting and mining at the emerald mine in North Carolina were attended with only partial success. Two pockets or deposits of emerald were removed during the year; other developments consisted mainly of exploratory work, which has continued into 1913.

The tourmaline output of southern California was small, but some magnificent specimen crystals were obtained. Especially fine gem crystals of kunzite were found and brought good prices. The production of turquoise was very small compared with some previous years. Beautiful amethyst was found in Warren county, North Carolina, and some fine gems have been cut from sample crystals. A few fine specimens of golden beryl were obtained from prospects in Alexander county, North Carolina. Beautiful gems were cut from some of these. The production of agate and associated varieties of chalcedony was again large in several Western states.

No great advances are reported in diamond mining in Arkansas during 1912.

Several dozen diamonds were found and several diamond-washing plants were constructed for operation in 1913.

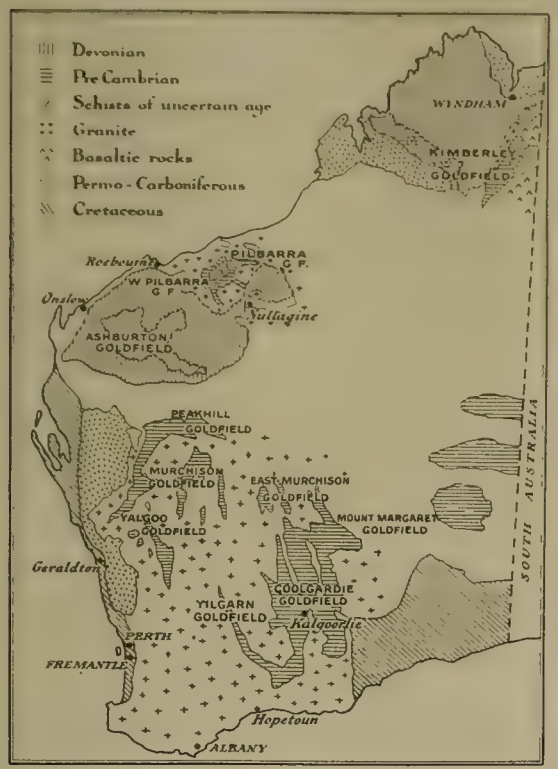
It has been practically impossible to determine the quantity and value of the diamonds found in the Arkansas field since the first discovery in August 1906. Most of the stones are still held by the mining companies and few have been sold. It is estimated from the figures furnished the Survey and from reports in the press and those furnished by private persons that about 1400 diamonds, weighing nearly 550 carats, have been found from August 1906 through December 1912. The total estimated value placed on this output in these reports amounts to $12,108.

Geology of the Kalgoorlie Goldfield—II

By Malcolm Maclaren and J. Allen Thomson

General Geology and Geological History

The area here briefly described lies between the 121st and 122nd meridians of east longitude, and between 30° 30′ and 31° 05′ 18″ south latitude, being approximately 40 by 59 miles and containing 2375 square miles. A general grouping of the rocks and deposits of the region may be made, in order of increasing age, as follows:



GEOLOGICAL MAP OF WESTERN AUSTRALIA.

(a) Recent and Pleistocene:

Drift sand, salt and gypsum (*kopai*) beds, calcareous cements, laterite (ironstone), kaolin clay ('pug'), magnesite deposits, alluvial 'wash', and valley and lake deposits in general.

(b) Pre-Cambrian:

1. Younger granite and quartz-porphyry.
2. (a) Younger Greenstones: serpentine, talc-schist, gabbroid rocks, coarse amphibolite, epidiorite, quartz-dolerite greenstones.
   (b) Porphyrite and felspar-porphyry.
3. Sedimentary Beds: shale, chert, quartzite, and conglomerate.
4. Older Greenstones: fine-grained amphibolite, calc-schists.
5. Gneissic granite (not as yet known in the region).

From the foregoing it will be apparent that there are essentially two rock groups: (*a*) a pre-Cambrian rock complex; (*b*) the denudation under desert conditions of that rock complex. The former is of chief concern.

A small-scale map of Western Australia would show the rocks of the area in question as a comparatively narrow band of greenstones, striking N.N.W.-S.S.E. in a wide area of granite. The band is widest from Coolgardie through Kalgoorlie to Kurnalpi, a distance of 75 miles; to the north and south there is an appreciable diminution in width, the greenstones indeed bifurcating northward (north of Broad Arrow) into two big narrow parallel belts. These changes are not, however, appreciable within the area here discussed, which indeed is almost entirely occupied by the greenstone complex, and shows only small areas of the enclosing granite near Coolgardie on the west, near Black Flag on the north, and at Juglah on the east. East and west of the area the granite outcrops for many miles.

Dealing then with the greenstone complex, the known rocks may be separated into three main groups: Older Greenstones; Sedimentary Beds; and Younger Greenstones, with which are associated porphyrite and porphyry dikes. The internal relations of these are naturally exceedingly obscure on the amount of mapping done, and it is certain that more detailed work would effect considerable local modifications.

Older Greenstones

The Older Greenstones together with the ancient sedimentary beds occupy the major portion of the area. The former are mainly fine-grained amphibolites, with allied or more probably derivative rocks generically termed calc-schists. Both names have only a general significance and give no clue to the original character of the rocks; an amphibolite is merely a hornblende-bearing rock and a calc-schist an indefinite rock characterized by abundance of secondary carbonates, as dolomite and siderite. They form in the field low, long, and broken ridges, which yield low swelling knolls, a physiographical form fairly characteristic of these rocks. Their weathering yields a talus of small rectangular fragments, which break with an approach to conchoidal fracture. Future more detailed mapping should reduce the area allotted to the Older Greenstones, since they have been utilized to embrace all doubtful or insufficiently examined rocks; they will in their reduction yield nothing to the sedimentary beds, but a great deal to the Younger Greenstones. Little may be said concerning the original nature of the rocks grouped as Older Greenstones; they may have been tuffs and ashes, or they may have been lava flows. It seems reasonable to regard them as representing alternations of lavas and ashes, the former furnishing the fine-grained amphibolites, the latter the calc-schists. The Older Greenstones are perhaps most typically developed in the great bands east of Kalgoorlie, for the broad western band at Coolgardie has been so altered by

the intrusion of the younger granite that it has lost many of the characters of the original zoisite-amphibolite (a hornblende rock characterized by the presence of the mineral zoisite).

Sedimentary Beds

In the absence of direct evidence of the nature of the Older Greenstones it is impossible in a time classification to separate from them the ancient indubitably sedimentary rocks of the area. The latter present a normal cycle of sedimentation ranging from coarse conglomerates to fine muds. They are best developed in the neighborhood of and to the south of Kurrawang; they will therefore henceforth be collectively termed the Kurrawang series. Between Coolgardie and Kalgoorlie the sedimentary beds are eleven miles broad across their strike; they run north-northwest across the low ground of the Kurrawang lakes, and pass some distance west of Black Flag. To the south they are lost in low lake country, and do not appear to pass beyond the great Mt. Monger thrust plane.

The series is well exposed in a long line of so-called 'breakaways' that lie on the edge of the 'lake' bed about two miles south of the main Kalgoorlie-Coolgardie road between Binduli and Kurrawang. The sediments remain above the lowest surface levels only with difficulty and only when they have been strengthened by ribs of conglomerate or by dikes of intrusive acid rock; the finer-grained rocks are therefore rarely seen and are ordinarily covered by lake deposits and by wind-blown sand. The conglomerates or 'boulder beds'—the latter is the better appellation—are only sporadically distributed through the sediments, and their appearance is reminiscent of the scattered beds of conglomerate of a great river valley, as that of the Brahmaputra, the individual beds being thin and soon running out to a feather edge. Their greatest development is in the high ground immediately southeast of Kurrawang, where they occupy the ridges and run as far south as Red lake. On the same strike they reappear to the north of the broad low Kurrawang valley in the ridges immediately west of the Black Flag lake. They are here and near Kurrawang composed chiefly of pebbles of quartz, quartzite(?), jasperoid rocks (often banded), and albite-porphyry, all being sparsely distributed in a schistose felspathic matrix. The individual pebbles are often so sheared that they show a succession of minute step-faults; where the pressure has been less severe they are generally deformed. They thus conform to the general type of Archean conglomerates in their scanty distribution through a schisted felspathic and often chloritic matrix. They have, therefore, been claimed by glacialists as products of ice action; but there is nothing in their distribution or in their internal characters that cannot be better explained by invoking the assistance of large tropical rivers, such as the Irawadi and the Brahmaputra of the present day.

Minor Areas

The grits associated with the conglomerates are ordinarily felspathic and come therefore under the old definition of greywacke. Occasional flakes of biotite with derivative chlorite are also found. The general arrangement of the quartz and felspar is indicative of strong shearing.

In addition to the broad Kurrawang area of sediments, three others of minor importance and much more ill-defined are known. Their position may often be traced only by the valleys that result from the lack of resistance offered by these rocks to the agents of denudation. They are all east of Kalgoorlie, the first lying in the long valley that runs down to Hannan's lake along the eastern slope of the Kalgoorlie ridge. This valley was largely used as a source of salt-water supply before fresh water was brought to the goldfield from the coast, and several water-shafts are scattered along its length. Their dumps furnish no information, and the only good exposure is in the Phoenix quarry, north of Hannan's brewery. Even here the rocks have been so crushed and altered that a sedimentary origin cannot be postulated for them with certainty, and the valley has, as a matter of fact, been mapped as a sedimentary area largely by comparison of its weathering products with those of the undoubted sediments of the Kurrawang area.

Much the same would have had to be said for the second band of sediments near Kurramia, were it not for the fortunate discovery of a small band of scattered boulders and pebbles in a cutting on the wood line tramway about one and a half miles east of Kurramia station. In this area also the width of the sediments, about three miles, is indicated by the width of the flat valley bottom. The eastern boundary is extremely indistinct since, and especially along the Kalgoorlie-Kanowna road, the sedimentary beds appear to join the Kanowna sheared-porphyry area, the surface of which also tends to sink to valley bottoms.

Secondary Sediments

The third area of sediments lies to the northeast. Its western boundary appears to lie near Penny's Find, about 17½ miles from Kurnalpi. Two miles farther east the road passes through a break in a low ridge, which, to the south of the road, shows beds of conglomerate rising to the top of the ridge. The pebbles of this conglomerate are chiefly basic amphibolite with banded jasperoid quartz, and are thus sharply differentiated from the conglomerate bands of the Kurrawang and Kurramia areas. The presence of basic amphibolite pebbles naturally raises the question of the age of the sedimentary beds, and since the amphibolite resembles the rock of the Older Greenstone rather than that of the Younger Greenstone, it is assumed that the sediments are younger than the former, which is undoubtedly the case.

Younger Greenstones

Under the general title of Younger Greenstones are included several rock species, which are, however, regarded as representing successive segregations from a single common magma. Their wide divergences as well as their close relationship is perhaps best indicated by the following table. For purposes of description, the intrusive dikes of porphyrite and albite porphyry, though they do not

strictly come under the heading of 'greenstones.' are included here:

Probable original rock.		Now represented in the field by:
Ultra-basic	A. Peridotite	Serpentine, talc schist, coarse carbonate rock.
"	B. Pyroxenite	Coarse hornblende rock.
Basic	C. Hornblende-dolerite	Lustre-mottled amphibolite.
"	D. Gabbro or dolerite	Epidiorite.
Sub-basic	E. Quartz-gabbro or quartz dolerite	1. Epidiorite with micropegmatite. 2. Chloritic rock with micropegmatite (quartz-dolerite greenstone). 3. Bleached and carbonated rock with micropegmatite ('granite' of the miners at Kalgoorlie).
Intermediate	F. Porphyrite	Porphyrite.
Acid	G. Albite-porphyry	Albite-porphyry.

The younger acid members are found intrusive into the intermediate and basic members of the complex. By far the most important member of the series, from an economic point of view, is the quartz-dolerite greenstone, so well developed in the Kalgoorlie mines, and, in its typically productive form, restricted, so far as examination has gone, to that area.

Ultra-Basic Rocks

The ultra-basic rocks have their greatest development in the neighborhood of Bulong. The serpentine arising from the alteration of the original rock, a peridotite, is often indicated, in the absence of rock exposures, by the magnesite boulders and fragments strewn over the surface of the soil. The long dike of ultra-basic rock running along the Boorara ridge and passing west of the Halfway hotel on the Kalgoorlie-Bulong road was thus first indicated. Nearer Kalgoorlie ultra-basic rocks occur in the north end of the Kalgoorlie belt and also in some profusion east and northeast of Mt. Hunt (or Mt. Robinson, as it is locally termed) four miles south of Boulder. Another small area is found west of the true Mt. Robinson, which lies eight miles east-northeast from Coolgardie. These areas were originally mainly peridotites, but with them occasional patches of pyroxenite appear to be associated.

The next group of rocks in this series includes quartz gabbro and quartz dolerite (diabase) now represented in the field by amphibolitic, epidiorite, and quartz-dolerite greenstone, the minor variations in rock features represented by the three latter types arising from slight original differences (generally in basicity) set up by segregation within a magma and also from differences in degree of later alteration. These rocks constitute, with the ultra-basic rocks, the great mass of the Younger Greenstones. Their greatest development is probably at Kalgoorlie, where the intrusive dike (the 'Kalgoorlie Dike') is 1½ miles wide. They occur normally as dikes in the Older Greenstones or in the sedimentary beds, and from this feature, which is best shown by the dike near Mungari and by its northward continuation in the Kurrawang valley, the relative ages of the two great series of greenstones is established.

Gabbros

The obviously gabbro members of the Younger Greenstones show remarkable persistence in direction. Two main bands have been made out, the first lying along the Abattoirs ridge, west of Kalgoorlie, and the second passing through Mt. Monger. The first passes away to the south along the ridge southwest of Mt. Hunt; northward it dies away in the Kurrawang valley to reappear much more clearly defined, both in position and in character, west of the Lady Bountiful. Farther north and a little distance southwest of the Slippery Gimlet mine, the band shows a much fresher rock. Here the pyroxenes are quite unaltered, and the structure is that of a normal gabbro. The second gabbro band is shown by the dark green band passing through Duplex and Simplex hills to near Mt. Monger township and so to Badalbi hill. This belt may be traced on the surface by its peculiarly dense vegetation, carrying a low branching shrub that reaches a height of three to four feet and is not so seen elsewhere.

The original dolerites (diabases) are not so strongly marked in the field as the gabbros. They form strong ridges, which are, however, not persistent. They now occur as epidiorite, or, if very much altered, as amphibolite. It may well be that in this group rocks of two ages are included, for certain dikes; for example, one crossing the road near the 39-mile peg on the Kalgoorlie-Bulong road, have a north-south strike, while the regular strike of the majority of the bands is north-northwest to northwest.

Some of these do not differ greatly from the country of the Kalgoorlie lodes, and probably would have resembled that exactly had they been wider and had thus greater opportunities for a more complete segregation of acid and basic components during cooling. The variations from the normal type on consolidation and the later changes induced by pressure and the passage of underground solutions will be fully detailed in later pages.

Porphyrite

The next member of the segregation series to be considered is porphyrite. This rock shows considerable variation in appearance when collected over a large area, ranging from dark gray to bluish rocks like diorite to light porphyrite rocks distinguishable with difficulty from felspar porphyry. They are all, however, characterized by the presence of notably large well shaped crystals of felspar. The felspar porphyries also show these large crystals, but do not contain the hornblende or the biotite (black mica) that are found in the porphyrites. Some varieties of porphyrite show little groundmass and few large felspar crystals; these are diorite-porphyrites. Others show a considerabe almount of groundmass with large crystals of felspar, hornblende, and biotite; these are hornblende-porphyrites or mica-porphyrites, as the hornblende show remarkable persistence as bands. The bands immediately west of Kalgoorlie may be traced southward by Feysville, and may be correlated with an obscure highly

sheared rock lying on the plain east of Wolluba. This band reappears beyond the Kurrawang valley on the ridge east of Mt. Black Flag, and farther north broadens considerably. At the Slippery Gimlet mine the rich lode now being worked lies in this rock, which is more easily recognized in the hand specimen as a porphyrite than under the microscope where the coarse structure is not apparent and the only name suggested for the rock is amphibolite, a useful general term denoting merely a hornblende rock and giving no clue to the nature of the original rock.

Other porphyrite areas are the neighborhood of the Majestic leases on the Randalls road; the country of the Queen Margaret lode at Kanowna; the Halfway Hill on the Gindalbie road; and near the 12-mile peg on the Coolgardie-Kunanalling road. The porphyrites weather badly and their limits are generally difficult, and often impossible to trace. They, moreover, weather as to the west of Mt. Hunt, to a product resembling a decomposed highly felspathic grit, and in this state may readily indeed be confounded with the true sediments of the Kurrawang series. It is also suspected that sheared porphyry areas furnish much the same weathered product and in these cases there is considerable doubt as to the original character of the rock, whether sheared porphyry, sheared porphyrite, or felspathic grit.

Albite-Porphyry

Probably closely connected in origin with the porphyrites is the albite-porphyry (also termed soda-porphyry and felspar-porphyry), which occurs in narrow dikes, striking as a rule with the country in a general north-northwest direction. It is best known at Kalgoorlie and Kanowna, few exposures having been found outside those centres. Their general features will be described in detail when dealing with the Kalgoorlie field. In the vicinity of Kanowna albite-porphyry of two ages is known. A broad band of this rock has been crushed, brecciated, and occasionally mashed; its occasionally rounded fragments have been regarded by several observers as pebbles and boulders in a conglomerate, while the southwestern mashed portion (above mentioned) has been claimed as a felspathic grit giving confirmatory evidence of sedimentary origin. The fragments are cemented by quartz. Throughout the whole band, however, there are only two kinds of fragments, albite porphyry and a sheared rock found near the northern boundary of the area and representing the basic greenstone which is developed on that side. Finally there are no quartz pebbles in the band. Considerable light is thrown on the origin of this crush-breccia by the Binduli quartz-porphyry dike, which on being followed southward into the lake country, passes gradually from solid quartz-porphyry into a breccia in every respect similar to that at Kanowna, all stages of the passage being obtainable. The Kanowna crush-breccia is penetrated by a broad albite porphyry dike, along the walls of which the main White Feather lodes have been developed. In this rock also the rich flat quartz-veins of the Red Hill at Kanowna have been formed.

Granite and Quartz-Porphyry

It has already been shown that the Kalgoorlie area as described above forms a portion of a band of greenstones enclosed within granite. The greatest area of granite within the area is found in the southwest near Coolgardie, where the normally even N.N.W.-S.S.E. boundary of the granite and greenstone is broken by long western tongues of greenstone brought into their present position by faulting along thrust planes. Tongues of granite are also intrusive into the mass from the south crossing the Red Hill road 10 and 15 miles southeast of Coolgardie. The granite is the normal biotite granite. Its contact with the greenstone certainly does not dip flatly to the west, for a diamond-drill bore in the granite (in search of artesian water!), sunk from a point a little west of the boundary, reached a vertical depth of 2300 ft. without meeting greenstone. Near Black Flag there appears the southern termination of a tongue of granite that splits the greenstone band in two, the western portion of the greenstone running out to a point in the wide granite area near Davyhurst. A small granite area is present at Juglah. The granite rarely appears at the surface, but its presence may nearly always be assumed with certainty from the white sand that its disintegration affords. Where it does appear above the surface it furnishes the 'gramma' holes of the natives; for regions that have not been visited in Western Australia the existence of large well defined gramma holes is assumed to be indicative of a granitic area.

The quartz-porphyry dikes that occur within the greenstones are to be considered tongues or apophyses from granite masses either now exposed to the east or west or concealed at great depths beneath the greenstones. They are therefore most frequently found toward the margins of the greenstone bands; none are known in the immediate neighborhood of the Kalgoorlie mines. They are intrusive both through the Older Greenstones (at Coolgardie) and through the sedimentary beds (at Binduli). The largest area of quartz-porphyry known within the greenstones is perhaps that lying five miles northeast of Kanowna where the quartz-porphyry forms the bold hills overlooking the flats that were the scene of the 'Sacred Nugget' rush of bygone days. Another large area is in the neighborhood of Hunt's old dam at Wongi, in the south of the area. These dikes may often be traced, like the granites, by the clean white sand they yield at the surface.

Geological History

The clearest view of the internal relations of the goldfield rocks may perhaps be obtained by recapitulating the geological history of the region, and, with the foregoing facts at command, it becomes possible to outline at least its salient features. Since all the important events in that history took place at a time inconceivably distant—perhaps 15, perhaps 25 millions of years ago—and since it was a period of great stress, during which some of the components of the rock complex lost or masked their identity, the history may err somewhat in the sequence of minor events; that it is possible to re-

construct any portion of its history is due to the fact that to its troubled youth there succeeded a long life of strongly contrasting quietude during which the region has gently oscillated moving perhaps an inch in a century—in faint response to world stressing forces that have beaten with little effect against the great rock buttress on which the goldfields of Western Australia lie. One other such region there is in the world, so similar in its rock composition and in its life history as to suggest that it forms the northern portion of a province, of which the middle portion has disappeared beneath the waters of the Indian Ocean, leaving the southern Western Australian section still uncovered. It is the Deccan region of southern India, and its previous examination has greatly assisted me toward the elucidation of the general problems afforded by the older rocks of Western Australia.

There is, in the small area studied, no exposure of the ancient gneissic floor on which the oldest rocks were presumably deposited. These gneisses do occur far to the east of Kalgoorlie, and they are also, it is believed, brought up by block faulting in the neighborhood of Albany; they may therefore be below the present surface, or, on the other hand, they may, and there is probability in the assumption, have been absorbed by later granitic magma as it 'stoped' its way toward the surface. That there were granitoid rocks is apparent from the pebbles in the conglomerate already described.

Sub-Kalgoorlie Formation

A broad granite area may therefore be imagined as the foundation on which the Kalgoorlie rock complex has been built up. Of its age, nothing can be said. It was before time, even as the word is understood in its geological sense, commenced to exist. It may indeed have been a portion of the fundamental gneiss of the older geologists, conceived by them to be the original product of surface solidification on the cooling of the earth. Its origin is immaterial, and further speculation concerning it is profitless. For long ages it lay bare in a world devoid of life, animal or vegetable, but at length there came an epoch that saw it shaken and riven by the forces of compression and tension that have molded the earth's surface; and up and through the fissures thus made, urged by the same lateral pressure or by the same release from overlying pressure that had induced the fissures, there welled a great lava magma that, emerging through volcani foci, covered the surface far and wide with lava flows, and, when much steam was present in the magma, with volcanic ashes. The first lavas were akin perhaps to andesite and basalt, and were succeeded in the natural order of the segregation of magmas, operating then, as now, by more acid lavas as trachyte and rhyolite. These rocks form the Older Greenstones. It is probable that the expiring effort of that cycle of igneous activity sent acid dikes (aplite, pegmatite, quartz, and felspar-porphyry) ramifying through the lavas and ashes; so much is indicated by the conglomerates of the sedimentary beds. The crushed and brecciated felspar-porphyry area of Kanowna may well belong to this period. After the solidification of these rocks earth-stresses engendered fault fissures and thrust planes, the filling of which with silica and iron oxides gave rise, but only near the surface, to bands of jasperoid rocks that rose to form the ridges of the country.

Erosion Agencies

On these rocks, then, the rains and winds and rivers of that far-off time acted as they would act today, decomposing and disintegrating the surface and transporting the resulting débris to lower levels. Only in rare cases were the lavas sufficiently resistant to form and to remain pebbles; ordinarily they were broken to sand and triturated to mud. The boulders of the coarser sediments therefore represent merely the harder ribs of the land; quartz-pebbles from quartz 'blows' and veins, banded jasperoid pebbles from the jasper ridges, aplite, pegmatite, quartz-porphyry, and felspar-porphyry from the dikes that seamed the country, and finally a few granitic pebbles from the presumably more distant granite mountains. These with much fine sand constituted the burden the great rivers carried toward the sea. The general facies of the sediments thus laid down indicates that the sea had not been reached within the Kalgoorlie area, but rather that the region lay in the track of a great river, as the Ganges or Brahmaputra, and that it was, like them, subject to periodic floods. The sporadic distribution of the conglomerate beds, together with the comparatively wide separation of individual pebbles, point to a river changing its channel from season to season and so moving laterally across its plain, and to a situation near the embouchure of that river from a high mountain range.

This concluded what may conveniently be termed the first stage in the geological history of the region; a great river plain had been formed, and from it there rose foothills of igneous rocks succeeded by distant mountain ranges and peaks of granite, from the deep valleys of which a many-branched river ran to the alluvial plain. No auriferous lodes or veins had then been formed in the rocks, and their débris therefore carries no ancient 'leads' or 'gutters'; whatever gold these Older Greenstones and sedimentary beds may carry, and it is little, is due to impregnation during a long subsequent epoch.

Effect of Compression

The region was now subjected to intense horizontal compression acting from E.N.E. to W.S.W. The horizontally bedded sediments and the then little-altered volcanic rocks were involved in the compression and were buckled into long low waves which became narrower from crest to crest until at length they were crowded on each other in intensely sharp folds, carrying far below in the bottom of the folds, the rocks that had originally been on the surface. The rocks have been crowded together so closely that it is now impossible to say whether the five bands of Older Greenstone—namely, at Coolgardie, Kalgoorlie, Boorara, Balagundi, and the Bullock Holes—are five separate beds of lavas and ashes, or are merely preserved portions of one and the same series; the same may be said with regard to the four bands of sedimentary beds.

Railroads and Transportation Problems in Bolivia

By G. W. Wepfer

This article is written primarily in the interest of mining engineers and prospective investors in Bolivian mines, for the purpose of shedding some light on Bolivian conditions and the future possibilities of the mining industry in that country. Three successive presidents of Bolivia have been working for the settlement and peaceful development of the country. President Pando arranged the frontier dispute with Brazil, President Cornel Montes made peace with Chile, and President Villazon is at present following the same policy. Within the country there is a difference in elevation between the *pampas* of the east and the snow-covered peaks of the Cordilleras of more than 20,000 ft. The food products of the temperate and the tropical zones supply a great part of the population of the Andean plateau and the miners in the Cordilleras. Further railroad and river navigation facilities are required to carry the products for export to the ports of Antofagasta, Arica, and Mollendo on the Pacific and to Para, Buenos Aires, and Montevideo on the Atlantic, and will undoubtedly soon be furnished.

MAP SHOWING OPERATING AND PROJECTED RAILWAYS OF BOLIVIA.

Silver v. Tin

The city of Potosi was founded in 1545 and by 1595, before the settlement at Boston, it had a population of 160,000 inhabitants. The ore in this locality is as rich as when mined by the Spaniards in the colonial days, and there is more of it in place today than mined by the Spaniards. The silver ore is not mined as much as the tin ore, which the Spaniards had no use for, and had left in the mines. As tin at the present time pays better than silver, it is given the preference. In most parts of Bolivia the wages of the ordinary miner is 60c. per day, from which the miner buys his own food. In the barren parts of the country and where food has to be brought a long distance, as at Potosi, wages are much higher. The silver and tin concentrates from Potosi are carried by llamas to the Pacific coast in the same manner as they have been for the past 368 years. The llamas require fifteen days to make the trip from Potosi to Uyuni. The new railroad from Potosi to the station at Rio Mulatos on the Oruro-Antofagasta line, which

will be opened this year, will require not more than 12 or 15 hours for this trip. When this line is opened, provisions can be delivered cheaply at Potosi which will result in a reduction in the high wages and also the freight charges to the coast ports.

Drilling is done entirely by hand at the present, and if air, electric, or oil drills were introduced a great saving in the cost of mining would be effected. Distillate and crude oil can be obtained from the Peruvian side of Lake Titicaca. These improvements will result in a more profitable working of ores for gold, silver, tin, copper, antimony, bismuth, tungsten, wolfram, and other minerals. The tax on mineral lands is only 60c. per pertenencia (2.47 acres) each 6 months. The export tax on metals is 1c. per ounce of silver and 20c. per ounce of gold.

Andean Plateau

In sheltered parts of the Andean plateau are fertile valleys which abound in wheat, corn, fruit orchards, and flowers. Cochabamba, a city of 25,000, and Lucre, with 20,000 inhabitants, have beautiful parks and pleasant surroundings. The families of many of the mining engineers reside here. Some live on the farms, as the natives are kindly disposed toward foreigners. The hot springs at Colcha are sought by many as a cure for rheumatism. Savage Indians are still in the country, but it is hoped that by their association with semi-civilized Indians they will be gradually raised to a state of usefulness.

Bolivia has an area of 59,721 square miles and a population of 2,500,000, including 240,000 savage Indians. The greatest part of the population are living on the Andean plateau and the eastern Cordilleras.

The first railroad in Bolivia, which was built between Antofagasta and Oruro by the Huanchaca Mining Co., was a 30-in. gage line and was splendidly equipped. The continuation of this railroad with broad-gage track is called the Bolivia Railway Co., and runs from Orura, *via* Viacha, to La Paz. The trip from Antofagasta to La Paz is made in 48 hours. Passenger trains leave Antofagasta for the interior every Wednesday and Saturday at 6:40 p.m. The steamships, as a rule, arrive in the roadstead of Antofagasta in the forenoon of those days, which makes it possible for the passengers to leave by the evening trains for La Paz. La Paz lies in the deep cañon of the La Paz river, about 700 to 800 ft. below the edge of the plateau. At a point above the city is the La Paz Alto station, the terminal of the steam cars. The train is subdivided into sections at this station and taken down the mountain to the city station by electric locomotives. The trains departing from La Paz city station are taken to La Paz Alto in sections, where they are united to form the trains for Viacha and other points. La Paz is a city of 80,000 inhabitants, and has electric power, electric light, street cars, and as good hotels as are to be found anywhere in South America.

Results of the Nitre War

In consequence of the unfortunate nitre war with Chile in 1879, Bolivia lost the provinces on the Pacific coast. While Peru also lost some of the seaboard, and keeps her animosity toward Chile, Bolivia has come to an amicable understanding with Chile and made an agreement whereby Chile is to build a railroad from the former Peruvian port of Arica to Viacha on the line to La Paz, and so give another outlet to the Pacific coast. Work trains were running over the whole of this road last year, but the line has not yet been opened to general traffic. Trains will go from Arica to La Paz in 12 hours. Passengers arriving at Arica during the day can leave the same evening and arrive at La Paz the following morning. The third connection of Bolivia with the Pacific coast is by rail from Viacha to Guaqui, a port on Lake Titicaca. Trains from La Paz leave early in the afternoon, arriving at the steamer pier in Guaqui at 6 p.m. Here the train is met by the fast twin screw steamer *Inca*, which crosses the lake and arrives at the Peruvian railroad station Puno at 6 a.m. The journey is then continued across the western Cordillera. At Crucero an altitude of 14,666 ft. is reached and the train then speeds down to the port of Mollendo (Peru) making the trip from La Paz in about 30 hours. The Peruvian Corporation, Ltd., of London and Lima, owns the railroad and steamer *Inca*, and has large locomotive and steamer repair shops at Arequipa. The *Inca* has good passenger accommodations. This Company also has a concession from the Bolivian government to improve the Rio Desaguadero by conducting the surplus waters of Lake Titicaca to Lake Poapo. The Company has steamers and barges along this river to collect tin concentrate, silver, and copper, and to carry them to Lake Titicaca and thence to Mollendo. There is also the port of Chilalaya on Lake Titicaca, toward which point can frequently be seen large convoys of llamas, numbering from 100 to 1500, wending their way laden with concentrates. From Chilalaya the concentrates are shipped to the coast by the Peruvian corporation.

River Navigation

By the settlement of the frontier dispute between Bolivia and Brazil, Bolivia received £2,000,000, which sum was used to build a railroad around the rapids of the rivers Beni and Mamore on the Brazilian frontier. These two rivers unite at Villa Bella and form the Rio Madera (Madeira in Portuguese). Near this junction there are 14 distinct rapids which prohibit navigation. These rapids have been navigated by rafts, and although the Indians have acquired much skill in handling them, the loss of life and merchandise is appalling, amounting to between 20 and 50% of the material transported. The tropical climate, together with every kind of fever and other disease, can only be compared with former conditions in Panama. In 1870 a Philadelphia company obtained a concession to construct a railroad around these rapids, but failed. Below the rapids, the river is navigable for large steamers for more than 2000 miles to the city of Para at the mouth of the Amazon river. Above the rapids, the river Bemi is navigable as far as Puerto Pando, the railroad terminus from La Paz, and also up the Rios Mamore and Chimore to the railroad terminus of the Oruro-Cochabamba-Chi-

more railroad. This railroad is now finished, and from Porto Velho to Guatara Merrim and Riberalta it is called the Madera-Mamore railroad, and is an American enterprise with headquarters in New York City. The greatest difficulty to contend with in the construction of this road was the climate. The Company has built at Porto Velho a model town and hospital.

Present Railroad Situation

The following table shows the railroad situation at the present time:

RAILROADS IN OPERATION IN BOLIVIA

	Miles.
Antofagasta to Oruro (within Bolivia)	574
Ollagüe to Oruro	303
Oruro to Viacha (standard gage)	126
Uyuni to Huanchaca	26
Arica to La Paz (within Bolivia)	273
Caraña to Viacha	125
Branch line to Corocoro	5

RAILROADS IN COURSE OF CONSTRUCTION

Uyuni to Tupiza	120
Rio Mulatos to Potosi	108
Machamarca to Uncia	52
Oruro to Cochabamba	119

RAILROADS PROJECTED

Tupiza to La Quiacha	58
La Quiacha to Trajai	131
Potosi to Sucre	106
Oruro to Caraña	189
Cochabamba to Chimore	124
Cochabamba to Vinto	11
Chimore to Puerto Valarde	77
Cochabamba to Arani	45
La Paz to Puerto Pando	158
Puerto Acosta to Rurrenabaque	283
Yacuiba to Santa Cruz	447
Riberalta to Guajara Merrim	66
Guajara Merrim to Velho	145
Porto Velho to San Antonio	5

The outlet from southern Bolivia to the east will be by way of Uyuni, Tupiza, La Quiacha, Jujuy, and Camposanto to Buenos Aires, and as soon as the line from Yacuiba to Embarcacion is built, this road will also be the outlet for the eastern part of Bolivia. Last year the line from Buenos Aires to Santiago was interrupted by snow for three months; passengers and mail had to go from Valparaiso around South America to Buenos Aires. The Argentine line could keep the trains running to the tunnel, but the Chilean line could not keep their end of the road open. The Rio Pilomayo and the Rio Paraguay are large rivers and require but little improvement. They unite at Asuncion and form a continuous water route to Buenos Aires and Montevideo.

Future Outlook

With the completion of the railways which are now in course of construction and the lines which are projected, together with the opening of the waterways, access will be possible to parts of Bolivia which to date have been practically inaccessible. With reduced transportation charges and an outlet to the markets of the world, the mining industry will undoubtedly make great progress and the mineral wealth of Bolivia will attract more attention in the future than it has in the past.

The Magnet Silver-Lead Mine, Tasmania

By P. G. TAIT

*This mine is owned by the Magnet Silver Mining Co., and is situated on the slope of the Magnet range, some five miles from Waratah, on the old Corinna track, which crosses the Pieman 12 miles from the coast, and was the original outlet for the Zeehan field. In its early stages the Company trammed its products to the Corinna-Whyte river road, then carted it to the Emu Bay railway at Waratah for shipment to Burnie on the north of the island. Today the mine is connected with the Emu Bay railway, near Waratah, by a substantial two-foot gage steel tramway, 10 miles in length. It is currently reported that this line, which cost $144,000, was built from the profits of a rich ore-pocket taken from No. 1 level. The scenery along this line is picturesque, and any visitors to Waratah would be amply repaid if they included this 10 miles in their tour. The railway cuts are studded with berries of various hues, and the fern gullies are really magnificent. The Company possesses two Koppel locomotives, and one by Krauss & Co., all of the articulated type, to negotiate the 99 curves on the route.

The Mine

The top workings of the mine consist of four adits, driven from the eastern slope of the range in a westerly direction, the lode being cut in 40 to 350 ft. of driving. The lode traverses the eastern slope, bearing south 30° west, and consists of a gossan formation from 1 to 30 ft. wide, rich in silver and lead, and carrying a little gold, with dolomite walls. The slate approaches close to the hanging wall on the north end, but is not seen on the south end of the worked portion of the lode. Near the surface the lode was worked by open-cut, and was rich in silver and lead. The Company made large profits out of this portion of the mine. The present workings of the mine are reached from No. 4 level. An inclined shaft at an angle of 20° has been sunk to a depth of 480 ft. The hoisting station is 350 ft. from the mouth of the main adit, and is equipped with a hoist and two Cameron steam pumps. The cross-cuts, of which there are seven, are 65 ft. apart. No. 5, 6, 7, and 8 are depleted so far as the present ore-shoot is concerned, but there is no reason why payable shoots of ore would not be found if the levels were driven south beyond the break or fault which cuts off the ore. The gossan formation, continued down to below No. 7 level in the central portion of the orebody, is being displaced on the north and south ends by dolomite. These levels were also rich in silver and lead, the gold contents diminishing with depth. The greater part of the mine's output is being produced from No. 9 level, which has an approximate ore reserve of 15,000 tons.

The main shaft was sunk two levels, or 130 ft., below No. 9 level, and two stations cut, and the bot-

*Abstract from *Mining and Engineering Review.*

tom level. No. 11, was driven first, the foot-wall of the lode being cut at 234 ft. from the shaft, when splendid ore was opened. The cross-cut was then continued across the lode until the hanging wall was reached, the lode measuring 60 ft. across. On the hanging wall a fine body of ore was cut 2 ft. in width. Prospecting drifts north and south of the cross-cut are being driven with excellent results, and the manager considers the prospects at this level are promising, and estimates that there is from 10,000 to 15,000 tons of ore in sight. At No. 10 the cross-cut was in 196 ft., and had just reached the foot-wall of the lode. Sullivan machine and hammer drills are used extensively. The air is supplied by a water-driven compressor. Since 1902, 80,500 tons of ore has been exported.

Concentrating Mill

The ore is trammed from the mine and dumped onto a sorting-floor adjacent to a shaking-screen, into which it is shoveled in order to give a more even distribution on the shaker. All pieces below 1¾ in. go direct to the mill, the larger pieces being fed onto a picking belt. The first-class ore and clean gangue are here separated, the middling going to a bin, thence to a 9 by 16 Blake crusher, where it is crushed to 1½ in. and trammed to No. 1 mill-bin. From this it goes by automatic feeder to No. 1 shaker. This has a screen with 3-in. square holes to catch any large pieces, chips, etc. All the undersize is fed to No. 1 rolls set ½ in., thence by No. 1 elevator to two lines of trommels screening to over ¾ in., between ¾ and ½, ½ and ⅜, ⅜ and 3/16, 3/16 and 3/64, and under 3/64 in. The screened ore is delivered to 10 two-compartment Harz jigs, which only make two products. The tailing (and over ¾ in.) join at a dewatering screen, ⅜ by 3/64-in. slots, delivering ore free from water to No. 2 elevator, and all the fine and water to a settling-box beneath. The fine is lifted by an ejector to a 3-in. slime pump, where it is joined by the undersize from the trommels. No. 2 elevator lifts the feed to a 100-ton bin, from there by roller feeder to No. 2 rolls set ⅛ in. Then it goes to No. 3 elevator, and to No. 4 shaker, giving over 7/32 in., between 7/32 and 3/64, and under 3/64; over 7/32 in. going to No. 3 rolls, and thence back to No. 3 elevator; between 7/32 in. and 3/64 in. to four 5-ft. Bigelow grinding pans, thence to No. 5 shaker. Under 3/64 in. goes to spitzkasten, where it joins the sand and slime brought up by a 3-in. pump, giving one spigot to No. 5 shaker and the overflow to five single spitzkasten. No. 5 shaker gives over 3/64 in. and under 3/64 in., the former going back to No. 3 elevator and the latter to one pair of 30-mesh Callow screens, giving oversize to two single-compartment May jigs, making heads and tailing. The undersize goes to one pair of 60-mesh Callow screens, giving oversize to two Card tables making heads, middling, and tailing; middling returned to No. 3 elevator; undersize of 60-mesh Callow screens to single spitzkasten, giving two spigots of two Card tables making heads, middling, and tailing; middling back to No. 3 elevator, overflow of spitzkasten to five single spitzkasten, giving one spigot each to five Luhrig vanners, making heads, middling, and tailing; middling returned to No. 1 elevator, and overflow to 11-compartment spitzkasten, giving 11 spigots, and overflow to waste; 11 spigots to one single spitzkasten, giving one spigot and overflow to waste; spigot to one Luhrig vanner giving heads, middling, and tailing; middling to No. 1 elevator. Dressing water is circulated by a 6-in. centrifugal pump, working at 1400 r.p.m. The ore is intimately associated with the gangue, making it undesirable to discard any tailing until it will pass 3/64-in. mesh.

Power Equipment

The mill is driven by three Pelton wheels, working under a 450-ft. head, No. 1 giving 67 hp.; No. 2, 86 hp.; and No. 3, 14 hp. It treats 50 tons per shift of eight hours. There is also a 10-drill Kelly & Lewis compressor, driven by a Pelton, and another for the lighting dynamo. All the Pelton wheels were supplied by local engineers and are giving very satisfactory service. An auxiliary steam plant in two units is available for use during the dry months.

Accretion of gold in amalgamation, according to Allan J. Clark and W. J. Sharwood, consists in the building up of a crystalline layer of comparatively hard amalgam of appreciable thickness, which in extreme cases, as at the Drumlummon mill, may exceed ⅛ in. If the plate is strained by buckling, or by blows, the brittle sheet of amalgam can be detached in a more or less broken condition, leaving little but the film held by adhesion. Heating over a fire, or the application of steam or hot sand, softens the crystalline amalgam and facilitates its removal by a scraper. In the cold condition it is so hard that it is impossible to avoid gouging into the copper plate when removing it by a steel scraper. Inside plates show accretion to an extreme degree, the amalgam in some cases building up to a thickness of an inch or more. In the case of outside plates such a layer of crystalline amalgam forms an exceedingly efficient, but somewhat expensive, medium for retaining the quicksilver or soft amalgam which is requisite to catch the finer gold from passing pulp. One of the principal objects of electro-plating is to provide a cheaper medium; unburnished electro-deposited silver forms a porous coating easily penetrable by mercury, in which respect it differs from rolled copper. A coat of silver has a minimum thickness of about 0.001 in. for every troy ounce of silver deposited per square foot, but the rough coat obtained in practice is considerably thicker.

Production of raw iron in Germany during May 1913 surpassed all previous records. The total output amounted to 1,641,600 metric tons, as compared with 1,587,300 in April 1913, and 1,492,157 in May 1912. The various sorts produced during May were: foundry pig, 309,892 tons; bessemer, 29,406; thomas, 1,049,524; steel and spiegel, 207,227; and puddle, 45,551.

Coke output of Alabama in 1912 was 2,975,489 short tons, valued at $8,098,412.

Tailing and Ore Treatment at Broken Hill

*The Zinc Corporation, Ltd., operates a flotation plant for treating tailing acquired from mines in the district, and a concentrating plant for treating ore from the South Blocks mine.

Zinc Concentrator

During the year 345,425 tons of tailing was treated, averaging 14.41% zinc, 6.94 oz. silver, and 5.5% lead, yielding 85,354 tons of zinc and 10,881 tons of lead concentrate. These products, at the average prices of metals for the same period, were worth

ZINC CORPORATION'S FLOTATION PLANT.

£449,047. A by-product, in the form of zinc slime, was also saved and stored for future treatment, which, if valued on the basis of a previous sale, would yield £14,989. It is hoped that results obtained from trials of the Horwood process, which indicate an increased revenue from this material, will be achieved on a working scale.

The recovery of metals in the various products was as follows:

	Zinc, per cent.	Silver, ounces.	Lead, per cent.
Contained in zinc concentrate	80.9	44.7	...
Contained in lead concentrate	..	14.6	32.8
Contained in zinc slime	4.8	6.3	4.6

The recovery of lead in the zinc concentrate was 32.8%.

The greatly improved metallurgical work now being achieved is apparent when it is observed that the grade of zinc in the material drawn from the dumps has dropped from 19.1%, the average milled by a former process, to 14.41%, the average for the period under review. The grade of silver is now about 1 oz. per ton less than formerly, while the grade of lead remains the same. Although the material treated during the greater portion of the period has been refractory, owing to many of the dumps being highly oxidized, it is gratifying to record the fact that the grade of zinc and lead concentrates has been improved beyond that for any previous period. The zinc recovery has been maintained, while the distribution of the lead recovery has been improved to the extent that, whereas by the former process the proportions were 40.6% in the zinc concentrate and 29.6% in the lead concentrate, the proportions for the period under review are 32.8 and 32.8%, respectively, a desirable alteration when it is considered that practically no payment is made for lead in the zinc concentrate.

The year's production of flotation concentrate before being re-treated by 'tabling' totaled 102,355 tons, assaying 43.9% zinc, 13.1 oz. silver, 12.9% lead, equal to a sterling value, based on metals at the average prices for the year 1912, of 69s. 5.2d. per ton of flotation concentrate.

Re-treatment by tabling was responsible for separating this product into:

	Zinc, per cent.	Silver, oz.	Lead, per cent.
85,354 tons zinc concentrate, assaying	47.2	12.5	7.4
10,881 tons lead concentrate, assaying	14.8	32.2	57.9

The sterling value of these products was 87s. 8.9d. per ton of flotation concentrate, the enhancement as the result of re-treatment being £93,685. As the cost of re-treatment amounted to £16,089, the profit was £77,596. In addition to the zinc and lead concentrates, a by-product consisting of zinc slime was saved and stored for re-treatment (by the Horwood process); this by-product amounted to 5971 tons, assaying 38.7% zinc, 25.15 oz. silver, and 14.9% lead, and which, valued on the basis of previous sales, less cost of shipping, would realize a further £14,989. The re-treatment operations for the period (including the by-product zinc slime) thus show a total net profit of £92,585. The sulphuric acid plant worked steadily during the period, and produced 4325 tons of acid.

The working costs ranged from 8s. 11d. to 10s. 3d. per ton, the average being 9s. 1.79d., a reduction as anticipated on the average for the previous period. The comparatively high cost of 10s. 3d. incurred in December (the next highest figure being 9s. 3d.) was due to the usual interruption to operations caused by the Christmas holidays; advantage being taken at the same time to effect outstanding repairs.

Plant Construction

Two Babcock and Wilcox boilers, a Bellis Morcom steam-driven air-compressor for supplying compressed air to the mining department, and a British Thompson-Houston 500-kw. mixed-pressure turbo-generator, complete with an up-to-date condensing plant, are being added to the power-plant.

It was found necessary to build extra vats, and so add to the storage capacity of sulphuric acid to hold the extra amounts produced during the winter months, and insure a supply for the mill in the event of a break-down of the acid plant. The total storage capacity is now 470 tons. In order to reduce the distance of belt conveying the residue, and to take advantage of the natural fall of the ground between the zinc concentrator plant and the residue dump, a sluicing and dewatering scheme has been installed, which has effected a considerable saving in belting and power.

In consequence of the favorable results obtained in the laboratory by using the Horwood process on zinc slime, and the results obtained from the 100-ton parcel of ore roasted in the Edwards furnace at Ballarat, Victoria, and afterward treated in the

*Abstract from the annual report of the Zinc Corporation, Ltd.

local experimental plant, it was decided to install a working unit of this process for the treatment of zinc slime. A plant for this purpose is now being erected, and good progress has been made with its construction.

Lead Concentrator

The mill ran 269 days for the period, treating 138,284 tons of ore, or an average of 514 tons per day. The ore averaged 15.3% lead, 2.57 oz. silver, and 9.16% zinc. This tonnage produced 25,227 tons of lead concentrate assaying 6.28% zinc, 9.05 oz. silver, and 67.34% lead, in addition to which 36,800 tons of zinc middling was produced assaying 17.15% zinc, 1.8 oz. silver, and 5.22% lead. At the average price of metals for the year, the concentrate was worth £214,335, and the estimated two-thirds profit on 36,680 tons of zinc middling dealt with by the treatment department, and based on same metal prices, amounted to £19,820. The extractions obtained were as follows:

	Zinc, per cent.	Silver, ounces.	Lead, per cent.
According to lead concentrate..... ..		64.34	80.0
According to zinc middling.....49.8		19.0	9.1

The extraction of zinc in the lead concentrate was 12.5%, but being of no financial value, is omitted from the above statement. Milling operations have throughout the year given satisfactory results.

The erection of additional tables, storage vats, and connection of the latter with the railway system, has been completed. This has given greater facilities for working, and has enabled the plant to make clean quartz tailing and simultaneously increase the production of zinc middling; the latter product being sent to the zinc plant for further treatment.

Following a number of successful small laboratory experiments with the Lyster selective process (the invention of the mill foreman, James Lyster), a small experimental unit was erected at the lead mill for the purpose of treating a quantity of slime on a working basis. The results obtained from this small unit gave such a profitable recovery of lead and silver that it has been kept in continuous operation, treating the bulk of the current production of slime. A full working unit for the treatment of the current and accumulated slime has been designed, and its erection will be put in hand at an early date.

The 75-stamp mill of the Lake View & Star mines, Kalgoorlie, worked 8028 hours in 1912, crushing 212,606 tons of ore, the duty being 8.47 tons per stamp-day. Concentrate saved amounted to 19,074 tons, yielding 32,715 fine ounces of gold and 757 oz. of silver, while the slime produced, 193,532 tons, yielded 26,396 fine ounces of gold and 5297 oz. of silver.

A hydro-electric power-station is now being equipped at Laufenburg, on the Rhine, which will, when completed in 1914, be the largest plant of its kind in Switzerland. The installation will comprise 10 turbines, each coupled to a 5200-kw. 3-phase alternator, generating 6000 to 6600 volts, to be subsequently raised to 47,000.

Workmen's Compensation Problems

By H. W. Gartrell

There are two main divisions of mining law; the first is concerned with the acquirement and holding of mineral lands, and the second with the control of mining operations, dealing particularly with the safety of the workmen. A great deal has lately been heard about the first part of Australian mining laws, but the second part is also well worthy of attention.

A very interesting case recently occurred in South Australia. It appears that a man working in a quarry was seen to place a drill in a partly charged hole; his partner struck the drill with a hammer, an explosion followed, and the men were killed. The explosive used was 'rack-a-rock,' which was cut in pieces before being put in the hole. The dependents sued for compensation under the Workmen's Compensation Act.

Summary of the Law

The law may be summarized as follows: (1) The part of the mining law in question applies to quarries on private or Crown lands. (2) An accident is regarded as *prima facie* evidence of the owner's negligence. (3) The general rules, which must be observed as far as reasonably practicable, include: "No iron or steel pricker shall be used" and "In no case shall an iron or steel drill be used for the purpose of drilling out a charge which has missed fire." (4) A mine manager, who contravenes or does not comply with the general rules, is liable to a penalty of $500, unless he proves that he has taken all reasonable precautions to prevent such contravention or non-compliance. Further, a printed copy of the general rules shall be posted in the office and in some conspicuous place in every mine. (5) The Workmen's Compensation Act provides for compensation up to $1500, unless there has been serious and wilful misconduct on the part of the workman.

It is interesting to note, though it has nothing to do with this case, that the contraction of lead, mercury, phosphorus, or arsenic poisoning, or of ankylostomiasis is regarded as an accident.

Accepting the supposition that before the hole was completely charged a pebble became jammed in it above the explosive, and that the men were attempting to break this pebble, the discussion first centres on such a procedure. The witnesses distinguished two cases: When the pebble is less than two feet above the explosive, it was generally admitted correct to continue charging and to expect to detonate the first portion of the charge. When the pebble is more than two feet above, four methods were then offered: (1) As above, but one may be permitted to doubt if detonation would often be obtained; (2) to break the pebble by means of half a stick of powder; (3) to drill or jump out the pebble; and (4) to drill a new hole alongside.

The discussion on this interesting contingency seems to have been generally avoided by legislators

and writers. Method (1) may be ruled out; method (3) was said to have been so frequently used by so many, and even when the sides of the hole were almost certainly smeared with explosive, that laymen might reasonably think it fairly safe. Probably most engineers would restrict themselves to the second and fourth methods. The second no doubt answers in many cases; it is quick and simple, but runs the risks of ruining the hole without exploding the charge or of exploding the charge so feebly that little rock is displaced and the face is put in bad shape. The fourth method is safe and certain, but expensive, and probably is little used unless experience has shown that the rock in question is likely to give poor results with the second method. Since one individual's experience of such cases is usually limited, this is a matter on which the experience of others would be very acceptable.

Workman's Position

The next question is, what is the position of a workman who breaks the law? This question was not raised, but probably it may be assumed that a workman is not supposed to know the law unless it is formally brought before his notice, and that if it is so brought, disobedience would be regarded similarly to disobedience to his superiors.

The words "serious and wilful misconduct" naturally offer a fruitful field for discussion. These words occur also in the English act, so naturally the English interpretation bears great weight. Briefly, it may be stated that the word "serious" applies to the misconduct and not to the consequences, and "wilful" is to be taken to mean deliberate and not to apply to acts done on the spur of the moment. From this it follows that unless an act is notoriously dangerous, that is to say, would be regarded thus by most of his comrades in a position to judge, a workman committing it has not been guilty of serious misconduct, and that there is an important difference in seizing a handy tool and going deliberately to fetch a similar tool.

In the case in question, it appears that the misconduct was legally wilful but not legally serious, for the majority of the workmen witnesses said that the act was customary.

Finally, although no appeal was made, it appears that in such a case the higher court would have decided not whether the judgment was correct, but whether the judge might reasonably have found as he did.

The Court's Decision

The judgment, which was wholly in favor of the workmens' dependents, contained several interesting points: "The burden of proving the misconduct, and that the injury was caused by it, is on the respondents, and they must prove it affirmatively and not by surmise. The evidence is conclusive that at the time of the accident the two men were engaged at their work, and it is sufficiently clear that the steel drill was used, but the proximate cause of the accident was not conclusively shown." The importance of this general statement is quite independent of the fact that many mining engineers would regard the proximate cause as conclusively shown. With regard to the fact that no definite rules were laid down and that the method advocated in court was not followed, "The quarrymen had a free hand to use their own judgment, based upon their own experience, and broke no rule," and "If employers require such methods to be followed, it entirely rests on them to make proper rules for enforcing them."

Here then we have a remedial statute designed to help the workman without putting new obligations upon him, and really doing so.

Improvement of Miners' Surroundings

The United States Bureau of Mines is about to investigate the conditions under which a miner works, believing that the unsanitary conditions which exist in some of the mines, as well as in some of the mining towns, are a factor in the death rate among the men. It is intimated that these conditions not only unnecessarily cause the death of miners through disease, but they are often responsible for accidents which might not have happened if the miners were in perfect health.

The Bureau has organized what is known as the Mine Sanitation Section, in charge of J. H. White, engineer, and hopes to bring about progress by appealing to the miner, the manager, and the owner, showing that all three can assist, and be benefited by good sanitary conditions. It will reach the miner by means of illustrated lectures, moving-picture exhibits, and pictorial circulars. These will show how sickness and suffering are spread by careless habits, and will drive home the importance of personal and household cleanliness.

Conditions Peculiar to Mining Towns

Mr. White, in talking about the conditions which exist in mining towns, said: "The mining town does not grow, but is built at a single stroke. The effect of this is that the valuable lessons learned by the 'try-out' method and the profit gained by previous mistakes do not exert their powerful influence, so that the errors existing in one house exist in all; if one house is not properly lighted, none of the houses will be properly lighted; if a few houses are placed too closely together, all houses will be similarly spaced; if there is congestion in one section, there will be congestion throughout. Of course, one could have learned from the experience of other mining towns already built, but this information was perhaps not readily available, and local conditions modify each case.

"One of the first investigations which the Bureau intends to take up is the house problem, with a view to putting before the miners the best practices and the ones which have stood the tests of time.

"The company ownership is the most important factor entering into housing conditions. Every house reflects the standard which the operator wishes to maintain. It is difficult to stimulate a personal pride among the inhabitants, and friendly rivalry is absent. However, if improvements are introduced, they are far reaching, and the tone of

the entire town is raised, so that one house does not point the finger of scorn at its neighbor. The employer being also the landlord means, as a general rule, compulsory payment of rent, and the importance of an assured income should be given due weight.

"In discussing the water-supply situation, it must be kept in mind that the townsite is generally determined by the location of the mine shaft.

"The necessity and importance of a satisfactory water-supply for the people was probably not given much consideration in the past; in studying conditions with a view to introducing a public water-supply into a town, the cost of improvements and the age of the town must be carefully balanced.

"In a limestone region, pollution of the water may come from miles away, which makes the potential danger of the well very great. This may involve the distribution of drinking water in bottles throughout the town, the well water being used for cooking and washing purposes only.

"The inconveniences due to the difficulty of getting water from the wells may be eliminated by establishing bath-houses at mine shafts, so that the men may wash upon coming out of the mine. These bath and change-houses are being widely introduced: in a few states they are required by law. A public laundry is a great convenience for the women, and bath-houses in or near the schools for the women and children are almost necessary accessories to the perfect well system. Wholesome and safe drinking water is essential to existence; its supply is one of the gravest responsibilities accompanying company ownership.

"There are a few mining towns with sanitary sewer systems. Such a system presupposes a public water-supply for flushing purposes. The approximate location of a mining town is determined by the mine shaft, and the topography must be accepted as it is. This is generally rough and hilly, and a single gravity system of sewers is next to impossible, as the cost of leveling off the hills and grading the streets is prohibitive. Moreover, a suitable stream to take the discharge of the sewers might not be near at hand, and the necessity of installing a sewage disposal plant looms up.

"Mining towns possess many advantages, but the drawback lies in the fact that the initiative in maintaining sanitary and clean conditions throughout the mining town rests entirely with the operator. Indifference on his part may give rise to deplorable unsanitary conditions. The residents have no official voice in the government of the town, and unofficial aggressiveness is seldom exerted because the total absence of property rights breeds irresponsibility and carelessness. Many of them are blissfully ignorant of the dangers of unsanitary surroundings, and when they protest it is the inconveniences rather than the dangers that bestir them."

West Virginia, next to Pennsylvania, contains a greater quantity of coking and high-grade coals than any other state.

Several rivers in the Yentna district, Alaska, have their sources in large glaciers.

Reopening the Hillabee Mine

Interesting work in reopening the old Hillabee gold mine, near Alexander City, Alabama, is being done by the Hog Mountain Gold Mining Co., under the direction of H. W. Fox and H. F. Lunt. This property has produced between $20,000 and $40,000 per year, or nearly the whole production of Alabama, for the past decade. Hog mountain, on which the mine is situated, is an intrusion of granite in slates, cut by numerous veins of quartz carrying gold. This has been described by H. D. McCaskey in Bulletin 340, United States Geological Survey, to which reference should be made for fuller description. Perhaps a dozen of the veins are of good size. The previous owners worked the oxidized surface ore, treating it by simple leaching without trouble, but were never able successfully to handle the partly oxidized and primary ore with any degree of success. This seems to have been due to lack of metallurgical knowledge rather than to anything in the ore. Recent experiments go to show that by concentrating before sending to the cyanide tanks a good recovery can be made. Inclines are being sunk on two of the veins to determine whether the ore persists in depth. These inclines are being run longitudinally with the veins on a 35° slope, this being the presumable dip of the intrusion. Not enough work has been done definitely to prove the dip. No speed records are being made in this sinking, partly due to the fact that the plant is in poor condition, and partly to the tendency of the natives to live up to their state motto, "Here We Rest."

Before sinking one of these inclines it was necessary to get rid of four or five hundred tons of ore that had been left in a stope above the place where it was desired to begin sinking. This ore had decomposed so that it could not be cyanided, and the process of decomposition had so cemented the pieces together that it was necessary to blast in order to get it out. It was found that enough gold could be saved to pay for taking out the ore by the roughest kind of blanket concentration and reconcentration. This method yielded concentrate containing about 100 oz. per ton. In experimenting with this concentrate, the interesting fact was disclosed that it contains an appreciable amount of bismuth, which is a rare associate of gold in this country. There was also found some coarse gold, an occasional particle being as large as the head of a pin. This doubtless accounts for some of the loss in cyaniding. Particles of gold occur mechanically mixed with what is apparently the bismuth mineral, porbably bismuth sulphide, just as sulphides of the base metals occur mixed in a hand specimen. This perhaps indicates why the previous owners claimed that it was necessary to grind to 200 mesh or finer in order to get good extraction. Since the gold is more or less covered with another mineral, it naturally will not dissolve easily. These observations were made on pulp from the tube-mill under the microscope, and as yet the gold and bismuth(?) particles have not been separated in sufficient quantity for analysis, and the laboratory at the mine is inadequately equipped for even the simplest work.

One feature of this work seems to offer great possibilities, namely, the microscopic study of mill products. In fine-grinding practice it is practically impossible to tell by the eye in what condition the gold or other valuable mineral is, after it has been through a tube-mill. Several interesting facts regarding its products at this mine have been learned by the use of a microscope equipped to magnify about 80 diameters. By letting the light shine on the slide from above and cutting off the reflector below the stage, a view of the pulp can be obtained that gives as good an idea of how it looks as could be obtained from looking at material from a coarse jig with the naked eye. This was how the mixture of gold and bismuth(?) above referred to was found.

If the bismuth proves not to contain harmful quantities of arsenic and a market for it can be obtained, it is quite possible that a salable product can be made on a Wilfley table. Most of the bismuth now produced comes from Bolivia, at Huayna, in Potosi, in La Paz, and at Chorolque, in Potosi. The principal region is Tazna, and the smelter is at Chorolque. The price of the metal is controlled by a syndicate and has remained at $1.60 per pound for many years. Bismuth is also produced in Queensland and New South Wales. Bismuth ores occur in the United States in Colorado and Utah, but there is no present production.

Rock-Drilling Contests

Every Fourth of July these exhibitions of skill take place at the principal mining centres of the Western states, and from the results of the recent contests we have compiled the following record.

At Bisbee, Arizona, the first contest was between three-men teams. They were allowed 15 minutes each, no time being taken out for changing drills or other work outside of actual drilling. The winning team was the Jacobson brothers and Fred Carlson, who drilled a hole 51.9 in. deep in 15 min., winning the prize of $300. A close second was the team composed of Lawrence Ligon, Joe Hockway, and Harry Lyons. Their score was 50.9, which took second money, $150. The boys' team contest was a good one, and great skill was shown by Hooks and Shelp, who drilled 17 in., while Matigan and Densmore drilled 15.9 in. The class of rock used is not stated.

At Cripple Creek, Colorado, excellent work was done in the allotted 15 minutes. Using a 16-V Waugh stoping machine, P. M. Smith, of the Elkton mine, drilled 20 ft. 6.7 inches in hard rock, followed by E. A. Belle, at the Burns mine, with 16 ft. 7 in.; Sid Walhorton, with 15 ft. 11.9 in.; Lee Empey, of the C. K. & N. mine, with 15 ft. 8 in.; John Hein with 15 ft. 7.5 in.; and E. Creek and Tom Rogers, practically at tie, with 14 ft. 2.4 in. All machines used ½-in. air connections, at the end of a 50-ft. ¾-in. hose, while 1-in. cruciform steel was employed. The contest was witnessed by superintendents, foremen, and blacksmiths.

At Globe, Arizona, the contest was one of the best ever held, and about 3000 admirers of the teams gathered around the block. This was rather a poor granite, which somewhat spoiled the results. There were two close contestants for the first prize of $250, Zapp and Adams of Globe and Haight and McIver of Miami, closing with only 0.07 in. difference. Zapp and Adams, after losing the first trial by encountering an old hole, captured first prize by drilling 33.16 inches in 15 min. Lundgren and Mills took third prize with 31.62 inches.

At Goldfield, Nevada, the following records were made. Double hand: Rice and Henderson, 52.2 in.; Wickstrom and Jimpola, 50.5 in.; Sikstrom and Schram, 48.9 in.; Trainor and Bannister, 48 in.; Guest and Buchanan, 43.5 in.; Peterson and Adamson, 42.5 in.; and Jonak and Pace, 41 in. Hill and Oist drilled into another hole and were disqualified under the rules. Single hand: Al Billett, 31.9 in.; J. Saxberg, 31.25 in.; Paul Malli, 29.5 in.; Joe Marque, 25 in.; and John Stablum, 19.5 inches.

At Virginia City, Nevada, results were as follows: First prize was won by Harper, who drilled 24.9 in.; second, Grivic, 21.25 in.; and third, Berry, 20.25 in. Time was 15 minutes.

At Tonopah, Nevada, the following results were obtained: A double-handed drilling contest was held, a mass of Rocklin, California, granite being used for the purpose, the following being the result: Page and Johnson, 40.7 in.; Jaleck and Burns, 40.6 in.; and Dahlen and Lindquist, 40.45 in. Last year's drilling records in the same block of granite were: Page and Pickens, 45.45 in.; and Dahlen and Lindquist, 41.45 in. Time was 15 minutes.

The sports at Wallace and Wardner, Idaho, drew large crowds. Nine teams were entered in the drilling contest at the former place, which makes a new record for the number of teams. Perola and Hill of Butte were the winners with 37.5 in. in the 15-min. contest, when their drill stuck and they did not use their last minute of time. Leaf and Morrison were second, with 35.9 in. The other entrants in the contest, with the inches drilled, are as follows: Patterson and Nygren, drilled eight minutes and broke a steel and did not finish; Roseman and Sherwood, 32.5; Spridell and Wurz, 33.3; Fridina and Mara, 32.4; Stokes brothers, 33.9; Siligo and St. Germain, 33.8; and Brady and Haff, 35.2.

The rock-drilling contest was the chief feature of the day at Wardner, and the $250 cash prize for the first place was won by Siligo and St. Germain, the Stewart mine team. They drilled 46.8 inches in 15 min. This is almost a record in this vicinity, but the rock is reported to have been softer than usual. Two of the teams split the rock while at work, and thereby lost a chance for the money. Sherwood and Roseman took second prize, drilling 42.75 in.

Five teams competed at Baker, Oregon, in drilling 15 minutes in granite. Two teams, George Baker and Albert Dodson, of the Bonanza mine, Whitney; and Andregs and Dago Joe, from the Buckeye mine, Sumpter, tied for first money, each team drilling a hole 30.7 in. deep. Goodrich and Leroe, from the Columbia mine, Sumpter, drilled 28.5 in.; E. Goddard and A. Porter, of the Ben Harrison, drilled 27.06 in., but had trouble with poor steel; and Johns and Scott, of Sumpter, drilled 26.25 inches.

Discussion

Readers of the MINING AND SCIENTIFIC PRESS are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment. Insertion of any contribution is determined by its probable interest to the readers of this journal.

Colloids in Ore Dressing

The Editor:

Sir—Mr. Caetani's most interesting monograph on sand, slime, and colloids, in the March 22 issue, is a welcome addition to the literature on the subject; and the remarks he makes as to the importance of the question of pulp viscosity are well worthy of attention.

In an article published in the *Mining and Scientific Press* last year on tonnage estimation, I ignored the possible presence of colloids in the system of ore density estimation described, being at a loss to suggest a method of making satisfactory allowance for the alteration of composition due to chemical combination during treatment; or for the difference of density before and after drying. In the same issue there appeared a letter from T. B. Greenfield, giving his experience of the difficulty of obtaining a satisfactory density result in an ore containing a quantity of clay. In replying to this, I pointed out that in most cases tonnage has no significance apart from assay value; and emphasized the necessity for drying the sample for density determination at the same temperature as the corresponding sample for assay. If this precaution is observed there would be no noticeable difference in the theoretical yield as a result of an error, however small, in the density estimation.

Some time later, and in another country, I received my current copy of the *Mining and Scientific Press*, which contained a courteous criticism and a gentle rebuke from T. T. Read on my original article. In this he pointed out that, in the presence of colloids, the method of density determination outlined would give the percentage of ore but not solid in the slime. The loss of water of hydration would account for the difference. On the other hand, I should consider that the action of the electrolyte used would affect the result in the reverse manner. The percentage of solid would be obtained but not the percentage of slime.

Had I the opportunity of seeing Mr. Read's criticism first, I should have amplified my remarks in this direction and would have pointed out that the assay of an ore similarly treated to that of a sample for density determination would also be correspondingly in error. As all *exact* determinations of tonnage are calculated so as to be used in conjunction with assay results, it is obvious that uniformity of treatment before weighing must be observed in each case. On the other hand, if it were possible to make correction in the density estimation to counteract the slight error due to colloidal interference, then a corresponding correction would have to be applied to the assay results.

I would like to take this opportunity of commenting on Mr. Caetani's observations, and to add my agreement to his remarks as to the importance of de-sliming previous to classification. The ill effects of colloidal matter in interference with the settlement of sand is particularly noticeable in connection with the working of cone dewaterers, which are in some cases used to reduce the moisture of the pulp forming the tube mill feed, and incidentally to act as classifiers. With a coarse feed, such as when the tubes are merely acting as re-grinders and not as slimers, the cone works fairly well. When all-slimed is practised, and the cone has to handle a fine return in addition to the constant feed, the action is indifferent and uncertain; and any appreciable proportion of colloidal matter becomes entangled with the fine sand, forming a deposit on the sides of the cone which leads to 'piping' through the centre. The result is that the cone works satisfactorily neither as a classifier nor as a dewaterer. No arrangement of vertical or horizontal baffles (whether termed 'diaphragms' or not) will counteract the ill effects of the viscosity of the pulp caused by the inclusion of the finer portions of the ground ore in the feed to the cone.

For a satisfactory method of working such cones, I would draw attention to Homestake practice, where fine screening (900 to 1200 holes per square inch) is used in the batteries, and where the pulp is given two preliminary cone classifications before reaching the dewatering cone, with the result that "the cone remains clear of any accumulation of sand, a rod introduced at the top meeting with no resistance until it reaches the bottom of the cone immediately above the bushing."*

The efficiency of cone feed for tube-mills was made the special subject for remark in the discussion following the publication of a paper on tube-milling, published in the most recent volume of the Transaction of the Institution of Mining & Metallurgy.† The attention of members was drawn to the evenness of the cone discharge; and the author's success in working the cone was commented upon. The results were taken as proof that watching and adjustment were both unnecessary; and the impression was created that mechanical separation and dewatering offered no advantage over the method under review.

In the author's reply to discussion and in answer to a request for further information, we find the remark that "the sand issued from the cone *in a dry state.*" The italics are mine, but serve to indicate that the condition of the feed to the tube can be made no subject for comparison or compliment, the cone being used neither as a classifier nor a dewaterer, nor in a manner which could be duplicated in ordinary practice.

The question of internal friction in mill pulp has been ably dealt with by Mr. Caetani in his article. The alternative definition of viscosity is 'stickiness', and it is this characteristic of moist clay which has an important bearing on the working of all apparatus with sloping sides and designed to thicken or classify a colloidal pulp. It is to the 'stickiness' of the clay that the ever-present dan-

*Clark & Sharwood, 'The Metallurgy of Homestake Ore,' p. 26, *Bull.* Inst. Min & Met., London.

†Ball, H. S., 'The Economics of Tube Milling,' *Trans.* I. M. M., Vol. 21.

ger of accretion, and eventual chokage of the outlet, is due. As a result, vertical-sided classifiers and thickeners, arranged for the mechanical displacement of settled solids, are becoming more and more popular; and their introduction has marked a decided advance in the progress of the handling and treatment of colloidal ores, insuring a continuity of operation and freedom from attention which was unknown before their adoption.

A. W. Allen.

Rhodesia, May 11.

The Microscope in Mining

The Editor:

Sir—In an editorial in your issue of June 7, entitled 'The Microscope in Mining,' you do not give definite reference to an article referring to "a scheme for utilizing the polarizing microscope in the determination of minerals of non-metallic lustre," by A. J. Moses. Will you be good enough to tell me in what publication the article appeared?

D. P. Hynes.

Chicago, June 21.

[We have received so many inquiries regarding the use of the microscope as an aid to mining work that a public reply to this inquiry may prove of assistance to other operators. The paper in question was published in the July number of the *School of Mines Quarterly*, single copies of which can be secured from the publication office, Columbia University, New York City, at 50c. each. Binocular microscopes are much more convenient than the ordinary type for the study of crushed mineral fragments, and hand specimens. The necessary attachment for taking photo-micrographs can be obtained at no great cost, or any ordinary good camera can be used for this purpose with the aid of a little ingenuity. A recent new development is the making of colored photographs, using Lumière plates. In this way the minerals are shown in their natural colors, which is a great aid to recognition. The colored photograph can be studied at leisure and preserved for reference in case later work brings out points which may have been overlooked at first. A little later we hope to publish a detailed description of this work by an investigator who has taken a prominent part in its development.—Editor.]

Winter Work in Alaska

The Editor:

Sir—I have read with interest the article in your issue of May 17 last from the pen of W. M. Brewer, on 'Winter Work on the Kanai Peninsula.' There is perhaps no one better qualified to write on this subject than Mr. Brewer, owing to his years of practical experience both in Alaska and the Yukon. In view of that fact it seems almost incredible that you should allow to pass unquestioned the statement made by T. A. Rickard in his otherwise very interesting article in your issue of May 24 on 'The Valuation of Mines.' On page 767 he states: "In some parts of the world, as in Alaska and Yukon, the active season only lasts four or five months; the period of idleness covering nearly two-thirds of the year," etc. If Mr. Rickard's statement of facts pertaining to other parts of the world are as far astray as those quoted above he will lose any influence he has attained as a writer of credence.

You no doubt have the information at hand without my entering into detail as to the number of days the gold dredges in and around Dawson operated during the year 1912; it is a matter of record. Instead of those dredges operating only four or five months, I think you will find they operated nearly two-thirds of the year. This for placer mining.

In quartz mining there is absolutely nothing to hinder operations the year round in the Yukon, which as a matter of fact is being done right along. If you will look up the records pertaining to the White Horse copper properties you will observe that operations were carried on during the winter of 1912, which, by the way, was the coldest on record in the territory. The Granville Power Co., which obtains its power from the North Fork of the Klondike river, operated during the entire winter of 1912 without the slightest difficulty from anchor ice in the ditch. So far as the company which I represent is concerned, we have not experienced any difficulty in operating and we are at an elevation of 4250 ft. The weather conditions are not one whit worse in the Yukon than they are in certain parts of Colorado, Montana, and Kootenay.

My only reason in calling your attention to this misstatement of facts as they are found in actual practice, is that it has a very bad effect on intending capital for investment in that region. The Yukon will be heard from in the course of a much shorter time than I care to predict. The quartz is there in place in large quantities and undoubtedly rich in free gold.

A. E. Garvey.

Vancouver, B. C., May 29.

The Editor:

Sir—In reply to Mr. Garvey's protest, I beg to say that the usual season for productive work in the Yukon and in northwestern Alaska is about four months. Last year the Yukon Gold enjoyed an operating season of 172 days (or nearly 6 months) and the dredges worked for 86% of the time, or 5 months. The Granville company worked a part of its plant from April to October, or 7 months. But these two companies are operating on a scale far above the ordinary, and under conditions more favorable than the average. The usual productive period among alluvial mines in that part of the world is, as I stated, about one-third of the year. As to quartz mining, the chief hindrance to continuous operations is the scarcity of gold-bearing quartz veins in the Yukon territory. I am aware of all the facts mentioned by Mr. Garvey, and some others. I see no reason to apologize for making the statement to which he takes vigorous exception. The emphasis was placed on the fact that productive operations in that part of the world are usually discontinuous.

T. A. Rickard.

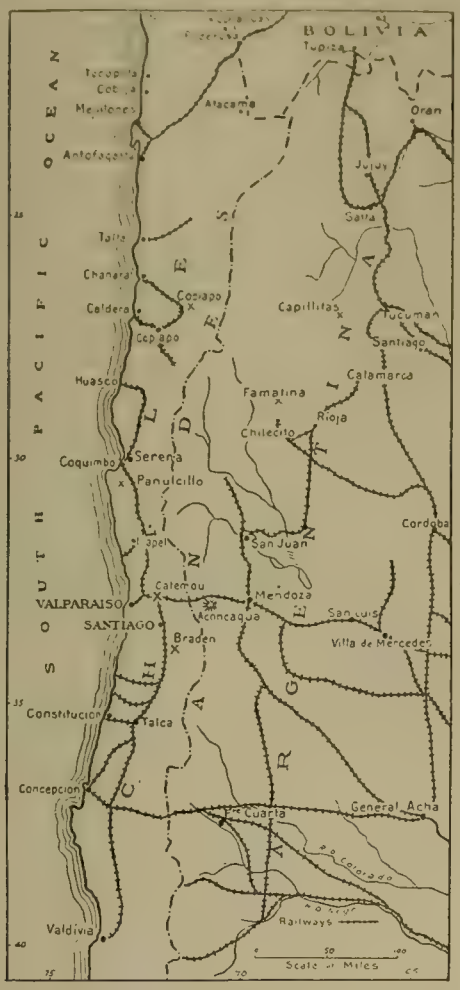
London, July 2.

Special Correspondence

NEW YORK

RESULTS AT THE BRADEN MINE—BRITISH COLUMBIA COPPER CO.—INTERNATIONAL SMELTING HALF YEAR—YUKON GOLD OUTPUT.—AFFAIRS OF TUOLUMNE.

Braden made a better showing in June than in any preceding month, 1,808,000 lb. of copper being produced, or at the rate of 22,000,000 lb. per year. In the two mills 61,127 tons of ore was treated, with a recovery of 68.2%. Development work in the Fortuna No. 2 adit advanced 39 metres in 2.97% ore; in the No. 2½, 19 metres in 2.15% ore; and the Teniente No. 1 advanced 12 metres in 2.19% ore. Following the recent announcement of an increase in the ore reserves, this constitutes an excellent 'bull' re-



MAP OF CHILE, SHOWING POSITION OF BRADEN MINE.

port. A special meeting of the Braden stockholders has been called for July 21 to authorize the action of the directors in extending the date of maturity of the convertible 3-year 7% gold bonds from July 1, 1914, to July 1, 1916. There is $1,000,000 of these bonds outstanding. The mill capacity is being increased to 3000 tons per day, and the need for funds for further development makes this a poor time to redeem bonds. The output of copper of the Braden for the half-year was 8,618,000 pounds.

New financing for the British Columbia Copper Co. will soon be undertaken, according to a statement attributed to Newman Erb. The Company has had a number of British Columbia properties under option, and Mr. Erb states that 1,500,000 tons of ore, up to 3% copper in grade, has so far been developed. If double this amount can be developed, new financing to take these properties over will be undertaken. The British Columbia Copper Co. now has an issued capital of $2,958,545. Net earnings last year were $425,985, and $177,512 was paid in dividends. The Company is well managed, but its ore reserves are low grade, and it has had a good deal of hard luck in one way or another, and dividends have been few and far between. The Shannon is another hard-luck company. The output for the quarter ended June 30 was only 3,242,000 lb.; the record by months being 1,238,000 lb. in April, 1,080,000 in May, and 924,000 lb. in June. It is announced that work will be confined to the better grades of ore as long as the copper market remains low, but even on a 15c. copper market, Shannon cannot earn dividends, as its operating costs are over 13c. per pound. Like nearly every other company nowadays, the Shannon is attempting to develop a leaching process for the treatment of its low-grade ores. Progress of experiments is necessarily slow, and the outcome is uncertain.

The International Smelting & Refining Co. has had a profitable half-year, earnings, exclusive of depreciation, being at the rate of 15% on its $10,000,000 capital, and is expected to do even better during the second half-year, as the earnings from new plants should continue to improve. Since its organization, the Company has spent $4,000,000 on new plants, without issuing new capital, but it is reported that the new smelter which will be built at Burch, in the Globe district, to handle the concentrate of the Inspiration, Miami, Keystone, and other companies, will necessitate the issuing of new securities. The details regarding this new plant seem not to be settled as yet, and there is indeed no hurry, as the Inspiration has not started to build the final mill which is to furnish the smelter with concentrate. In connection with this new construction, Stone-Webster & Co. will undertake the construction of an interurban electric line between Miami and Globe.

The Yukon Gold Co.'s production at Dawson, for the season to June 30, was $1,015,700, according to a recent report, and for the Iditarod district $125,400, making a total of $1,141,100, as against $1,132,800 last year. The yardage excavated by the Dawson dredges was practically the same as last year, but the value per yard was 70c., as against 76c. for the same period last season, and 66c. for the entire 1912 season. The reconstructed Pacific No. 1 dredge, to be operated on the new properties acquired on the American river, in California, should be ready for operation about the first of November, and this smaller property should, therefore, begin to produce at about the time the Dawson and Iditarod dredges close down for the winter.

At a recent meeting of the Consolidated Coppermines Co. it was voted to issue $2,500,000 in 15-year 7% bonds, convertible at par, and redeemable at 110, with accrued interest, on any interest day. A considerable amount of these bonds have already been subscribed by the principal shareholders. More than enough of the shareholders in the subsidiary companies have accepted the terms of the merger to give the Consolidated company the necessary physical control, as provided under the laws of Delaware. Another merger, this time at Butte, is to be voted on August 18, when at a special meeting the proposal to increase the capital of the Tuolumne from 860,000 to 1,500,000 shares will be voted upon. The purpose of the increase is to take over the property of the Butte Main Range Mining Co., and efforts are being made to bring the Pilot Butte inside as well. It is reported that the Colusa Leonard Extension may be taken in also. Early in the week it was reported that the La Rose and Nipissing companies had made a joint agreement to take an option in the Plenaurum, at Porcupine. This evoked a vigorous denial from E. P. Earle, who ought to speak with authority. At the meeting of the Chambers-Ferland Mining Co., George Richardson, R. T. Shillington, and Arthur Ferland were elected directors. The basis of exchange between Chambers-Ferland and the Aladdin Cobalt Co., Ltd., shares was not settled, but it is reported that it will be on the basis of one share of Aladdin for 20 shares of Ferland. The output of the Rand mines during June amounted to 747,000 ounces.

BOSTON

ORGANIZATION OF THE MONTANA MINING & DEVELOPMENT CO.—OHIO COPPER CO.'S AFFAIRS.—COPPER PRODUCTION OF CALUMET & HECLA.—NEVADA-DOUGLAS AFFAIRS.—EXPANSION OF THE WOLVERINE COMPANY.

Freeman I. Davison is again at Butte, completing the details of incorporation of the Montana Mining & Development Co., a $15,000,000 corporation being formed under the laws of Montana. Its object is to develop 140 claims, including the French Gulf mine, in Beaverhead county, and extend a railroad for approximately 50 miles from Divide, Montana, to these new properties. It is understood in Boston that Mr. Davison has associated with him in this enterprise Mr. Allen, the former lieutenant-governor of Montana, Sir Frederick W. Borden, of Ottawa, Canada, and a number of large Canadian, New England, and Western capitalists. The proposed railroad will open an extensive ranching district in the Big Hole Basin country. The general impression here is that Butte Central interests have been largely transferred into the new Company the past few weeks, and it is believed that eventually these transfers will result in the new Company absorbing Butte Central.

Practically the same process is being gone through in exorcising F. A. Heinze from control of the Ohio Copper Co. as was the case in the Davis-Daly company, and not until the purging is completed will Ohio be reinstated in market favor on the Curb here. Recently the annual meeting of the Company was held at Portland, after four postponements in which somebody was apparently jockeying for control, and then no financial statement of the Company was made. This has disgusted Boston people, who see in it some peculiar tactics. Less than a year ago, Ohio stockholders paid an assessment of $1 per share, and now the stock is selling at not much more than half of that figure, while they are kept in the dark as to the result of operations and the control and management. There is great dissatisfaction expressed at the continued activity of the Heinze methods, and Ohio will be left alone until there is a change for the better. The Mascot tunnel contract has also a retarding effect on the Ohio.

The outputs of the Lake Superior copper mines have been the leading features of interest locally during the past week. The trend of copper prices to a level under the 15c. basis naturally directs attention to the output end of the copper business, and when it was noted that the Calumet & Hecla and its subsidiaries were recording a lower refined copper production than for many months the local coterie was pleased. Calumet & Hecla with its subsidiaries produced approximately 60,000,000 lb. of copper in the first six months of this year, this being a decided reduction from the production of the same six months of 1912, and the lowest record in over four years.

While the sum total of the Calumet properties recorded a loss, the Allouez and Centennial companies were the highest for June in several years. Ahmeek continues to hold well, the largest decrease in production coming from the Calumet & Hecla mine itself.

It was announced here recently that the stockholders of the Nevada-Douglas Copper Co. were to be given the privilege of exchanging 10 shares of Nevada-Douglas for 1 share of Nevada Copper Belt Railroad Co. stock. But first they must be the owners of 188 shares each of Nevada-Douglas to be eligible for the exchange ratio. This works out a value of $17.50 per share for Nevada Copper Belt Railroad stock, taking the current market quotations of Nevada-Douglas as a basis, and, figured in 'rights' on 188 shares, is equal to *nil*. This works out as follows: Nevada Copper Belt stock was given as a bonus to the purchasers of the Company's bonds. There is no market for the stock now; that is, public market. Nevada-Douglas has a market value of $1.75 per share. Holders are asked to exchange 10 shares of stock valued at $17.50 in the market today for a share of stock of the Nevada Copper Belt which has no market value so far as known.

Much interest was aroused by the statement issued by S. L. Smith, a director of the Wolverine Mining Co., who wants a further expansion of the Wolverine company. This is the first official who has to date committed himself on the subject. The absorption of the Old Colony and Mayflower companies is what Boston expects. At present market prices, Mayflower is selling for a total value of $600,000 and Old Colony Copper for $325,000.

TORONTO, CANADA

QUARTERLY STATEMENT OF METAL PRODUCTION.—DEVELOPING THE JUPITER THROUGH THE PEARL LAKE.—MCKINLEY-DARRAGH AND SILVER CLIFF MINES.

Returns made to the Ontario Bureau of Mines of the mineral output of the first three months of the year show an increase of $2,000,000 in value over the corresponding period of 1912. The total production was valued at $9,469,938. As the stamp-mills at Porcupine were not in full operation during the first quarter of 1912, no comparison can be made. The principal producers of gold were the Hollinger and Dome. The quantity of ore milled was, in all, 69,905 tons, the average yield being a little over $15 per ton. The production of silver was 174,485 oz. less, as compared with the first quarter of 1912. Nearly all the output came from the Cobalt mines, South Lorrain furnishing only 198,381 oz., and Gowganda 54,350 oz. Shipments amounted to 7053 tons of ore, 2130 tons of concentrate, and 1,926,150 oz. of bullion. There was recovered by silver refineries in Ontario 2,754,292 oz. The Sudbury mines yielded 1589 tons more of nickel and 538 tons more of copper than during the same period last year. The present producing companies are the Canadian Copper Co. and the Mond Nickel Co., but a new concern which has acquired the holdings of the Dominion Nickel Copper Co. is making active preparations for production. The output of pig iron showed an increase of 64,218 tons in quantity and $647,901 in value.

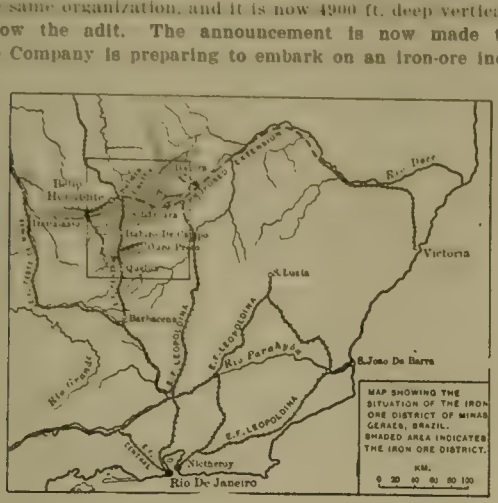
The annual meeting of the Jupiter was held on June 26 when it was announced that an arrangement had been effected with the Pearl Lake, whose property lies immediately adjoining, for the exploration of the Jupiter western areas through the Pearl Lake shaft, by drifts on the 400 and 600-ft. levels. The deep underground workings of the Pearl Lake are close to the Jupiter western boundary, so that mutual economies can be effected from this coöperation in development. Plans for a mill with a crushing capacity of from 80 to 100 tons per day are in perparation, and an electrically-driven compressor has been ordered. The mine has an ore-shoot on the 300-ft. level, 290 ft. in length, averaging $20 per ton. The Mines Leasing Co. is operating the Rea on a royalty basis and is treating about 18 tons per day with a small stamp-mill. There is 1000 tons of good ore on the surface, and 10,000 tons blocked out underground. At the Hughes-Porcupine, a 10-ft. vein has been cut at the 200-ft. level, and if it opens well at depth a larger plant will replace the 2-stamp mill now working. At the Porcupine Reserve, several good veins have been cut by diamond-drilling.

The May production of the McKinley-Darragh mine, at Cobalt, showed a heavy incerase. The output for the month was 206,781 oz., of which 42,662 oz. came from the Savage property. The aërial tramway connecting the latter with the mill is in operation, and the large amount of low-grade ore in the Savage dumps is being reduced by 75 tons per day. The capacity of the mill has been increased, and 50 stamps and 3 tube-mills are in operation, treating 250 tons per day. The Silver Cliff property, now owned by a Toronto syndicate, is opening well, but owing to the poor recovery made, a new mill and six slime tables will be installed. On the Keeley, at South Lorrain, now in the hands of Ehrlich & Hamilton, an English firm, a 3-in. vein of high-grade ore has been opened for some distance. A cross-cut is being driven at the 150-ft. level. The Right of Way Mines, Ltd., capitalized at $2,000,000, has surrendered its charter and will be dissolved. During June the high and low-grade mills at the Nipissing treated 147 and 6291 tons, respectively, yielding bullion worth $388,883, having a net value of $215,418.

LONDON

IRON ORE DEPOSITS IN BRAZIL, BEING DEVELOPED BY THE ST. JOHN DEL REY MINING CO.—INSTITUTION OF MINING AND METALLURGY SECURES A PERMANENT HOME.—OFFICE BUILDINGS IN LONDON.

On several previous occasions I have made reference in this column to that celebrated gold mine in Brazil, the Morro Velho, belonging to the St. John del Rey Mining Co. For over eighty years it has been continuously worked by the same organization, and it is now 4900 ft. deep vertically, below the adit. The announcement is now made that the Company is preparing to embark on an iron-ore indus-


Victoria
St Lucia
Barbacena
S. Joao De Barra
Rio Paraibuna
Rio De Janeiro
MAP SHOWING THE SITUATION OF THE IRON ORE DISTRICT OF MINAS GERAES, BRAZIL. SHADED AREA INDICATES THE IRON ORE DISTRICT.
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try on a large scale. Nothing was said by the directors in their annual report; or at the meeting of shareholders held last month, but hidden away at the end of George Chalmers' (the manager) voluminous report is found a paragraph that appears to be of prime importance. It is well known that the state of Minas Geraes, in which the mine is situated, contains enormous deposits of iron ore, of pre-Cambrian age, and that both English and American iron masters are giving close attention to them. The gold-bearing lodes worked by the St. John del Rey and Ouro Preto companies are found in these iron formations. The iron ore occurs in various forms and grades. On the surface they are mostly fragmental, and of medium and low grade, while below, the ore is laminated or massive hematite of the highest quality. The St. John del Rey company has for the past few years been quietly buying land adjoining the gold mine, and it now owns an unbroken estate of 140 square miles. Development was commenced on one deposit in January 1912, and already Mr. Chalmers is able to estimate the proved ore at 160,000,000 tons, averaging as high as 67.3% iron, with only 0.053% phosphorus. This is covered by fragmental surface ore, of a quality not quite so good. The hematite is soft enough to make mining easy, and at the same time sufficiently hard to make timbering unnecessary in the underground workings. The cost of mining will be low, and the chief item of cost will be that of transport by rail and sea. The Company has no intention of working the deposits in the immediate future, but intends to wait until the exhaustion of the high-grade ores of Spain and the United States creates an active demand for supplies from more remote parts of the world. In any case, it would be impossible to exploit them at present, owing to the scarcity of labor, which even prevents their systematic development. The gold mine is suffering for the same reason, and negotiations are in hand for the importation of laborers from Japan. Railway facilities will also have to be greatly improved. At present they are both insufficient and inefficient. Probably ten years will elapse before progress can be made. In the meantime, the chances are that the gold mine will continue to provide dividends, as the ore reserves contain a four years' supply, and the lode is remarkably persistent.

The Institution of Mining and Metallurgy continues to make gratifying progress. A few months ago I recorded that negotiations were in hand for a royal charter of incorporation, the effect of which will give it a legally recognized existence. A further step, of no less importance, has now been taken by the acquirement of a home of its own. Until the present time, the society has had to be content with quarters in one or other office building, first Broad Street House, and lately Salisbury House. The new home is a freehold building on the other side of Finsbury Circus to Salisbury House. This has been purchased outright, ground and all, and a better investment could not be found for the funds of the institution. The building has five floors. The general offices will be on the entrance floor, and the secretary's room and council room on the floor above. The top floors will be occupied by the library and reading-rooms. It is opportune to remind American engineers that nine-tenths of the offices of English mining engineers and mining companies are to be found within a quarter of a mile of Salisbury House. With the development of the London Wall estate, commencing fifteen years ago, the mining fraternity gradually drifted in that direction, from districts round and to the south of the Bank of England. Few of our friends are found nowadays in Cannon and Queen Victoria streets. The last to be left in that quarter is the firm of John Taylor & Sons, who still retain the offices in Queen Street Place close to Southwark bridge. The two handsomest office buildings in the City are London Wall Buildings and Salisbury House. The south sides of these are on London Wall, and their crescent-shaped northern sides on Finsbury Circus. All American visitors should stroll through the gardens in the centre of Finsbury Circus and admire the view across the lawn and flower-garden with the trees on each side and the towers of the two buildings rising above them. We do not boast of sky-scrapers here. For one thing, the light is not sufficiently strong to penetrate into the cañons formed thereby. For another, the ground is not sufficiently dependable, as is evidenced by the anxiety in connection with the stability of St. Paul's Cathedral. We are saved from many heart troubles caused by express elevators. We take things easier, but we get there just the same. The funds for building the two houses I have mentioned came from the diamonds and

SALISBURY HOUSE, LONDON.

gold of South Africa. Wernher, Beit & Co. built London Wall Buildings, and S. Neumann & Co., Salisbury House. The accommodation at the latter consists of 700 rooms distributed over 9 floors. The offices are numbered up to 850, but owing to many numbers being skipped so as to make the century numbers coincide with the floors, the actual accommodation is about 700. Considerable care is taken in accepting tenants, as the reputation of the house is jealously guarded. The Transvaal Chamber of Mines has its London office here. The agent-general for British Columbia is a tenant, though he is shortly to follow the lead of the Institution and find a house of his own. Consulting firms, such W. R. Feldtmann & Co., and Bainbridge, Seymour & Co., are among the tenants, as are also

mining companies such as the Golden Horse-Shoe and Ivanhoe, and the machinery houses identified with the names of Allis-Chalmers, Wilfley, Hardinge, Deister, and Crompton. I need not add that *The Mining Magazine* is reckoned one of the most respectable of all the tenants.

JOHANNESBURG, TRANSVAAL

THE RECENT STRIKE, ATTITUDE OF LABOR, AND CHANGES OF MANAGEMENT.—MAIN REEF WEST AND CONSOLIDATED MAIN REEF DEVELOPMENT.

A miners' strike on the Rand is rather a unique occurrence, for during the whole history of these fields there has been only one strike of any importance, and the men lost so decisively in that instance that it was generally thought a similar struggle would have been undertaken only after every other resource had failed. However, at the New Kleinfontein mine, owing largely to a want of tact in making a change in the hours of the machine fitters, and a prevailing suspicion on the part of the men against any change in the working hours owing to a recent change in the management, the whole of the white men came out on strike, and at one time threats were made to attempt to involve the whole of the Rand. However, the New Kleinfontein company has, after due consideration, agreed to revert to the original hours, and all danger of the strike spreading has been thereby averted, but as the strike committee is principally composed of professional agitators and socialists, they have been able so far to prevent the men resuming work, on the grounds that the management has repudiated them in arranging the settlement. Hitherto on the Rand, the mine administrations have always refused to recognize the trade union officials in any way, and so far have been able to maintain that attitude, and in this instance, although that attitude has caused a prolongation of the strike, there are not wanting signs that the strike will not extend much longer than a month. This means, however, a loss in profits alone of at least $96,000 to the Company, in addition to the huge unproductive expenditure a strike usually involves. When the Company gave way, the strike committee attempted to impose new and more onerous conditions in the shape of an eight-hour day from bank to bank, instead of from face to face, as legalized in the Transvaal. Such an innovation would have imposed a heavy burden on the mines, with their constantly growing depths and areas of operation, and it is fortunate that the New Kleinfontein miners have not responded to the innovation. The lesson taught by this strike is the growing need of tact in attempting to make changes in working hours, and generally to recognize that, on the Rand, there is a strong feeling against the numerous and often unnecessary changes made in the management. Up to the present these changes often have involved a complete change of staff, with new ideas and a tendency to attempt to lower the working costs, before the new administration has obtained a proper insight into the actual conditions prevailing in the mine.

Among the mines on the Rand, there are few that have given so much cause for anxiety owing to the large proportion of unpayable ore developed, as the Main Reef West. At one time this mine was regarded as one of the most promising mines on the Western Rand, and shares were bought in usually well informed quarters at high prices. Since then the shares have fallen to the extent of one-eighth their former value, and the development record of this mine for the last quarter is indeed a most unsatisfactory one. Out of 3434 ft. of development, 2386 ft. was on the 'reef,' but, of this, only 931 ft., or 39% of the whole footage, was found to be profitable. No less than 2386 ft. was found unprofitable, only showing an assay value of $3.30 per ton. The property, however, is an extensive one, and there is every probability of another profitable area being soon discovered, while the mine is far from being in difficulties, as the present developed profitable ore reserves already amounted to 633,610 tons. While the Main Reef West property has deteriorated to this extent, its neighbor, the Consolidated Main Reef, has improved, so that sooner or later there is every reason to look for an early change for the better in the Main Reef West also.

BUTTE, MONTANA

THE DRUMLUMMON MINE.—ANACONDA COMPANY'S BELMONT SHAFT TO BE MAIN ORE OUTLET.—TUOLUMNE COPPER CO.'S AND BUTTE MAIN RANGE PROPERTY.

Now that the protracted and bitter litigation between the St. Louis and the Drumlummon interests has been brought to a final close, the St. Louis Mining Co. is beginning to look about for some use to make of its hard-earned possessions. A new cyanide plant has been built, and prospecting is under way at both properties, so as to keep them running. The best ore has been mined, but shoots containing a good tonnage of cyaniding ore undoubtedly await development. In the meantime, the pioneer owner of the Drumlummon is successfully operating nearby properties, and proving to those interested in the district that his successes are not altogether due to luck.

Butte, like most mining districts, is all the time struggling with a few 'lame ducks' which were born in good faith and with high promise, but whose injuries come about from inability to find ore in sufficient quantities. Among such at present are the Raven Copper Co. and the Davis-Daly Copper Co. In both of these properties, conscientious and intelligent efforts have been made to develop paying mines, but the orebodies seem to be wanting. The only complaint to be made is that the true speculative features of such conditions are frequently concealed by promoters, and many Eastern people invest under a wrong impression as to the chances involved. Raven copper, for instance, seems to have done nearly enough work to prove that it is not a mine, and the discouragement of the stockholders is being reflected in the sagging of the stock.

Many of the shafts of the Anaconda Copper Mining Co. are situated high on Anaconda hill, several hundred feet above the level of Silverbow creek. Ore through these shafts is hoisted to the top of the hill and taken down again by way of the surface trains. This wasted energy is appreciated by the Company, and it is planned to obviate it to some extent by making the Belmont, at the foot of the hill, the chief ore-producing shaft in the future. Electric trains on the different mine levels will deliver the ore to large skip pockets at the Belmont shaft. Of course, no one shaft can handle the ore and supplies for all of the mines, but it is, nevertheless, expected that ore-handling at the Belmont will effect a large saving.

The Tuolumne Copper Co. is considering the acquiring of the burdens of the new Butte Main Range Mining Co. An attempt was made recently to finance Butte Main Range independently, but, it would seem, with indifferent success. It is now proposed to increase the capital stock of the Tuolumne company from 800,000 to 1,500,000 shares, with a view to raising money to develop Butte Main Range. It appears that the Tuolumne will have its hands full with its own and the proposed business. Butte Main Range may prove to be a big mine, but it seems too bad for a good little mine like the Tuolumne to run the risk of adding to its burdens the prospecting of a new property in an admittedly unproved part of the district.

SILVERTON, COLORADO

DISPUTE BETWEEN THE TONOPAH AND CONTINENTAL MINING COMPANIES OVER TITLE TO THE BUFFALO BOY MINE.

The trouble between the Tonopah Mining Co. and the Continental Mining Co. is rather strange, and it is hard to get much data on the subject. The facts, as nearly as can be gathered, are as follows: Last fall, D. M. Haines came into the San Juan and began taking options on properties along the so-called Eastern gold belt lying to the south of the Animas river, its best known mines being the Highland Morn, Shenandoah, Dives, Old Abe, Buffalo Boy, Intersection, Esmeralda, Trilby, Kittmac, and others of less importance. Mr. Prosser, during his services

as secretary of the Silverton Commercial Club, had spent much time in a study of this region, and was selected by Mr. Haines as his assistant, and still serves in that capacity. Most of the options, it is understood, are in Mr. Prosser's name. The Continental company owned the Buffalo Boy, and had spent about $30,000 on development, and claimed to have opened ore, averaging $19 per ton, over a distance of 1200 ft. in the main adit. The property was examined about a year ago for the Mines Company of America, but for some reason the deal fell through, although it is rumored on fairly reliable authority that this Company estimated the value of the property to be $600,000. This is, of course, doubtful, but the value of the ore is nearly correct. Mr. Haines bought the Old Abe, or at least a controlling interest. This property adjoins the Buffalo Boy. Mr. Haines then attempted to buy the stock of the Continental Mining Co. at 38c. per share, the controlling owners, Martin Heller and Joe Bordelean, holding out for 52c. per share, which Mr. Haines refused. Mr. Haines then bought the stock of A. A. Brown at a rumored price of $30,000, this stock consisting of a one-sixth interest in the Company.

In January, while the Continental company was actively at work on underground development, Mr. Prosser relocated all the Buffalo Boy ground in the name of Mr. Belford, and served notice on the mine superintendent, Ed. Haas, that he was a trespasser, and to vacate the premises at once. Mr. Haas, of course, refused to do so, and is still in possession. The exact grounds for the re-location are not known, some claiming that the original locator was not a citizen, others that the Buffalo Boy locations are on other claims and are invalid. The strange part of it is that Heller and Bordelean should hold such a valuable property without a patent for six years. It was, however, surveyed last summer, and an application for patent is now before the Surveyor General. Local feeling is divided, the majority favoring the Continental company. It seems as though Haines and Prosser hope to force this Company to settle on their terms, but at the same time the title is bad. Mr. Haines has a right to protect the Tonopah people, as it is rumored that their total investment in the Buffalo Boy and vicinity amounts to $110,000. The Continental people were the makers of this mine and have held it in good faith for six years. However, their way of doing business seems to be a poor one; and if they lose the property through a faulty title, they have only themselves to blame.

BRITISH COLUMBIA

MINING ON THE NORTHERN COAST.—HISTORY OF THE HIDDEN CREEK PROPERTIES DEVELOPMENT. — PORTLAND CANAL TUNNELS, LTD.

The purchase in 1910 by the Granby Consolidated Mining, Smelting & Power Co., Ltd., of the mineral claims on Observatory inlet, Portland canal, assured for that portion of the province operations of such magnitude as would place it in a prominent position. The history of this Hidden Creek property is quite interesting, because of the fact that it just escaped being numbered among the abandoned prospects that are to be found in every mining camp on this continent. In 1900, M. K. Rodgers bonded this group of claims from the original owners, Flewin and Rudge, of Port Simpson. Mr. Rodgers at that time was acting for the late Marcus Daly, and after Mr. Daly's death the executors had examinations made of all his mining properties, including those taken up for him by Mr. Rodgers. Chief among these were the Nickel Plate mine at Hedley, and this Hidden Creek copper property on Goose bay, now known as Granby bay, Observatory inlet. The result of this examination was that, although about $15,000 had been expended on the property, it was ordered abandoned, and reverted to the original owners. Later, about 1906, the group of claims was bonded by a Vancouver syndicate on the same terms, namely, $40,000 purchase price, as had been given to Mr. Rodgers. This syndicate expended altogether about $20,000, and in February 1908 the property was again purchased by Mr. Rodgers for himself and Thomas Hudgins of Butte for $135,000. These gentlemen continued development on the mining claims, constructed a tramway, wharf, camp buildings, developed water power, and erected a power-house. They also located some adjoining ground, expending thereon quite a large sum of money, and developed such extensive copper ore reserves as to be able to sell the property in 1910 to the Granby company for about $500,000.

At the end of June there were 1125 men on the Company's payroll at Granby bay, most of them being engaged in general construction work. The smelter and converter plant will be completed and in operation about the first of next year and will have a treatment capacity of 2000 tons per day. The mine is now sufficiently developed to ship that quantity of ore daily, it being estimated that there is over 8,000,000 tons of ore in sight. The difference in the elevation between the upper exposures of ore on the mountain, and the lowest of a series of adits is 865 ft., and

SITUATION OF HIDDEN CREEK COPPER MINES.

between the upper exposures and the deepest diamond-drill holes sunk to a point 300 ft. below sea-level, there intervenes a vertical depth of approximately 1500 ft. This will serve to convey some idea of the area of ground that has been proved to be ore-bearing. The last cores of mineral taken from the lowest diamond-drill holes gave assays of 6 and 11% copper.

Stewart has experienced quite a slump, and at present, except for the work being done by the Portland Canal Tunnels, Ltd., of which W. J. Elmendorf is manager, there is little activity, as the investing public is waiting for the results from the adit being driven by that Company. The proposed length of this adit is about 2300 ft., and from the direction in which it is being driven it will cross-cut the ground owned by the Glacier Creek Mining Co., the Stewart Mining & Development Co., and the Portland Canal Mining Co. In the last named property this adit will cut through at a depth of about 2000 ft., below the present workings on the Portland Canal mine. The present face of the adit is about 1800 ft. from the portal, and it is expected that it will be completed about November. The future of the 'camp' to a great extent hangs on the completion of this work, and if the orebodies are found at this level, the success of the district is assured.

General Mining News

ALASKA

The unexplored islands of the Aleutian group will be examined for mineral deposits by George A. Parks, who is employed by the United States Land Office. Of the territory to be explored, Akun is on the western shore of Unimak pass, in the Krenitzin group of the Aleutians. Akutan is the largest island in the same group, and is situated northeast of Unalaska.

Fairbanks

A good deal of drilling is being done on Ester creek, but results so far have not been published. On June 11 the Chatham property changed hands. Work is proceeding steadily and the 4-stamp Hendy mill is running. Quite a number of miners are sluicing on Deadwood creek, in the Circle district. According to reliable reports, the Red Mountain district of the Koyukuk should produce $50,000 in gold this season, or about twice as much as in 1912. In the Ruby district, the Ferry Bros. are the only ones who have done extra well. At the spring clean-up they recovered $18,000 from their dump. On Long and Poorman creeks a good deal of prospecting is being done.

Juneau

(Special Correspondence.)—The Sheep Creek adit of the Alaska Gastineau Mining Co. was advanced 570 ft. during June, and for 10 days a speed of one foot per hour was maintained in good ground. The adit is 8 by 10 ft. Three shifts are working. P. O'Neil is foreman and B. L. Thom superintendent. A new dam will be built at the Nugget creek power-site of the Alaska Treadwell company. A sample of one ton of ore from the Kensington mine has been shipped by B. B. Neiding, the superintendent, to the Merrill Metallurgical Co., San Francisco, for testing purposes.

Juneau, July 3.

ARIZONA

Cochise County

The Gus Baron group of zinc claims in Montezuma cañon, in the Huachuca mountains, have been bonded to a group of Tennessee capitalists. The first payment has been made and development of the property will begin shortly. This property was at one time leased to the Mitchell Development Co. The new mill of the Commonwealth Mining & Milling Co., at Pearce, will be ready to operate by August 1, according to H. J. Rahilly, who has been supervising its construction. The mill has 30 stamps, three Hardinge mills, and three tube-mills, Pachuca tanks for agitation, and four Dorr tanks for settling. The pulp is then run through four Oliver continuous filters. The mill will treat about 350 tons of ore per day.

Gila County

At the Miami mine, good progress is being made in reopening the caved ground. During June, development totaled 7285 ft. A good deal of work is being done at the Captain shaft. Underground work at the Inspiration has slackened of late, and in June this covered 2600 ft. It was necessary to cement the drill-hole at the Southwestern Miami in order to recover a string of tools. A 40-ft. headframe and 25-hp. gasoline hoist has been erected at the Inspiration Extended.

Mohave County

On July 11, four bars of bullion, valued at $99,500, were shipped from the Tom Reed mine to Pasadena, California. This gold output was the clean-up for June from the 30-stamp mill. The Gold Road shipped gold worth $20,000 on July 10, this being a clean-up for the first week in July.

George W. Heintz, general manager for the United States Smelting, Refining & Mining Co., recently inspected the Gold Road mine. An average of about 50 tons of ore per day is being treated. If mine conditions warrant it, the Company proposes to raise the mill capacity to at least 500 tons per day. Mining operations are being carried on much the same as they have been since the property was acquired. The ore sent to the mill is coming from the upper levels and a goodly portion of it from the 500-ft. level. The drift from the lowest workings has cut the ore in stringers and bunches, and a raise is now being driven toward the shoots higher up.

Pinal County

(Special Correspondence.)—The old Mammoth-Collins mines, at Schultz, which for many years were the chief factor in the prosperity of so many people in that part of the county, have changed ownership, and hereafter will be operated by the Young Bros. of the Great Western Copper Co., of Courtland. They will put the mine workings in a good state of repair at once, then proceed with development on the 800 and 900-ft. levels. Later on, the mines will be equipped with more modern machinery, including a new reduction plant. The property has produced several millions in gold, and the new owners believe that they can be made to duplicate the past record many times over. Below the 800-ft. level the vein on the Mammoth ground is about 30 ft. wide, and averages about $9 gold per ton and from 4 to 6% copper.

Schultz, July 10.

Yavapai County

Operations have been resumed at the old Waddell group on Copper creek, in the Hassayampa district. About 50 ft. has been driven in the old adit, in a continuous shoot of copper ore. Attention is again being attracted to the placer mines of Sam Norlan at the Three Mile house, on the wagon-road to Walker. According to reliable reports, the ground is reputed to be rich. In work performed recently it is believed the original channel has been opened.

CALIFORNIA

Eldorado County

The Channel Bend mine, on the Forest Hill divide, in former days called the Eagle Bar, and at one time very rich, is to be reopened and tested by local people, among whom is N. L. Kohn, who for several years has been endeavoring to bond the property and has only recently been able to secure an option on it. Last week the first load of supplies and prospectors left for the 'North Side,' among them Fred Hoskins, and Irving and Lee Cohn, who will start development work.

Glenn County

L. N. Comstock and B. L. Dyer, of Fresno, and H. Hordorn, of Willows, have been leasing oil land for some time and have obtained options on upward of 10,000 acres. At the same time J. T. Leland, who is declared to be a representative of the Standard Oil Co., arrived on the scene and took a number of options. All the land leased is in the vicinity of the Butte ranch, west of Germantown. The Butte ranch is owned by Frank Freeman and associates. It is said that Comstock and his partners got the ranch option. Some months ago oil was found in a deep well on the ranch, and promising sands were found. A test well is to be sunk in a few weeks.

Kern County

(Special Correspondence.)—A carload of copper ore has just been shipped by Joseph Weringer from his Greenback mine to the Selby smelter. He has only recently reopened the property.

Woody, July 10.

Nevada County

Suspension of work at the Gaston mine, in the northern part of the county, was only temporary. The 10-stamp mill is being moved to a position on Porman's creek below the lower adit, which is in 4000 ft. At the Erie, near Graniteville, 35 men are employed, and the stamp-mill is in full operation. At the Ancho, Birchville, and Republic the mills are also crushing good ore.

Placer County

Three carloads of machinery have been received for the Guggenheim mines at Mammoth Bar, recently purchased by these interests. Buildings are being erected and work has been commenced on the dredge. Representatives of

the Guggenheims are investigating various bars along the American river, and it is likely that Poverty bar, near Butcher ranch, will be purchased by them in the near future. A full force of men is working in the Bullion and Grass Ravine mines at Ophir. A drift is being run on the 400-ft. level of the Bellevue into the Bullion ground, and is now about 30 ft. below the old workings. Another drift from the same level is being run into the old California ground. Machine drills are being used in both drifts. The 80 tons of ore from the Bellevue which were run through the mill of the Big Busar company gave good returns, and another lot of 50 tons from the Grass Ravine mine was crushed last week. The mill at the Crandall has been repaired and is again crushing ore from the mine. About 25 men are working at the Black Canyon mine around the sawmill and in road-making and getting the mine in shape to commence development. The people who are working the black sand at the Mayflower, near Forest Hill, have installed a new gas-engine. It is much larger and more powerful than the first one, and it is hoped that the Company will be soon grinding the sand.

Shasta County

The Hayfork Mining & Milling Co., composed of people of this county and Oregon, has leased its property at Harrison Gulch to C. A. Mueller, of Redding. He is driving a long cross-cut to intersect the extension of the Midas vein system. A rock-crusher will be installed at the mill. At the Murphy-Layman mine, in this district, a 4-stamp mill is crushing good ore.

Sierra County

The Telegraph gravel mine is temporarily closed until arrangements are made for regular operation. At the Sierra del Oro (Ironsides) the men are opening an old adit and will extend it to the ore-shoot. The old adit is already in about 200 ft., and by driving 300 ft. more they can develop the rich shoot 100 ft. deeper than has been done heretofore. H. B. McCormick is manager. The shoot opened in the Uncle Sam or North Fork, at Forest, is said to be showing free gold and arsenical pyrite, and prospects are good.

It is stated that the old Ruby gravel property, near Forest City, is to be reopened. Oakland people have an option on it, and if on examination is satisfactory, will probably buy it. The Ruby has a large acreage of lava-capped ground and was worked extensively in the early days through a long tunnel tapping the channel at 2200 ft. in from Rock creek near the northern boundary line of the Bald mountain. It was mined the full length of the claim and then abandoned. Since then it has passed through several hands, until the present people took an option.

Tuolumne County

(Special Correspondence.)—The Atlas mine, at Tuttletown, has been purchased from Fred Sutton by J. L. Witney, representing the company that has extensively developed the property during the past year or more. The mine was previously deeded to Mr. Sutton by Robert R. Morrison, of San Francisco. Mr. Witney has also secured an option on 40 acres of mining land adjoining the Atlas from Ferguson McArdle. The renewal of activities at the Atlas is expected soon.

The Wagner Mining Co. has acquired the Paymaster group of three claims, situated south of Tuolumne, and is vigorously carrying on development work. The Paymaster vein, which was opened by adits, aggregating several hundred feet in length, by the original owner, Andy Omodt, ranges in width from 3 to 12 ft., and assays indicate that the ore will give mill returns averaging at least $10 per ton.

Sonora, July 12.

The old Dutch mine, at Quartz, is having considerable equipment installed, while in about two months it ought to be free of water. John Segale and associates are preparing to construct a large dam and excavate a ditch above the Clio mine to turn the river from its natural course, and the work will be rushed to completion before the heavy fall rains set in. It is expected that a good deal of gold will be recovered by working the old river bed.

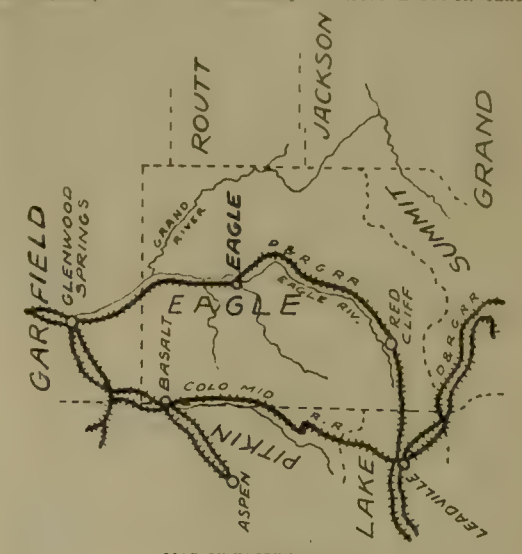
COLORADO

Eagle County

(Special Correspondence.) The Lady Belle mine has shipped its nineteenth car of ore, averaging over 100 oz. silver per ton. The mine is opening well. There are several prospecting parties in the district.

Eagle, July 14.

The *Eagle Valley Enterprise* states that an interesting mining project, adjacent to Eagle, is the draining of the lake at the headwaters of Lake creek. The object in view is placer mining the 80 ft. of deposit of wash in the bottom of the lake. Samples of the wash run as high as $13 to $20 per cubic yard. In order to drain to the bottom of the deposit, it will be necessary to drive a 900-ft. tunnel



MAP OF EAGLE DISTRICT.

from below. Work is being done at present on this project. Edward J. O'Flaherty has charge of the operations for the Electra Gold Mining Company of Denver.

Gunnison County

The Tin Cup Gold Dredging Co., a newly organized Denver concern, is erecting a dredge at Taylor Park, which should be ready in about 60 days. The Company owns 1900 acres, and will build two more dredges if results are satisfactory. The new machine is 45 ft. wide and 85 ft. long, and will weigh 150 tons. The ground has been properly tested by drilling, which proved bedrock to be 35 ft. deep. W. B. McDonald is in charge of the dredging work.

Lake County (Leadville)

The Western Mining Co. is practically the only property shipping carbonate of zinc ores at present, and only large operators can afford to produce it, according to S. D. Nicholson, manager for the Company. The drainage of Fryer and Carbonate hills is being arranged, although both will be separate propositions. Work in the lower adit of the Mt. Champion is opening a good deal of ore, and the mill is working regularly. Gold and copper ore has been opened in the Eureka in a raise above the adit. The Bertoneli lease at the Little Jonny shaft No. 4 continues to produce rich ore. A recent sampling of the shoot returned 484 oz. silver, 11 oz. gold, and 5% copper.

Birdseye, Alicante, Big and Little English gulches, and French gulch lately have witnessed an influx of prospectors, or owners of small claims, who have started to do the annual work for the year on the different claims. Some prospectors are working toward the head of the different gulches looking for mineral alongside of the big porphyry dike that trends through that part of the country, and the same that comes from the famous Little Jonny, Breece hill. Interest in Lackawanna and Half Moon gulches becomes more apparent each week, as reports from these districts state that prospectors can now be found scattered over the different hills and gulches. They have all found

float which yields from a few dollars up to 3 and 5 oz. gold per ton, and a search is being made to find the vein from which the float came.

The Pyrenees Consolidated Mines Co. is increasing its capital from $100,000 to $250,000. The old mill of the Leadville public sampling works is being overhauled and repaired, to make a test run on zinc ore from La Plata and other shafts in the neighborhood.

OURAY COUNTY

No. 7 level is now being driven from the Camp Bird shaft, which is down 800 ft., and will probably cut the vein in about 150 ft. Three shifts are extending No. 5 level of the Humboldt north toward the mountain top. A contract is to be let for sinking a further 125 feet.

SAN MIGUEL COUNTY

The Junta Consolidated Gold Mining Co. owns 20 claims on Ballard mountain and La Junta basin, south of Telluride. At the former section, an adit has been driven 1450 ft. on a vein, averaging $12 per ton over 7 ft. In the Junta group several adits have been driven. About 300,000 tons of ore is said to be opened, and a 300-ton mill is being erected. A 3000-ft. tramway has been constructed to the mill. T. E. Thomas, of Telluride, is in charge.

TELLER COUNTY (CRIPPLE CREEK)

During May, Stratton's Independence mine produced 4624 tons of ore on company and lessees' account, while the mill treated 11,800 tons of dump ore, resulting in a total profit of $10,325.

MONTANA

FERGUS COUNTY

During May the Barnes-King Development Co. mined and milled 3895 tons of ore from its North Moccasin property at Kendall. Mining and milling costs were $3.50 per ton, a total of $13,632, leaving a balance of $19,002, of which $14,252 was paid on the North Moccasin property and $4750 retained by the Barnes-King company. From December 14, 1912, to May 31, 1913, the Company mined and milled 18,897 tons of ore, averaging $8.70 per ton and having a gross value of $164,418.

LEWIS AND CLARK COUNTY

The East Helena smelter has a large district to draw upon for ore, and its supplies are likely to be increased by opening old mines. The Dobler property, 15 miles east of Helena, is to be reopened. The shaft is in swampy ground, and is flooded, but the vein opened was profitable, so pumps are to be installed. The Eureka, 12 miles from Helena, is also to have a new pumping plant. It is under bond to the Anaconda company, and it will be developed to 500 or 600 ft. The Fisher claim is opening well. The Montana copper-silver mines are opening in a promising manner.

LINCOLN COUNTY

(Special Correspondence.)—The Vermillion Silver & Lead Mining Co. is developing its claims in the southern part of the county, and it is intended to begin shipping ore soon. The main adit being driven on the vein is now in a distance of 500 ft. The ore contains gold, silver, and lead. The Mountain View Mining Co. is installing a 6-drill air-compressor on its property, 40 miles south of Libby. The main adit is in 1400 ft. and will be continued until it cuts the four veins in the claims. The ore is said to be rich in gold. The Company owns twelve claims. S. F. Ralston came in recently from the Kalispell-Lincoln Gold Mining Co.'s property, bringing with him $1000 in gold that had been cleaned up after a short run with the small 5-stamp mill. Most of the machinery for a concentrator and an additional five stamps has arrived at Libby and will be taken to the mine and erected. Latest reports from the Shaughnessy Hill mine, which is being developed by the Hazel T. Mining Co., are to the effect that the drift is in an orebody 15 ft. wide, containing mostly silver and lead. The Company proposes erecting a concentrator.

Libby, July 12.

SILVERBOW COUNTY

(Special Correspondence.)—Development is still being done on the 1900-ft. level of the Raven mine, and while some ore is between 3 and 4% copper, there is not sufficient yet to pay the operating expenses. However, the management still believes that a large body of good shipping ore will be opened, and with that object in view the work is being done.

The Butte & London property, which has been idle for the past six years, will be reworked in about 60 days. The electric equipment has been ordered, and it should be delivered about the middle of August. The power has been arranged for and as little delay as possible will occur after the machinery arrives. The mine is to be operated by the Rainbow Development Co. under an agreement that the shaft will be carried from its present depth of 1100 ft. to 1660 ft. When the property was closed during the panic of 1907 there was every evidence that some good ore was about to be opened, but conditions were such that it was deemed advisable to quit work, and later the directors sold the machinery. The Rainbow Development Co., which is controlled by Duluth capitalists, has a shaft down to a depth of 680 ft. It is operated by electricity. E. C. Congdon is president of the Company, and Thomas F. Cole is a member of the board of directors. According to reports, the Colorado mine produced 7250 tons of ore, during the past month, averaging 3.4% copper and 6½ oz. silver per ton. The force of men has been increased, and development is being done on the 1700 and 1900-ft. levels.

Butte, July 13.

The new surface plant on the Gambrinus claim has been completed and active development work by the Corbin Copper Co. on its group of claims adjoining the Gagnon mine is now well under way. The plant has capacity for sinking to a depth of 1500 ft. Compressed air is used instead of steam for motive power, and is generated by an electrically operated compressor. The Gambrinus shaft is now down to a depth of about 50 ft., and is of three compartments. The future appears to be exceptionally promising.

NEVADA

CLARK COUNTY

(Special Correspondence.)—Seven feet of ore carrying 10% copper and $18 per ton in gold has been opened at the Duplex, on the 700-ft. level, 225 ft. from the portal. This ore was not expected, as the drift was driven to cut the New Year's Gift vein. At the Quartette, the 1100-ft. level, west of the main shaft, opened free-milling ore with a little copper. Ore shipments continue from the Southern Nevada, Fourth of July, Chief of the Hills, Bamberger-Wheatley, Blossom, Duplex, Good Hope, and Quartette leases to the mills, and in some cases show an increase of tonnage. The June production of the district was valued at about $61,400.

Searchlight, July 12.

ELKO COUNTY

(Special Correspondence.)—The drift, at a depth of 53 ft., in the winze of the Flaxie mine, has opened another rich shoot showing gold. Work is to be started at the Alpha in cutting a station and installing a hoist at the junction of the adit and shaft, at a depth of 250 ft. At the Success, the cross-cut is in 100 ft. in hard rhyolite. The upper adit of the Jarbidge-Altitudes is in 30 ft., showing 30 in. of rich ore, while the lower adit is in 330 ft., but has not yet cut any ore.

Jarbidge, July 7.

ESMERALDA COUNTY

Preliminary estimates of the Goldfield Consolidated company's June output show the treatment of 30,308 tons of ore yielding $361,000. The 1750-ft. station in the Merger is finished, and cross-cutting is under way to the Atlanta. The Vernal is shipping ore varying from $42 to $55 per ton.

LYON COUNTY

The Adams gypsum mine and plant at Mound House is working three shifts, as the Pacific Portland Cement Co. has a contract with the San Francisco fair authorities for 3000 tons of refined product.

Nye County

In our issue of last week the production of Tonopah for the first half of the current year was given as $1,210,889. This should be $6,210,889, as is apparent to those who are interested in this great camp.

There are 30 men employed at the Nevada Cinnabar Co.'s property at Ione. Material for the furnace and buildings is arriving at Austin by train, and is then carried up Reese river on a 5-ton Pierce-Arrow auto-truck. About 100,000 bricks have been made, while 400,000 are necessary. There is enough ore opened to keep the 50-ton furnace busy for about a year.

During the week ended July 12, the mines at Tonopah produced 9681 tons of ore worth $224,375. The decrease was due to the holidays. In June, the Belmont mill produced 397,504 oz. of bullion from 15,214 tons, with a profit of $182,971. The Halifax made its first shipment of 50 tons of ore to the West End mill for a bulk test. The mine is opening satisfactorily. On the 600-ft. level of the West End, rich sulphide ore was opened last week.

Storey County

The monthly expenses of the United Comstock Pumping Association since December 1, 1912, have been as follows: $19,719, $20,393, $18,058, $16,233, $15,278, and $15,656. These include all salaries and wages, supplies, power, hoisting, air, and pump repairs. The rearrangement of pumps was an important job, and has been proved to be beneficial.

NEW MEXICO

Eddy County

Arrangements for drilling in the Carlsbad field are about completed. About 12 years ago some prospecting for oil was done here, and oil men now think the district worth further trial. At Artesia, the Dayton Petroleum Co. has reached the second oil-sand at 1800 ft., showing oil and gas.

The Dayton Petroleum Co., after encountering considerable resistance from a hard formation, has its test well down about 950 ft. and has set its 10-in. casing with a dry hole. The 12-in. casing was set at 700 ft. This is the first test well drilled in the valley, and is controlled by E. L. Doheny, of Los Angeles.

The Pecos Valley Gas & Oil Co. is down 750 ft. on the Martin well and has set its 10-in. casing at 600 ft. It has closed a contract with L. W. Feemster for drilling a well on the Terry lease, which is southwest of the Brown well. The derrick and machinery are in place and work will be commenced at once. The Company continues operating the Brown well that is producing about 50 bbl. of oil per day. Drilling continues by the company on the Fowler lease.

Grant County

A large quantity of water has been encountered on the 400-ft. level of the Emma copper mine at Fierro, and has risen to the 200-ft. level. Larger pumps are being installed. The Colorado Fuel & Iron Co. continues to ship a big tonnage of iron ore to its plant at Pueblo, Colorado. The assessed value of the Fierro property has been set at $53,591 by the county commissioners, and this value has been accepted. The assessed value of the Chino Copper Co.'s property is $3,093,925, and net product at $1,000,000. The Company accepts the former value, but will contest the latter.

Socorro County

This county produced gold valued at $525,629, and 1,126,429 fine ounces of silver, being 67 and 73% of the total state yield, respectively, in 1912, according to the United States Geological Survey.

OREGON

Baker County

(Special Correspondence.)—The Sumpter dredge is working three shifts of 8 hours each, the only time lost being about once a week when the clean-up is made. The value of the nugget found recently at Susanville, Grant county, was $1408.75. The district is fairly active in that this year the mines within 60 miles of Baker will produce approximately $2,400,000 in gold, as compared with about $750,000 for the entire state of Oregon in 1912. Eastern Oregon, with the introduction of electric power and dredges, is 'moving.'

Sumpter, July 13.

UTAH

Beaver County

The adit at the Montreal group will be extended under the ore deposits that have been exposed near the surface. A big exhaust fan will be installed and rails laid. When this work is completed, machine drills will be placed at the face of the tunnel and development work pushed. The owners believe that they have a good mining proposition in the southern part of the state and purpose to carry on development work extensively.

On July 8 the offices and warehouse of the Horn Silver Mining Co. were destroyed by fire. It is alleged that the damage was purposely done by unknown persons. This is a well known and profitable company.

Juab County

The Chief Consolidated M. Co. has declared a dividend of 10c. per share, amounting to $87,640. Ore is being produced at a rate of 60,000 tons per year, and the mine is the second largest producer at Tintic. The main shaft causes some delay, as it is too small down to the 1200-ft. level. The Mammoth Mining Co. paid a dividend of 15c. per share on July 19, amounting to $20,000, the total to date being $2,300,000.

Summit County

During June, Park City mines shipped 6819 tons of ore, as follows: Silver King Coalition, 3126 tons; Daly West, 1395; Daly-Judge, 1643; Silver King Consolidated, 218; lessees, 191; Mines Operating Co., 64; American Flag company, 42; Ontario-Johnson lease, 32; and Grasselli Chemical Co., 76 tons.

Tooele County

Four reverberatory lead furnaces are working at the International plant, and a fifth will be ready in about a month. The lead slag plant, recovering a further percentage of metals, is giving good results.

Utah County

The Iron Blossom company at Provo has declared a dividend of 10c. per share, amounting to $100,000, making a total of $1,670,000. The 300-ft. level of the Colorado mine is opening a fair tonnage of ore.

WASHINGTON

Stevens County

The vein in the Hecla mine, Chewelah, has a width of about 8 ft. in the face of the drift, carrying copper and silver ore assaying from $23 to $93 per ton. About 70 tons of high-grade ore has been extracted and piled on the dump ready for shipment as soon as the wagon-road, about 1½ miles in length, is completed and other preliminaries finished.

Joseph T. Pardee, of the U. S. Geological Survey, is completing his inspection of the Colville reservation. Work in 1912 showed that part of the area east of Nespelem, which contains most of the mineral deposits, has been classified. Although some of the lands classified as mineral have been proved by underground work to contain valuable orebodies, most of the lands have not been developed, and their mineral classification is based upon evidence offered by the surface and by the geology of the region in general.

WYOMING

Uinta County

Within about two months, the United States Phosphate Co., a Salt Lake organization, will have in operation its grinding plant at Border, the first company to install equipment within the phosphate deposits of Wyoming, Utah, and Idaho. This Company for over a year has been making regular shipments of the crude rock to the various markets around Salt Lake City, but the plant now being erected will grind 95% of the rock to 100 mesh, thereby bringing it into immediate shape for use as a fertilizer. The plant will have a capacity of 100 tons per day.

CANADA

Ontario

Bullion shipments from Cobalt during the week ended June 28 were 186,332 oz., valued at $108,204. La Rose sent to the Deloro plant at Marmora 54 tons of ore containing 151,658 oz. silver. According to the Bureau of Mines of Ontario, the first quarter of the current year resulted in the following production:

Product.	Quantity.	Value.
Gold, ounces	50,637	$1,030,920
Silver, ounces	7,264,559	4,040,450
Copper, tons	3,075	436,328
Nickel, tons	6,311	1,309,870
Iron ore, tons	15,389	25,695
Pig iron, tons	181,042	2,506,175
Cobalt and nickel oxides, pounds	280,096	120,500

Yukon

The Mayo district is showing considerable activity. On Highet and Dublin creeks, 28 men are working. The roads are rough and ought to be improved to help the district.

COLOMBIA

A corps of engineers of the Breitung Mines Corporation arrived in Barranquilla in April last for the purpose of exploring mines in the republic. The party has mining tools and instruments, gasoline motor-boats, and other supplies, and is said to be the best equipped mining expedition that has ever come into the country with the object of making explorations on a large scale.

MEXICO

On April 11, 1913, the Government published a list of 100 mines declared void since October 24, 1912, according to the law of June 6, 1892. Similar lists have appeared earlier. These mines had been located, 24 in the state of Tamaulipas and 76 in the state of Zacatecas. Most of them were for both gold and silver, but many had been denounced as containing silver and lead, a few with copper, and several of either gold or silver alone. The largest was for a copper mine in Zacatecas of 50 *hectares* (123½ acres), the smallest for a mine of silver and gold in Zacatecas of only 0.37 *hectare*.

PHILIPPINE ISLANDS

Gold has been discovered on the banks of the Mariquina river within 15 miles of Manila. The Malaguit Dredging Co. has been incorporated at ₱1,000,000 to take over from A. J. MacDonald 480 acres of placer claims on the Malaguit river. It is reported that the dredge now on the ground saves 200 oz. of gold per month from the placer workings. The incorporation of this company means that more dredges will be installed in the Camarines to work the claims, and good results are expected in the near future.

According to press reports, the Guamos Placer Co. has liquidated its debt of ₱38,000 since last November, and up to April 3 had paid ₱175,000 in dividends. The capital of the company is ₱500,000. It is figured that 10%, or ₱50,000, will be paid monthly. The Philippine Exploration Co. holds 55% of the Guamos stock. The past six months' output from the dredge was ₱$328,000, which gives an idea of dredging possibilities on the Paracale river. Other dredges operating are those of the Maximelo Gold Dredging Co. and the Paracale Bucket Dredging Proprietary, Ltd. The latter is a Melbourne, Australia, concern. Its new 7-ft., close-connected dredge is nearly complete. Another Australian company, the Philippines Dredging Proprietary, Ltd., is building a dredge nearby. On the Malaguit river, a Risdon dredge, under J. A. Bruce, has been producing about 250 oz. of gold per month for some time. There is said to be 3000 acres of gold-bearing ground on this river, of which 1000 acres are suitable for dredging. A dredge with a steel hull is to be installed on the Umival river, which flows into Dingaban bay, on the east coast of Luzon. Sydney, New South Wales, people are providing the money. The Luzon Gold Co. has acquired ground in the upper reaches of the river. The quartz properties in the Paracale district are attracting attention. The Surigao Gold Mining Co., at Surigao, will build a hydraulic plant of 100,000 cu. yd. monthly capacity during the next eight months. About 1000 acres of gravel are available, and it should average 29 centavos per cubic yard. Those chiefly interested in the company are D. M. Carman, E. O. Parker, George C. Sellner, Ralph McCulloch, and C. A. Briggs. Mr. Carman was in Manila recently.

Personal

Professional men are invited to send news of their engagements and travels. Such news is interesting to friends.

H. S. Coe is leaving for Nicaragua.

J. Parke Channing has been at Butte.

Lionel E. Hill has returned to Rossland, B. C., from London.

E. P. Jennings has returned from a professional visit to Tintic, Utah.

Paul R. Fanning, metallurgist for the Division of Mines, at Manila, is at Grass Valley.

P. G. Beckett, general manager for the Old Dominion Copper M. & S. Co. is on the Coast.

Frank H. Probert is in the East, and is not expected to return to Los Angeles for six weeks.

Robert H. Chapman will be for several months with the Geological Survey, Yerington, Nevada.

Algernon Del Mar has resigned from the superintendency of the Bishop Creek Milling Company.

William Maloney, of Nome, has been appointed territorial mine inspector, with headquarters at Nome.

Victor C. Alderson was seriously injured recently in an accident near the drainage tunnel at Cripple Creek.

Francis P. Bray has visited Broken Hill Proprietary works at Port Pirie and Iron Mountain, South Australia.

Fayette A. Jones, of Albuquerque, was, on July 15, elected president of the New Mexico State School of Mines.

J. B. Tyrrell is making a short visit to the Hurricanaw district in northern Quebec to investigate some recent gold discoveries.

D. C. Jackling, Frank Janney, W. O. Bradley, and Harry E. Tooker are at Juneau, visiting the property of the Alaska Gold Mines.

Jack E. Shaw, recently assistant superintendent of the Gaston Gold Mining Co., is now superintendent of the Birchville Mining Co., at Graniteville, California.

Josephus Daniels, Secretary of the Navy, will be the guest of the San Francisco Chamber of Commerce at a banquet to be held on July 25, at the St. Francis hotel.

Walter J. Radford has accepted the position of engineer for the company operating the Lady Belle Lease at Eagle, Colorado, and will have his headquarters at Denver.

J. H. Batcheller has resigned his position as metallurgist for the Tomboy Gold Mines Co., Ltd., of Telluride, Colorado, and is temporarily on professional business at Tonopah.

George J. Young, head of the Mackay School of Mines of the University of Nevada, has resigned to accept a position as professor of mining and metallurgy in the University of Minnesota.

B. A. Bosqui will leave San Francisco shortly to take charge of the new mill of the Commonwealth Mining Co., at Pearce, Arizona. The plant will probably be ready for operation during August.

H. C. Wilmot has resigned as superintendent of the Colorado Mining Co., Aroroy, Masbate, Philippines. After having examined the property and designed the mill for the Syndicate Mining Co., he has accepted the managership.

The engagement is announced of Miss Elizabeth McNear, of Oakland, California, to John Power Hutchins, of St. Petersburg, Russia. The wedding will take place in October at the residence of Mr. and Mrs. Edgar Rickard in London.

The Metal Markets

LOCAL METAL PRICES

San Francisco, July 1.

Antimony	12–14c	Quicksilver flask	$61
Electrolytic Copper	16–16½c	Tin	39–40c
Pig Lead	4.00–4.05c	Spelter	7–7½c

Zinc dust, 1400 lb. casks, per 100 lb., small lots $9.50; 9.75; large $7.75–8.50

EASTERN METAL MARKET

(By wire from New York)

NEW YORK, July 17.—Copper has shown a slight change for the better, and the market is firmer. No large sales are reported. The visible supply afloat, on July 15, in England and France is stated to be 72,358 tons, which is a slight increase for the past two weeks. Rotterdam, Hamburg, and Bremen stocks show a decrease of 2109 tons. The lead market is quiet and spelter remains dull with but little trading reported. The London market closed on July 16 with copper spot at £63 and futures £63 5s. Lead £20, and spelter £30 10s. Tin is quoted at £181 15s. and futures at £182 5s.

SILVER

Below are given the average New York quotations, in cents per ounce, of fine silver.

Date.		Average week ending	
July	10	June 4	59.99
"	11	" 11	59.75
"	12	" 18	59.08
"	13 Sunday	" 25	58.12
"	14	July 2	58.20
"	15	" 9	58.29
"	16	" 16	58.43

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	56.25	63.01	July	60.67	....
Feb.	59.06	61.25	Aug.	61.32	....
Mch.	58.37	57.87	Sept.	62.95	....
Apr.	59.20	59.26	Oct.	63.16	....
May	60.88	60.21	Nov.	62.73	....
June	61.29	59.03	Dec.	63.38	....

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.		Average week ending	
July	10	June 4	4.33
"	11	" 11	4.33
"	12	" 18	4.33
"	13 Sunday	" 25	4.33
"	14	July 2	4.33
"	15	" 9	4.33
"	16	" 16	4.33

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	4.43	4.28	July	4.71	....
Feb.	4.03	4.33	Aug.	4.54	....
Mch.	4.07	4.32	Sept.	5.00	....
Apr.	4.20	4.36	Oct.	5.08	....
May	4.20	4.34	Nov.	4.91	....
June	4.40	4.33	Dec.	4.20	....

ZINC

Zinc is quoted as spelter, standard Western brands, St. Louis delivery, in cents per pound.

Date.		Average week ending	
July	10	June 4	5.11
"	11	" 11	4.94
"	12	" 18	4.90
"	13 Sunday	" 25	4.97
"	14	July 2	5.07
"	15	" 9	5.10
"	16	" 16	5.08

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	6.42	6.88	July	7.12	....
Feb.	6.50	6.13	Aug.	6.96	....
Mch.	6.57	5.94	Sept.	7.45	....
Apr.	6.63	5.52	Oct.	7.36	....
May	6.68	5.23	Nov.	7.23	....
June	6.88	5.00	Dec.	7.09	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California, being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending			
June	19	July 3	41
"	26	" 10	41
		" 17	41

Monthly averages.

	1912	1913		1912	1913
Jan.	43.75	39.37	July	43.00	....
Feb.	44.00	41.00	Aug.	42.50	....
Mch.	46.00	40.20	Sept.	42.12	....
Apr.	42.25	41.00	Oct.	41.50	....
May	41.75	40.25	Nov.	41.50	....
June	41.30	41.00	Dec.	39.75	....

COPPER

Quotations on copper as published in this column represent average wholesale transactions on the New York market and refer to electrolytic copper. Lake copper commands normally from 1-5 to 1-4c. per lb. more. Prices are in cents per pound.

Date.		Average week ending	
July	10	June 4	15.18
"	11	" 11	14.79
"	12	" 18	14.70
"	13 Sunday	" 25	14.47
"	14	July 2	14.43
"	15	" 9	14.25
"	16	" 16	13.81

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	14.09	16.54	July	17.19	....
Feb.	14.08	14.93	Aug.	17.49	....
Mch.	14.68	14.72	Sept.	17.56	....
Apr.	15.74	15.22	Oct.	17.32	....
May	16.03	15.42	Nov.	17.31	....
June	17.23	14.71	Dec.	17.37	....

COPPER SURPLUS

Figures showing the visible supply of copper at the beginning of each month are now widely available. Below are given the amounts, in pounds, known to be available at the first of each of certain months. The figures are those of the Copper Producers' Association supplemented by Merton's figures of foreign surplus.

		U. S.	European.
July	1912	44,335,004	107,817,920
August	"	50,281,280	113,285,760
September	"	46,701,376	112,743,680
October	"	63,065,587	107,396,800
November	"	76,744,967	103,803,840
December	"	86,164,059	96,949,440
January	1913	105,311,360	96,859,840
February	"	123,198,352	100,067,520
March	"	122,302,198	95,542,720
April	"	104,269,270	106,565,760
May	"	75,549,108	102,654,720
June	"	67,474,225	93,378,880
July	"	52,904,606	85,565,760

UNITED STATES PRODUCTION AND CONSUMPTION

		Production.	Domestic deliveries.	Exports.
May	1912	126,737,836	72,702,237	69,485,945
June	"	122,315,240	66,146,229	61,449,650
July	"	137,161,920	71,093,120	60,121,600
August	"	145,628,521	78,722,418	70,485,150
September	"	140,089,819	63,460,810	60,264,796
October	"	145,405,453	84,104,734	47,621,342
November	"	134,695,440	69,369,795	55,906,550
December	"	143,353,280	58,490,880	65,712,640
January	1913	143,479,625	65,210,030	60,383,845
February	"	130,948,881	59,676,402	72,168,623
March	"	136,251,849	76,585,471	77,699,306
April	"	135,333,402	78,158,837	85,894,727
May	"	141,319,416	81,158,800	68,286,097
June	"	121,860,853	68,452,572	68,067,901

The fortnightly statistics of copper show that the European stocks, including Hamburg and Rotterdam, on June 30 decreased 1727 tons, while copper supplies afloat decreased 50 tons, making a total decrease in the visible supply of 1777 tons to 38,199 tons, as compared with 39,976 tons on June 14 last.

TIN

New York prices control in the American market for tin, since the metal is almost entirely imported. San Francisco quotations average about 5c. per lb. higher. Below are given average monthly New York quotations, in cents per pound:

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	42.53	50.45	July	44.25	....
Feb.	42.96	49.07	Aug.	45.80	....
Mch.	42.58	46.95	Sept.	48.64	....
Apr.	43.92	49.00	Oct.	50.01	....
May	46.05	49.10	Nov.	49.92	....
June	45.76	45.10	Dec.	49.80	....

The Stock Markets

SAN FRANCISCO STOCKS AND BONDS.
(San Francisco Stock and Bond Exchange.)

BONDS.

Listed.	July 16. Bid	Ask	Unlisted.	July 16. Bid	Ask
Associated Oil 5s	$ 97	—	Natomas Dev. 6s	94	100
E. I. du Pont 4½s	83½	—	Pac. Port. Cement 6s	99	—
Natomas Con. 6s	79½	82½	Riverside Cement 6s	77	79
Unlisted.			Standard Cement 6s	91½	—
Ass. Oil 1st ref.	80	90	Santa Cruz Cement 6s	[illegible]	85
General Petroleum 6s	61	—	So. Cal. Cement	70	75

STOCKS.

Listed.	July 16. Bid	Ask	Unlisted.	July 16 Bid	Ask
Associated Oil	38½	—	Mascot Copper	1½	2½
Amalgamated Oil	80½	—	Noble Electric Steel	—	3½
E. I. du Pont com.	—	135	Natomas Consol.	—	8
Pac. Coast Borax, prd	90½	—	Pacific Port. Cement	59	—
do com	—	100	Riverside Cement	42½	—
Pacific Crude Oil	—	25c	Standard Cement	—	21
Sterling O. & D.	—	1.95	Santa Cruz Cement	—	36

NEVADA STOCKS
(By courtesy of San Francisco Stock Exchange.)
San Francisco, July 17.

Atlanta	$ .15	Mizpah Extension	$ .52
Belmont	6.10	Montana-Tonopah	1.15
Big Four	.42	Nevada Hills	.92
Buckhorn	—	North Star	1.02
Con. Virginia	.14	Ophir	.19
Florence	.30	Pittsburg Silver Peak	.48
Goldfield Con	1.67	Round Mountain	.58
Goldfield Oro	.11	Sierra Nevada	.12
Halifax	1.30	Tonopah Extension	2.42
Jim Butler	.74	Tonopah Merger	.80
Jumbo Extension	.12	Tonopah of Nevada	6.00
MacNamara	.16	Union	.14
Mexican	1.10	West End	1.30
Midway	.46	Yellow Jacket	.19

COPPER SHARES—BOSTON
(By courtesy of J. C. Wilson, Mills Building.)

	July 17. Bid	Ask		July 17. Bid	Ask
Adventure	$ 1¼	1¼	Mohawk	$ 44	45
Allouez	32½	33	North Butte	25½	25½
Calumet & Arizona	60½	60¾	Old Dominion	44½	45
Calumet & Hecla	415	420	Osceola	75	76½
Centennial	11½	13	Quincy	57½	58½
Copper Range	38½	39¼	Shannon	7½	7½
East Butte	10¼	10¾	Superior & Boston	2½	2½
Franklin	5	5½	Tamarack	29	29½
Granby	55½	56	U. S. Smelting	36	36½
Greene Cananea	6½	6¾	Utah Con.	8½	9
Hancock	16½	17	Victoria	97c	1.00
Isle-Royale	19½	19¾	Winona	1¼	1¾
Mass Copper	2½	3	Wolverine	44½	45

NEW YORK QUOTATIONS
(By courtesy of E. F. Hutton & Co., Kohl Building.)
July 10.

	Bid.	Ask.		Bid.	Ask.
Alaska Mexican	8½	9½	Mason Valley	5¾	6½
Alaska Tread	3 7/8	3 9/8	McKinley-Dar.	1⅝	1¾
Alaska United	17⅝	18⅝	Miami 6s	168	173
Alaska G. M.	1 7/8	1 8/8	Mines Co. Am.	2¼	2½
Braden Copper	6⅝	6⅞	Nipissing	8¼	8½
B. C. Copper	2⅛	2⅜	Ohio Copper	½	⅝
Davis-Daly	1⅞	2⅛	San Toy	20	23
Dolores	2	4	Sioux Con.	2	4
El Rayo	1	2	S. W. Miami	5	7
Ely Con.	9	10	So. Utah	¼	⅜
First Nat.	2	2 1/8	S. O. Calif.	169	170
Giroux	1⅜	1½	Tri Bullion	⅛	¼
Green Can.	6	6⅛	Tuolumne	1	1⅛
Hollinger	16	17	United Copper		⅛
Kerr Lake	3⅛	3¼	Wettlaufer	12	14
La Rose	2⅛	2⅜	Yukon Gold	2¼	2½

LONDON QUOTATIONS
(By cable, through the courtesy of Catlin & Powell Co., New York.)

	July 17. £	s.	d.		July 17. £	s.	d.
Alaska Mexican	1	16	9	Kern River Oilfields	0	6	3
Alaska Treadwell	7	17	6	Mexico Mines	5	7	6
Alaska United	3	15	0	Messina	1	10	0
Arizona	1	17	6	Oroville	0	5	0
California Amalg	0	2	6	Pacific Oilfields	0	2	6
California Oilfields	4	0	0	Rio Tinto	71	17	6
Camp Bird	0	15	0	Santa Gertrudis	0	17	6
El Oro	0	15	0	Stratton's	0	2	6
Esperanza	1	1	3	Tanganyika	1	17	6
Granville	0	10	0	Tomboy	1	5	0

AUSTRALIAN

	July 17. £	s.	d.		July 17. £	s.	d.
British Broken Hill	1	17	6	Mount Boppy	0	15	0
Broken Hill Props	1	13	9	Mount Elliott	4	12	6
Golden Horse-Shoe	2	8	9	Mount Lyell	1	3	
Great Boulder Props	0	12	6	Mount Morgan	3	6	
Ivanhoe	2	16	9	Waihi	2	2	6
Kalgurli	2	0	0	Waihi Grand Junc.	0	18	[illegible]

JUNE COPPER PRODUCTION

	Pounds.
Calumet & Hecla	4,809,797
Centennial	193,295
Osceola	1,424,640
Ahmeek	1,281,960
Tamarack	598,770
Isle Royale	496,134
Allouez	556,675
Superior	382,080
Old Dominion	2,511,000

PRESENT CONDITION OF COPPER MARKET

It is difficult to comment upon the New York copper-metal market, except as an example of how long it is possible for consumers to stay out of the market. For over a month there has been no extensive buying of copper, and the average metal prices quoted in this and other journals have been more or less in the nature of approximations, for there has been little or no buying at the prices named by the large agencies, while the amounts which have changed hands at prices "below the market" are not commonly important enough to establish quotations. It was expected that if the Copper Producers' Association figures on July 9 showed a decrease in the stocks, buying would be resumed. The figures were favorable, showing a decrease of nearly 15,000,000 lb. in the metal on hand at the end of June, as compared with the beginning of the month. The foreign stocks also showed a decrease of 5,000,000 lb., so that the world's visible supply on July 1 was 20,000,000 lb. less than on June 1, and nearly 10,000,000 lb. below the previous minimum record. Figures for the half-year in the United States are now available, showing that the output of the refineries was 809,194,006 lb., and total deliveries of 861,692,002 lb. The decrease in refinery output in June was largely due to the shut-down of the Nichols refinery, at Laurel Hill, though mine production (during April, it should be remembered) also shows a slackening. Cananea and Miami have been in difficulties about that time. Work at Laurel Hill has been resumed, but output will not reach normal at the plant for some time, as it requires some time to get a large refinery into its stride. All this has left consumers utterly unmoved, and the agencies then dropped their quotations ½c. per pound. This was also without any result, and on July 11 there were no sales of any importance recorded, though plenty of copper was available at 14⅜c., delivered 30 days. Exports for the first ten days of July were 7985 tons, as compared with 11,945 tons for the same period last year. Cables from London state that the Amalgamated agency had reduced the price of electrolytic to £67, the equivalent of 14½c., while the A. S. & R. is offering at £66 1s. and dealers are selling September copper at £66, corresponding to 14⅜c., and even at these prices the demand was poor. As a contrast to the dull state of the copper sellers is the booming business of the American Brass Co., one of the large consumers, which is said to be receiving orders faster than they can be attended to, and to be planning extensive additions to its plant. It is only a question of time, of course, until consumers will have reduced their stocks to the point where it will be necessary to come back to replenish them; meanwhile they are giving an interesting exhibition of the importance of the so-called invisible stocks of copper.

Movement of copper in Germany from January to May, 1913, were as follows: Imports, 94,920 tons; exports, 4353 tons; consumption, 90,567 tons; compared with 80,347 tons during the same period of 1912.

Copper Statistics and the Copper Market

*During 1912 the world's production of copper was 1,008,290 long tons, against 869,370 tons in 1911, as shown in the following table:

Producing countries.	1904.	1908.	1911.	1912.
United States	367,700	420,700	487,300	557,590
Mexico	51,000	38,200	54,050	71,980
Japan	31,600	40,000	55,000	65,000
Spain and Portugal	48,000	52,000	55,000	58,000
Australia	34,000	43,000	44,600	45,500
Chile	31,000	36,580	29,600	37,000
Canada	20,000	23,900	24,000	33,500
Russia	10,700	16,800	25,500	33,000
Germany	24,500	23,300	30,500	30,510
Peru	6,800	17,000	26,000	27,400
Sweden and Norway	5,900	12,015	9,500	10,000
Cape Colony	7,500	7,000	7,000	7,000
†Servia	....	.....	.....	6,000
†German S.W. Africa.	....	.....	.....	6,000
†Austria-Hungary	1,500	1,350	2,520	3,960
Italy	3,300	3,150	3,000	2,350
Bolivia	2,000	2,500	2,500	2,000
Newfoundland	2,300	2,000	2,100	1,000
Turkey	1,000	2,000	700	500
Miscellaneous	1,300	5,000	10,500	10,000
Totals	644,800	746,585	869,370	1,008,290

†Hitherto included in miscellaneous.

The United States production, including foreign material smelted or refined there, was 715,147 tons, equal to 71% of the total. This country had an increased domestic production of 70,290 tons.

The world's consumption of copper for the corresponding years is as follows, in long tons:

	1904.	1908.	1911.	1912.
Germany	140,006	187,127	234,229	253,429
France	64,235	80,509	106,997	106,753
England	135,327	134,492	159,736	148,877
Austria-Hungary	26,366	36,972	40,000	51,574
Russia	31,370	21,450	31,845	38,813
Italy	18,162	29,496	30,437	34,378
Belgium and Holland.	10,590	9,500	13,000	13,000
Scandinavia	3,500	9,700	‡7,500	‡7,500
Rest of Europe	1,800	2,500	‡2,500	‡2,500
Europe	431,356	511,746	696,244	656,829
North America	214,285	214,734	316,791	365,922
Rest of America	1,900	2,000	‡3,000	‡3,000
Europe and America	647,541	728,480	946,035	1,025,751
China	15,386	10,000	‡4,500	‡4,000
Japan and rest of Asia	9,500	8,000	‡21,000	‡27,000
Africa and Australia	2,000	2,000	‡2,000	‡1,000
Totals	67,442	748,480	973,535	1,057,751

‡Estimated.

An absolute comparison between the figures of production and consumption is impossible, as the latter include the imports of manufactures of some countries, although these also appear in the consumption totals of the country of origin. The quantities of old metal, which are not shown statistically, also render an exact comparison impossible.

The outlook was rather obscured at the beginning of the present year. The war cloud in the Balkans had not lifted, and there was not that improvement in the strained economic situation which could ease the financial burden of European countries. There were also signs of a relapse in the United States, which first became apparent early in December, and were more marked as the time for the new President to take office approached, and uneasiness at the certainty of tariff revision was increased by the uncertainty as to when these changes would come into effect. Moreover, the attitude of the new democratic President toward capital and trusts was viewed with trepidation. At the time of publication, in March, the international pendulum is swinging toward better conditions. The monetary stringency in Europe has become less keen, and peace in the Balkans is at hand. In the copper-consuming industries fresh activity is promised, not alone by reason of increase in armaments, but also by works of peace, as the development of the territories acquired by the Balkan states, the building of power-stations, etc. Recent increases of capital of the German electrical companies foreshadow further extension. In America, generally, the internal situation is still regarded as excellent. Business here has not slackened, and after making due allowance for domestic political unrest, it must be admitted that the business situation in the United States since 1905 and 1906 has never been so healthy as at present. The view is now gaining ground that the tariff changes will not be of a very radical nature. Provided the harvest is at least up to the average, and the international money market not unduly burdened, the hope may reasonably be expressed that trade conditions in the United States in the second half of 1913 will be as good as, if not better than, at any time in 1912.

Even though producers will have to reckon with a lower price level than obtained in the last months of 1912, exaggerated fears of a decline in price are to be deprecated. The outlook for consumption promises well, and the copper-consuming industries may look ahead with confidence.

Stocks on hand at the end of the last four years is estimated as follows, in long tons:

	1909.	1910.	1911.	1912.
United States	63,289	54,480	39,937	47,016
England	95,673	66,917	42,104	27,763
France	6,299	6,080	5,254	4,396
Rotterdam and Hamburg	2,200	16,300	13,400	2,882
Totals	167,461	143,777	100,695	82,057

The average price of electrolytic and lake copper in New York since 1903 is as follows, in cents per pound:

	Electrolytic.	Lake.		Electrolytic.	Lake.
1903	13.63	13.45	1908	13.22	13.38
1904	13.09	13.12	1909	13.02	13.35
1905	15.82	15.89	1910	12.80	13.02
1906	19.39	19.66	1911	12.47	12.64
1907	20.10	20.65	1912	16.43	16.56

*From 'Statistical Compilations About Copper,' issued by L. Vogelstein & Co., New York, representing Aron Hirsch & Sohn, Halberstadt, Germany.

Sulphuric Acid Production

The sulphuric acid production of the United States in 1912 was as follows, in short tons: 50°B., 1,047,483, valued at $5,378,411; 60°B., 451,172, valued at $2,727,764; 66°B., 774,772, valued at $9,360,630; and other grades, 66,166, valued at $871,214, according to the United States Geological Survey.

Sulphuric acid is produced in several grades: (1) 50°B. acid, also known as chamber acid, containing an average of 50.76% SO_3, or 62.18% H_2SO_4; (2) 60°B. acid, containing an average of 63.41 SO_3, or 77.67% H_2SO_4; (3) 66°B. acid, known as oil of vitriol, containing approximately 76% SO_3, or approximately 93.19% H_2SO_4. Higher strengths of acid usually contain SO_3 dissolved in sulphuric acid, for example, pyrosulphuric acid and fuming or Nordhausen acid. Oleum is a grade which contains 30% of free SO_3, or a total of 87.14% of free and combined SO_3.

The production from copper and zinc smelters was as follows, reduced to 60°B. acid:

	Tons.	Value.
Copper smelters	321,156	$1,985,704
Zinc smelters	295,917	2,255,237
Total	614,073	$4,240,941

This is 27% of the United States production, and an increase og 175,773 tons compared with 1911.

Decisions Relating to Mining

Specially reported for the MINING AND SCIENTIFIC PRESS.

OIL PLACERS IN LOUISIANA

A locator on placer ground belonging to the United States, surveyed or unsurveyed, is the equitable owner of the mining ground, and the government holds the premises in trust for him to be delivered upon the payment specified; and he has sufficient interest to maintain a defense to an action of ejectment.

Producers' Oil Co. *v.* Hanzen (Louisiana) 61 Southern, 754. March 31, 1913.

ANNUAL LABOR—FORFEITURE FOR NON-PERFORMANCE DENIED

Where a stockholder in a mining company had been employed to look after and superintend mining properties of the company, and the company failed to perform annual labor on its claims, the said stockholder, occupying a fiduciary relation to the company, will not be allowed to relocate the claims in his own name and divest the company of title thereto, but such re-location will be held as insuring to the benefit of the company.

Co-operative Copper & Gold Mining Co. *v.* Law (Oregon) 132 Pacific, 521. May 27, 1913.

CONSTRUCTIVE POSSESSION OF MINERALS

In 1874 the owner of a certain tract conveyed the surface rights therein reserving the minerals. The grantee went into possession of the surface, and he and his grantees, including complainant, remained in possession ever since: no one having any separate actual possession of the minerals. Held, that the possession of the minerals accompanied the possession of the surface, and the complainant having acquired title to the minerals by adverse possession, was in the constructive possession thereof, so as to entitle him to sue to quiet title to the mineral rights.

Moore *v.* Empire Land Co. (Alabama) 61 Southern 940. April 23, 1913.

COAL LEASE—ROYALTY CLAUSE CONSTRUED

A coal lease provided that a minimum royalty should be paid each year, that if insufficient coal were mined during a given year to enable this minimum royalty to be paid from the proceeds, that the balance should be paid in cash, but might be credited on the royalty of a succeeding year when the coal mined should be more than sufficient to make the payments. Held, that the lease did not contemplate that royalties in excess of the minimum, derived from the mining operations of a given year, could be credited on payment of the minimum royalty of a succeeding year.

Vandalia Coal Co. *v.* Underwood (Indiana) 101 Northeastern 1047. May 28, 1913.

FIXTURES ON MINING CLAIMS

What constitutes and what does not constitute a fixture upon a mining claim is a question which usually has to be passed upon anew every time a case comes up, owing to the difficulty of formulating general rules to govern each specific instance. For example, an engine and pump bolted and spiked to a wooden frame bedded in the ground sufficiently to make it level, has been held to be a fixture[1]; an electric hoist, bolted to a substructure of timber and cement together with the head-frame and engine house surrounding it, were considered fixtures[2]; electric motors bolted to a concrete foundation, a transformer affixed to a pole, and an electric pump used in unwatering a mine were treated as fixtures.[3] The intent with which the articles in question were placed on the claim has much to do with it, but this intent will be inferred form the character of the articles, use for which they were intended, and manner in which they are placed upon the soil. Ore extracted from a shaft and stock piled on adjoining land for future treatment, is personal property of the lessee and not a fixture.[4] It is common practice for the lessee to stipulate in a mining lease for the removal of machinery and buildings, placed or to be placed by him upon the claim, in the event of the subsequent forfeiture, abandonment, or termination of the lease, and in such event he has a clear right to remove them. It would seem that a shaft-house and head-frame might be removed under such a clause if it could be done without permanent injury to the mine.

[1]Merritt *v.* Tudd, 14 California, 59.
[2]Arnold *v.* Goldfield, etc., Mining Co., 109 Pacific, 718.
[3]Conde *v.* Sweeney, 116 Pacific, 319.
[4]Ritter *v.* Lynch, 123 Federal, 930.

Petroleum Production in United States

The great production of petroleum in 1911, which was 220,449,391 bbl., was equaled and passed in 1912, when the total reached 222,538,604 bbl. Higher prices were the rule in 1912 except in California, and even in that state there was no material decline. The total value, therefore, increased markedly, reaching $164,087,342, or 22.41% above the value for 1911, according to the United States Geological Survey. The greatest increase in quantity was in California, where the total advanced from 81,134,391 to 86,450,767 bbl., a gain of 5,316,376 bbl., or 6.55%. Wyoming showed the remarkable gain of 742%, from 186,695 bbl. to 1,572,306 bbl., owing to the increased activity of the Mid-West Oil Co. and the Wyoming Oil Fields Co. Operations in northern Texas also more than offset the usual decline in the Gulf region and resulted in a significant gain for the state.

The volume of crude oil and of all the usual products exported from the United States increased, owing to the fact that foreign conditions were much more favorable to American exporters. Meanwhile the importation of gasoline from the East Indies was a favorable element in relieving the growing demand for this product on the Pacific coast. The improved conditions in the export trade and the increased capacity of the refiners to take care of the great yield of crude oil resulted in a marked decline in stocks in all fields except California, and even there the storage of petroleum was checked by an increase in consumption.

The total stocks of all crude oils at the beginning of 1912 aggregated 138,000,000 bbl. By the close of the year they had declined to 125,000,000 bbl., a decrease of about 10%. The decline was greatest in the fields east of the Rocky Mountains, where on January 1, 1912, the stocks aggregated 94,000,000 bbl.; they were reduced during the year to 79,000,000 bbl., a decrease of about 16 per cent.

This decline at once brought out a marked stimulation of prices all over the East, with a view to increasing the activity of drilling. Its effect was so marked that the natural decline of the older fields was checked. Even Ohio showed a slight increase in production in 1912 for the first time in 12 years.

The total production by states is given below:

State.	Production (barrels). 1911.	1912.
California	81,134,391	86,450,767
Colorado	226,926	206,052
Illinois	31,317,038	28,601,308
Indiana	1,695,289	970,009
Kansas	1,278,819	1,592,796
Kentucky	472,458	484,368
Louisiana	10,720,420	9,263,439
Michigan	7,995	*
Missouri		
New York	952,515	874,128
Ohio	8,817,112	8,969,007
Oklahoma	56,069,637	51,852,457
Pennsylvania	8,248,158	7,837,948
Texas	9,526,474	11,735,057
Utah	186,695	1,572,306
Wyoming		
West Virginia	9,795,464	12,128,962
Totals	220,449,391	222,538,604

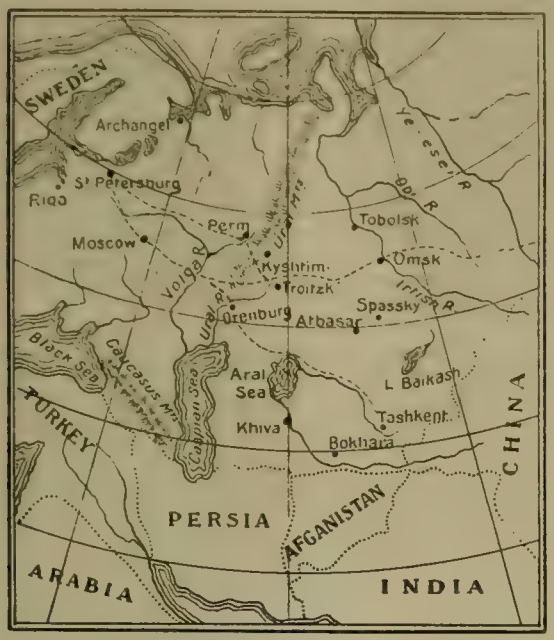
*Included in Ohio.

Prices ranged form 50.7c. per barrel in Wyoming to $1.644 in Pennsylvania, while the average for all states was 73.7c., against 60.8c. per barrel in 1911.

Company Reports

SPASSKY COPPER MINE, LTD.

This Company was formed in 1904 to acquire the Yuspenssky copper mine, the Spassky smelting works, and the Karagandy coal mine, in the Akmolinsk district of Siberia. In 1911 a controlling interest in the Atbasar company, owning another copper property to the southwest, was purchased. Last month the whole of the Atbasar property was absorbed by the Spassky company. The report of the Spassky for the year ended September 30 shows that 28,315 tons of ore was raised, averaging 20% copper. The smelter treated 23,759 tons, averaging 18.5% copper, yielding 3998 tons of metal. As regards development, the Annensky



----------RAILWAYS. ..... BOUNDARIES.

RUSSIA AND WESTERN SIBERIA.

shaft has been sunk to 560 ft., and a level opened at that point with encouraging results. Further sinking is in progress. At the coal mine, 64,757 tons was raised, chiefly for use at the smelter. The income from the sale of copper was $1,756,000, the average price being $4368 per ton. The net profit was $782,000, out of which $719,000 has been paid as dividend, being at the rate of 25 per cent.

JUPITER GOLD MINING COMPANY, LTD.

This Company belongs to the Consolidated Gold Fields group, and was formed in 1896 to acquire property on the dip of what is now in the Geldenhuis Deep. As is known in mining circles, the Company owns a mill conjointly with the Simmer Deep, and the normal proportion of stamps is 120. Milling commenced in 1908, and the dividends so far paid have been 5% for 1909, and 5% for 1912. The capital is $4,865,000. The report for 1912 shows that 492,789 tons of ore was mined, and, together with 21,391 tons from the dumps, sent to the sorting station, where 7.25% was removed as waste. The average number of stamps working was 100, and 6.3 tube-mills. The gold yield was worth $2,342,000. Working costs were $2,068,000. After sundry items of income and expenditure were included, the working profit was $307,000. Out of this, $245,000 was distributed as dividend, being at the rate of 5%. The working cost per ton was 75c. less than in 1911, and the yield per ton was 56c. less. The amount of ore treated was 161,800 tons greater, so the increased profit per ton and the increased tonnage contributed to an increased profit for the year of $144,000. The scarcity of native labor has led to more machine-drills being used, and during 1912 the proportion of ore broken by machines was 92%. The ore reserve on December 31 was estimated at 1,270,000 tons, averaging $4.40 per ton, as compared with 1,232,511 tons, averaging $5.10 the year before. The ore developed during the year was of poorer quality than the average, and the greater proportion of machine-drilling involving wider stopes accounts partly for the fall in average content of the reserve. It should be noted that the Jupiter and Simmer Deep companies now return their reserves in tons of ore in the mine, and not in milling tons allowing for the rejection of 10% waste. This alteration is due to the fact that the low grade of the ore makes it impossible to reject so large a proportion. The report refers to a proposed increase in the capacity of the mill from 45,000 to 60,000 tons per month, made possible by the recent improvement in the labor supply. The number of stamps will not be increased, but coarser crushing will be adopted, with extra tube-mills.

TEKKA, LIMITED

This Company belongs to the Wickett group, with headquarters in Redruth, Cornwall, England, and was formed in 1907 to acquire a property in the Kinta district of Perak, Federated Malay States, on the other side of the Kinta valley to the Tronoh and Lahat. In 1910 an additional property was purchased, in the Taiping district, north of Kinta. Dividends were first paid in 1909, and the profits have steadily grown. The Tekka ground is hydraulicked, and a suction-pump dredge is used at present at Taiping property. The report for the year ended January 31 last shows that at Tekka 593,493 cu. yd. was treated for a yield of 435 tons. The recovery was 1.64 lb. black tin per cubic yard. At Taiping, 296,350 cu. yd. was treated, yielding 127 tons, or 0.93 lb. per cubic yard. Development points to bucket-dredging as being the best method of working the deposit, and an alteration is contemplated. The total profit for the year was $172,000, out of which $144,000 has been distributed as dividend, being at the rate of 37.5%. Osborne & Chappel are the managers.

Gold Production of Western Australia

The gold production of Western Australia in April was $2,195,300, the principal producers being as follows:

Name.	Tonnage.	Value.	Profit.	Dividend.
Great Boulder	18,212	$240,000	$127,800	.....
Ivanhoe	19,715	188,400	70,000	$275,000
Kalgurli	10,620	107,000	46,200	120,000
Bullfinch	4,343	66,100	44,100	.....
Fenian	2,750	53,900	33,400	.....
Yuanmi	10,400	89,400	32,800	.....
Golden Horse-Shoe	25,460	184,800	24,900	.....
Victorious	8,550	56,800	20,000	.....
Lake View & Star	18,226	105,500	18,600	50,000
Sons of Gwalia	13,400	105,400	14,500	.....
Queen of the Hills	3,254	28,600	10,900	.....
Sand Queen	1,230	23,700	10,000	7,500
Mararoa	2,630	24,100	9,100	.....
Oroya Links	11,350	60,000	7,900	.....
Mountain Queen	3,302	24,600	6,500	.....
Perseverance	20,622	116,700	6,500	174,930
South Kalgurli	9,694	55,000	6,500	.....
Associated Northern	1,940	30,000	7,000	87,500
Golden Ridge	2,894	22,300	5,000	.....
Associated	10,435	56,400	4,200	.....
Kyarra	895	14,000	3,800	.....
Ingliston Consols	2,120	15,800	2,700	.....
Lake View Consols	8,675	8,100	2,400	.....
Menzies Consols	1,904	16,500	1,200	.....
Burbanks Main Lode	2,052	22,500	100	.....
			Loss.	
Great Fingall	5,896	55,000	830	.....
Commodore	1,100	4,200	300	.....

The production in general has shown a slight decline for the past year, but with the new producers which are being developed, the future outlook is bright.

Concentrates

Most of these are in reply to questions received by mail. Our readers are invited to ask questions and give information dealing with the practice of mining, milling, and smelting.

THE FOREST AREA of Canada covers about 800,000,000 acres.

COPPER PRODUCTION of the world in 1800 was 10,000 tons, while in 1912 it was 1,008,290.

PRODUCTIVE oil and gas wells in the United States in 1912 were 12,512 and 1811, respectively.

POWER CONSUMPTION of a 16 by 22-ft. Trent agitator at the Ohpir mill, Virginia City, Nevada, averages 4½ horsepower.

'ROCK' STAMPED by the mills of the Lake Superior copper region amounted to 11,411,941 tons in 1912. Of this, 81.2% was amygdaloid, and 18.8% conglomerate 'rock.'

DUTY on impure sodium and potassium cyanide imported into Bolivia is $1.412 per 100 lb. In addition to the regular customs duties, there is a surtax of 15% of the duties.

THE SLIME AND SAND from the concentrator at Anaconda is being made into tile and bricks at the Washoe brick plant. The product is experimental so far, but gives promise of success.

SILVER PRODUCTION of Michigan copper mines in 1912 was worth $324,999. This is from the Keweenaw district, where both metals occur native in lodes remarkable for their extent and uniformity.

GOLD STEALING on the Rand and the disposal of the same in England has, it is reported, taken on a new form, in that the gold is exported in the form of process blocks. These look much like heavy 'electros.'

MINING CLAIMS granted in Peru during the fortnight ended June 1 were as follows: silver, 2; silver and copper, 12; coal, 3; and lead and silver, 1. These were situated in 13 different provinces, and were granted to 12 petitioners.

ANALYSES OF PYRRHOTITE show the following composition: from Sudbury, Canada, iron 56.39%, sulphur 38.91%, and nickel 4.66%; from Lancaster Gap, Pennsylvania, iron 55.82%, sulphur 38.59%, and nickel 5.99%; and from Mountain, Wisconsin, iron 56.154%, sulphur, 43.846%, and no nickel.

ELECTRIC POWER in Madrid, Spain, was recently reduced from 18 to 3c. per kilowatt-hour as the result of a rate war, but an agreement is being arranged to charge 7c. per kilowatt-hour. The Compañia Coöperativa Electrica Madrid derives its power from a hydro-electric plant 150 miles from Madrid.

SULPHUR PRODUCTION in the United States in 1912 was 303,472 long tons, valued at $5,256,422, compared with 265,664 long tons, valued at $4,787,049, in 1911, according to the United States Geological Survey. The sulphur came from Louisiana, Nevada, and Wyoming, the production of Louisiana being the dominant factor in the domestic sulphur industry.

EXTENSIONS of the Mt. Morgan, Queensland, ore deposits have never been found beyond the boundary of the holdings of the Mt. Morgan company. The Extension company has sunk a shaft 1992 ft., and a drill-hole was driven 3068 ft., besides other drilling and driving. Only traces of gold and copper were found. The company intends to persevere. Mt. Morgan has produced gold and copper worth $86,000,000.

ANALYSIS of mine operations in the Transvaal during April, according to the Chamber of Mines, shows the following: Ore hoisted, 2,627,989 tons; percentage of waste sorted, 11.78; ore milled, 2,356,204 tons; stamps working, 10,046; tube-mills working, 285; plants in operation 27.19 days of 24 hours each; stamp-duty, 8.85 tons per day; gold production, $16,010,000, of which $1,070,000 was from amalgamation and $5,840,000 from cyanidation; and working costs of 60 companies averaged $4.32 per ton.

ANEROID BAROMETER READINGS should always be made while the instrument lies flat. A good instrument is now made for mining purposes, so graduated that observations below sea-level may be taken. It has its entire circle graduated to represent 6 in. of the mercurial column between 27 and 33. The range of altitude extends between 2000 ft. below and 4000 ft. above sea-level. The altitude scale is divided into 10-ft. spaces, and may be read by verniers to single feet. The reading lens rotates about the circumference to facilitate such observation.

ELECTRIC TRACTION will be used on the new route from Spiez by way of the Loetschberg tunnel to Domodossila, Italy, the electric locomotives being constructed by the Oerlikon Machine Works, near Zurich, Switzerland. The weight of the locomotives is 112 tons, and they are fitted with two motors of 3000 hp., weighing 27 tons each. The cost of construction is about $40,500, or twice that of an ordinary steam-engine. The overhead or trolley system is employed, a current of 15,000 volts being carried. The locomotives are capable of pulling a train weighing 310 tons up the maximum grades of 27 per 1000 at the rate of 31 miles per hour.

BAUXITE is the principal ore of aluminum and is mined largely in Arkansas. It is a result of weathering of crystalline rocks. In part it has been redeposited in Cretaceous clays. It probably occurs at a number of places where it has been overlooked, as it may easily be confused with low-grade iron ore, or even iron-stained clay. It is really a hydroxite of alumina and contains 34 to 45% aluminum when pure. It is whitish, yellowish, or brownish in color; dull and earthy as to lustre; has no crystal form and no cleavage; breaks with a smooth to uneven fracture; has a white to pale yellowish streak; is 1 to 3 in hardness; and has a specific gravity of 2.5. It is most frequently oölitic or pisolitic in form, and that is the most ready means of recognizing it in the field. However, it also occurs in granular earthy form which is deceiving. It yields water at high temperatures in a closed tube, is difficult to dissolve in hydrochloric acid, and is infusible, but gives a deep blue test with cobalt nitrate. The United States production in recent years has been about 150,000 tons per year, and the average price at the mine about $5 per long ton. Being a surface material, it is usually cheaply mined.

ORE DEPOSITS of the Joplin district, Missouri, vary in character with the depth of mining. The shallower ores beginning at the surface are universally pockety and are found in residual clays or in 'runs' in the basal breccias of the region. The breccias and the forms of the 'runs' are largely, if not altogether, due to solution of the limestone strata. One form of run, according to B. S. Butler and J. P. Dunlop, of the United States Geological Survey, which is fairly numerous, is the 'circle' deposit, which, in the popular view, has come to be nearly synonymous with rich deposits. Small veins, vertical sheets, and thin crevice deposits are often found in prospecting, but unless they develop into stringers leading into paying orebodies, are forgotten in the multitude of rich pockety deposits which the district has yielded. The blanket deposits or 'sheet ground' are found in the Grand Falls chert member of the Boone limestone, at depths varying from 125 to 275 ft., depending on the topography and the geologic structure. Below this horizon there are, in the rocks of Kinderhook age, deposits of disseminated ore. They have been found in prospect shafts or drill-holes near Springfield, Aurora, Granby, Carterville, Joplin, Hornet, and Cave Springs, in Missouri; at Galena, in Kansas; and at Quapaw, in Oklahoma.

Recent Publications

Reinforced Concrete Wall Footings and Column Footings. By Arthur N. Talbot. Bulletin 67. P. 114. Ill. University of Illinois. Urbana, 1913.

The Coastal Plain of North Carolina. By W. Bullock Clark, Benjamin L. Miller, L. W. Stephenson, B. L. Johnson, and Horatio N. Parker. North Carolina Geological and Economic Survey, in conjunction with the United States Geological Survey. P. 552. Ill., maps, plans, charts, index. Raleigh, North Carolina, 1912.

United States Geological Survey publications, Washington, 1913:

The Yentna District, Alaska. By Stephen R. Capps. Bulletin 534. P. 75. Ill., maps, index.

Sulphur Deposits in Park County, Wyoming. By D. F. Hewett. Advance chapter from Bulletin 540, 'Contributions to Economic Geology, 1912.' P. 6.

Bureau of Mines publications, Washington, July 1913:

Safety Electric Switches for Mines. By H. H. Clark. Technical Paper 44. P. 8.

Use of Heavy Oils in Internal-Combustion Engines. By I. C. Allen. Technical Paper 37. P. 36.

The Analysis of Black Powder and Dynamite. By W. O. Snelling and C. G. Storm. Bulletin 51. P. 80. Ill.

The Flash Point of Oils, Methods and Apparatus for Its Determination. By I. C. Allen and A. S. Crossfield. Technical Paper 49. P. 15. Ill.

First Series of Coal-dust Explosion Tests at the Experimental Mine. By G. S. Rice, L. M. Jones, J. K. Clement, and W. L. Egy. Bulletin 56.

Advance chapters from 'Mineral Resources of the United States, 1912.':

Production of Chromic Iron Ore. By J. S. Diller. P. 10.

Gems and Precious Stones. By Douglas B. Sterrett. P. 42.

Production of Anthracite. By Edward W. Parker. P. 19.

Potash Salts. Summary for 1912. Compiled by W. C. Phalen. P. 36.

Precious and Semi-Precious Metals in the Central States. Mine production. By B. S. Butler and J. P. Dunlop. P. 87.

Geology and Ore Deposits of the Philipsburg Quadrangle, Montana. By William Harvey Emmons and Frank Cathcart Calkins. Professional Paper 78. P. 271. Ill., maps, plans, index.

Copper Leaching at the Nevada-Douglas Property

Leaching processes are having their inning in the copper world at present. In addition to those recently reported, the Nevada-Douglas Copper Co.'s principals claim to have been successful in conducting experiments for some months under the supervision of W. L. Austin, bringing the process to a point where it can be operated commercially to produce copper at a cost of 7 to 10c. per pound. Laboratory results show costs at Butte with a similar process to be 5c. per pound. The Nevada-Douglas management is jubilant over the success of these experiments on both the high and low-grade ores of the mines. The ore is pulverized and leached with 10% sulphuric acid, and it is claimed tests have shown that agitation for two hours will give an extraction of 85%. After the copper is dissolved it is precipitated from the solution by an electrolytic process, the same as that employed in the Atlantic coast refineries. That there is a good future for the leaching process as applied to copper ores seems evident, and the mining public will await with interest the results when tried on a working scale. J. Parke Channing is of the opinion that leaching methods will prove most effective in saving the copper now lost in treating the ores of Miami.

Catalogues Received

Keystone Placer Drill Co., Beaver Falls, Pennsylvania. 'The Keystone Drill Magazine' for July. 16 pages. Illustrated. 5 by 7 inches.

Henry R. Worthington, 115 Broadway, New York. Catalogue No. W-202, 'Volute Centrifugal Pumps.' 64 pages. Illustrated. 6 by 9 inches.

Smooth-On Manufacturing Co., Jersey City, New Jersey. 'Extracts from Instruction Book No. 12.' 16 pages. Illustrated. 3½ by 6 inches.

A. S. Cameron Steam Pump Works, 11 Broadway, New York. Bulletin No. 150, 'Cameron Centrifugal Pumps.' 16 pages. Illustrated. 6 by 9 inches.

Lidgerwood Manufacturing Co., 96 Liberty St., New York. Bulletin No. 12, 'Lidgerwood Electric Hoists.' 20 pages. Illustrated. 9 by 12 inches.

Cyanide Plant Supply Co., Ltd., 1, Broad Street Place, London, E. C., England. Supplement No. 23, 'Brown Agitator or Pachuca Tank.' 28 pages. Illustrated. 8 by 5½ inches.

Chicago Pneumatic Tool Co., Chicago. Bulletin No. 127. 'Pneumatic' Drills, Reamers, Wood Borers, Flue Rolling and Tapping Machines and Grinders.' 40 pages. Illustrated. 6 by 9 inches.

Sullivan Machinery Co., Chicago. Bulletin 58-M. 'Sullivan Cross Compound Power-Driven Air Compressors.' 20 pages. Illustrated. 6 by 9 inches. Also booklet No. 112 on Sullivan Air Compressors, and Bulletin No. 66M, 'Hammer Drills for Quarry Purposes; and Stone-Dressing Tools.' 20 pages. Illustrated. 6 by 9 inches.

Commercial Paragraphs

The Hardinge Conical Mill Co., believing that it will be conferring a benefit upon the users of cylindrical tube-mills without material injury to its own interests, begs to inform such users of cylindrical tube-mills that it will grant a limited number of privileges for converting cylindrical tube-mills into Hardinge mills upon the following conditions: 1st. That the owner or user of a tube-mill will furnish the Hardinge Conical Mill Co. with dimensions of the unconverted tube-mill, also information relative to the work now being done and which will be required of the mill after conversion, but the privilege shall only apply to tube-mills installed previous to January 1, 1913. 2nd. That the converted tube-mill shall bear a license plate which will be furnished by the Hardinge Conical Mill Co. 3rd. The consideration for the privilege shall be $1 upon the furnishing of the license plate, and the further consideration of information relative to the comparative merits of the mill before and after conversion, as soon as such information is available. 4th. The granting of such privilege shall be entirely at the discretion of the Hardinge Conical Mill Co. and is at present intended only for applications received during the remainder of the year 1913. 5th. The unlicensed use of any such converted tube-mill, without the written authority of the Hardinge Conical Mill Co., will be construed and prosecuted as an infringement of its patents, which have already been adjudicated in favor of the Hardinge Conical Mill Co. in the United States Circuit Court and the United States Circuit Court of Appeals.

The Goldfields Water Scheme, which supplies the Eastern Goldfields and many farming districts in Western Australia, showed a consumption of 1,134,800,000 gal. during the year that ended on June 30, 1912. Of this, the mines used 449,400,000, and mining towns 307,500,000 gal., a total of 756,900,000 gal. The revenue from all sources was $1,100,000, operating expenses, including pumping, maintenance, management, etc., $375,000, interest $499,000, and sinking fund $455,000, leaving a deficit of $129,000. Pipes cover a length of 1016 miles.

The Eureka T & T Hook

This contrivance was invented for use in the tie preserving plants of Montana. The special features of the hook consist of the two points on the hook and two opposing spurs on the toe ring, giving a non-swiveling grip on the timber, tie, or barrel to which it is fastened. With this hook a corner hold from right or left and an end-lifting hold for carrying and piling can be had, using two opposite hooks. It can also be used as a lug-hook for pole work. It will be found of especial value in handling short

THE EUREKA HOOK.

timber about the framing shed in the preserving plant, at the shaft or slope, and on the underground stations. It can be used to advantage in handling boxes of castings, hardware, etc., and in all kinds of railroad work. The verdict of the tie and lumber men and the miners of this state is expressed in the question repeatedly asked when shown the tool: "It is so simple why has someone not thought of it before?" The hook has been well received by the miners as well as the lumbermen. The tool shown in the illustration is 18 in. long and adapted to standard ties. Two larger sizes are contemplated for mine timber and use on carriages in the sawmills where such a hook is required. The hook was patented on June 24, 1913, and is manufactured by the Eureka Tie & Timber Hook Co. of Helena, Montana. The hook is a valuable asset in mining and railway construction work.

The 'Neptune' Diving Apparatus

This apparatus is designed particularly for work in flooded mines and other difficult situations where the use of air-pumps and tubes would be impracticable. The wearer is supplied with a perfectly respirable air without the aid of air-pumps, tubes or any communication whatever with the surface. The maximum depth of water at which the apparatus can be safely used is 60 ft., and the duration of supply one hour with one cylinder, or two hours with two cylinders. The principle of the apparatus is that the wearer breathes the same air several times over, the moisture and being absorbed from the exhaled breath, and the requisite amount of oxygen restored to it thus rendering it pure and fit for inhalation again. The apparatus consists of a patent diving helmet and dress in combination with a steel cylinder or cylinders containing compressed oxygen and atmospheric air in certain proportions, and a metal chamber containing a substance which absorbs the carbonic acid of the exhaled air. It is fitted with valves which allow the air and oxygen to pass into the helmet and dress in the required quantity no matter at what depth the diver may be working. There is also a patented safety device whereby, in the event of a valve failing, the diver would be enabled to supply the requisite amount of air independently of the valves. Any excess of air that accumulates in the dress escapes automatically. The apparatus is manufactured by Siebe, Gorman & Co., Ltd., London, S.E. The American representative is H. N. Elmer, 1140 Monadnock block, Chicago, Illinois.

Sears' Acme Mill

The 'Acme' mill was evolved from experience, which showed the possibilities of, and the actual need for, in the mining field, an improved mill of the Chilean principle, adapted to the practical and efficient fine grinding of ores, for amalgamation, concentration, or cyanidation.

This mill is especially adapted to the work of amalgamation, is versatile, convenient to operate or repair, automatic in adjustment for wear, has automatic feed, and is continuous in operation. In short, a mill with capacity, effectiveness, and none of the objectionable features of former mills.

It is not an experiment, for the principle is older than the stamp-mill, and has been thoroughly tested. It differs from other mills of this style vastly in the improved mechanical design, to better adapt it for amalgamation, facilitate the general operation, and eliminate the causes of vexatious delays and annoyances, so numerous in other designs. It is claimed that there is no other mill made which can be cleaned so quickly or thoroughly. By a convenient arrangement the spider and wheels are removed at one lift, then the die is taken out, and the mill may be cleaned easily and thoroughly. The whole operation of taking out spider and die, cleaning mill, and replacing working parts ready for new run can be accomplished in less than one hour. This feature is especially valuable in a custom mill. There are no adjustments necessary but that can be made while the mill is in operation, such as adjusting to change from a low-grade to a high-grade ore, or vice versa, or from maximum to minimum capacity, changing or renewing screens, or raising or lowering discharge. It can therefore run for 60 days without a moment's stop.

The arrangement for starting up with a load in the mill is an original and exclusive feature. In other makes of Chilean mills, if they have to be stopped with a load in them, it is necessary to shovel it out before starting, or run the risk of breaking the gearing or some other part of the machinery, whereas with this mill there is absolutely no danger, as it can be stopped at any time, and started with ease and safety with maximum load. No grease can get in from any of the bearings and they can be lubricated just as needed, at all times, while running.

The amalgamating features are the best that can be designed from years of experience.

Entirely automatic adjustment to compensate for wear on tires and die; and automatic feed, are two strong points. Variable capacity by changing speed and raising or lowering discharge while running, is another important feature. The screens have long life, owing to their proper position above die; are reversible and changeable, and in plain sight of the operator at all times. Friction is reduced to the minimum by roller and ball bearings, saving horse-power, wear, and lubricant. The cost of upkeep has been reduced to the minimum.

It is designed and built by an experienced millman, who knows from the millman's standpoint, what is necessary in a mill of this kind to make it practical, effective, convenient, and durable. This mill has a capacity of 20 to 60 tons per 24 hours, according to the material and size to which reduced. Feed must be ¼-in. mesh to get the above capacities, but as coarse as ½ to ¾-in. feed may be used. Five to ten horse-power will be required, varying according to speed. Fifteen to thirty revolutions should be the limit within which the best results can be secured.

One or more of these mills installed below stamps, or any other auxiliary crushers reducing to ¼-in. mesh, will increase tonnage, and at the same time increase saving by amalgamation, put the pulp in the best condition for concentration or cyanidation, and in many cases eliminate the necessity for cyaniding by the increased extraction due to finer grinding. The mill is manufactured by the Sears-Smith Engineering Co. of Stockton, California.

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EDITORIAL

ONCE more the spot-light has been turned on the high-cost-of-living question. Surely it would seem that the times are out of joint when a cabinet officer is forced, by his own statement, to carry a side line of lectures in order to make both ends meet. However, with a stipend of $12,000 a year and a grape-juice diet it is a question, under the present delicate diplomatic situation, whether it would not be more expedient to devote a greater time to decreasing expenditure and less to increasing income.

IT is extremely gratifying to note that the Government is to establish a metallurgical and testing plant at Salt Lake City, which will be ready for operation about October 1. It will not be the purpose of this station to supplant private enterprises, but to conduct research work in the treatment of refractory ores and low-grade deposits which are at present beyond the pale of profitable investments. The motive is solely for conservation, and it is to be hoped that the large tonnage of lead-zinc ores which are in the mines and on the dumps throughout the Middle West may be turned into good investments through the efforts of this branch of the Bureau of Mines.

REACHING its majority was recently signalized by the Institution of Mining and Metallurgy of London by the raising of a twenty-first anniversary fund to serve as a permanent endowment for the society. To this, as a memorial to the late Sir Julius Wernher, his widow has subscribed £10,000, and others have contributed smaller sums. Recently a freehold house at the corner of Finsbury Circus and West street, and but a few yards from the centre of mining activities in London, was purchased for £9500, and, after being redecorated, will serve as the headquarters of the Institution's activities. The cost of this is practically already met by those subscriptions which are available for expenditure in this form, and it is confidently expected that the small temporary deficit will be promptly met by further subscriptions. What the Institution has been able to accomplish during the twenty-one years of its existence speaks for itself; we need not gild the lily. But we desire to compliment it upon the modesty of its present plans. When the American Institute of Mining Engineers acquired its permanent home, expenditure was upon so lavish a scale that the pressure of the 'high cost of living' was felt for years afterward, and the land debt has only just been liquidated, through the untiring efforts of Dr. James Douglas. Even allowing for

fundamental cost differences between New York and London, the expenditure of approximately $55,000 to secure a permanent home for the Institution is commendably modest indeed. London is the great centre of world activities, and the engineer who comes from the far corners of the earth can now find within a few steps of Salisbury House and London Wall all those social, professional, and technical relationships and activities that he has missed in his period of exile.

Prices and Quotations

Not a few anomalies are presented in the prices at which various commodities are sold. A man's hat costs practically the same, no matter what the time of the year, or where it is bought; a bushel of wheat sells for one price today, another tomorrow, and at different prices today according to the place and time of delivery. Yet wheat is scarcely more likely to decrease in value if its sale be delayed than is a hat, and its transportation certainly offers no more difficulty, nor represents a larger proportion of its value than is the case with a hat. The reason for this curious contrast is that wheat is a commodity in which there is active speculation, based upon varying but imperative demand, while in the case of hats and similar commodities there is no such speculation. If an operator were to corner felt hats, the public would promptly take to wearing straw head-coverings; but if manipulators corner No. 1 hard wheat, millers cannot expect to be able to feed the public with graham flour or cornmeal. Under which of these two forms of selling the public reaps the greatest advantage is at least open to question. Evidently the stable selling price suits the producer best, for the first action of a concern which obtains control of the production of any commodity is to place selling upon a fixed-price basis. Where competition is restricted, the producer alternates between large gains and heavy losses.

As a whole, metals sell in this country on a competitive basis, though not upon a basis for speculation, generally speaking. In this our chief metal market, New York, differs in marked degree from London, where there is active speculation in metals. In the case of copper, for example, the chief producers sell directly to the principal consumers, either directly or through affiliated agencies, and nothing is sold except the actual metal. In London, on the contrary, there is a large business in copper warrants, which do not differ materially in character from the cotton futures which it has recently been proposed to tax out of existence. Why this is not done in New York is perhaps largely due to the reason assigned by the Chinese farmer, who on being asked why the Chinese house is not provided with a north door to let in the breeze in summer, replied, "We do not have north doors to our houses." It is also due to the fact that the American consumer of copper apparently does not feel the need of 'hedging' his investments in the metal. The English consumer who buys a consignment of copper proceeds to sell, at the same time, a warrant upon the exchange for approximately the same amount. If the price of copper goes down or up, the loss on the metal will be practically compensated by the gain on the warrant, or conversely.

Dealing in copper futures is therefore employed as a form of industrial insurance which may be utilized by the consumer of copper; it may be, and is, of course, also made a medium of unadulterated speculation by market operators. If the arguments of that group of individuals, who are strenuously upholding the necessity for continuing speculation in cotton futures, are valid, it would apparently be to the advantage of copper producers to have similar dealings in copper in the New York market, but business here has so far failed to evidence any necessity for it. A fundamental difference between the two commodities must not be overlooked; copper is continuously produced, while cotton all becomes available at picking time and must be fed slowly to the consumer throughout the ensuing year. Any lack of correspondence with the supply of copper and the demand is due to conditions other than seasonal changes. For years consumption has been leading the market; in other words, it has been so steady and of such large amount that it has governed the amount produced. When it tends to exceed production, the price of the metal tends to advance, properties become workable that at lower metal prices yield no profit, and the output increases. If it increases too fast, the price of copper falls, and the mines which are working on a narrow margin are obliged to shut down.

This simple relation is complicated by the lack of relation between the discovery of large valuable orebodies or the new methods of mining and metallurgy on the one hand, and on the other the rapid changes in the business world which may follow as a result of wars or business crises. Underlying these fundamental conditions is a maze of relationships that cause prices to fluctuate from day to day. If copper sells at 15 cents for any considerable period, it is only because producers are able to sell it at that figure and still make a fair operating profit. At all times they are willing to take more, if they can get it; at times they may be willing to sell for less, but year by year there exists what may be called a normal selling price for copper. Unfortunately this defies exact determination, for the metal may sell for 20 cents or 12 cents, when its norm is 16. For this reason it is impossible to determine the normal price by averaging actual prices over a long period, for the laws of chance do not strictly apply.

Another reason why this is impossible is that price quotations are at best but approximations. On any given day numerous agents are selling lots of copper of different sizes at prices which vary slightly. The average price realized may easily be approximated, but to determine it with precision would require exact information as to the weight and price of every lot of the metal sold, and the making of allowances for the difference in selling terms, if any exist. Furthermore, no real basis for quotations may exist. During June, in New York, copper declined from approximately 15½ cents per pound at the beginning of the month to 14½ cents at the close. But as a matter of fact, no considerable amounts of copper were sold at these or any

other figures. Finally, about the middle of July, buying was resumed in considerable volume on the basis of 14¼ to 14⅜ cents. By averaging quotations, those days on which no copper was sold have equal weight with the days on which it was sold in large quantities. It is evident, therefore, that statistics regarding prices can never be brought upon a basis of absolute precision. The present method of computation of approximate averages offers, however, a useful guide to the trend of the market and furnishes a practicable basis upon which business transactions can be concluded.

Mining Schools and Politics

Politics has all too frequently paralyzed technical schools, and we regret keenly to chronicle the fact that two state mining schools have just suffered a shake-up, due fundamentally to partisan politics. Eleven years ago Mr. Regis Chauvenet, despite his learning and high standing in metallurgy, fell a victim to dissension within and politics without, and was retired from the presidency of the Colorado State School of Mines. This year his successor, Mr. Victor C. Alderson, has suffered the same fate. Despite the excellent situation and many favoring conditions, the school at Golden has failed somewhat to realize its opportunities and ambitions. It has sent out excellent engineers, and a number of mediocre ones; in which it is neither better nor worse than other mining schools. The question inevitably arises whether the graduates of which the school has reason to be proud, would not have been even better men if they had been trained by a more united faculty. Knowing something of the internal politics that seems inherent in the faculty of an educational institution, in the United States at least, we are frank to say that in our judgment the Colorado School of Mines has chronically suffered from more than the usual amount of this trouble. More than once professors have been forced out of the faculty. Matters would probably have gone smoother if there had been an even more complete change of personnel. Trouble within a faculty is bad enough, but interference for political purposes is worse, and we are told that the present Governor of Colorado protested that, this being a Democratic administration, there were too many Republican instructors at Golden! Since when, may we ask, has skill in technical work or in instruction been dependent upon a professor's belief as to the tariff? It is a disgrace to the United States that such matters should enter into the making of appointments in an educational institution, and any school that submits to such treatment is sure to lose standing. It is not a matter of personalities in the least. Whether Mr. Alderson or another administers the school is a minor matter as compared with the big question whether a harmonious faculty is to receive help from outside or to be torn by dissension and hindered by the overruling politicians. Mr. Alderson devoted his talents, and with excellent results, to building up the plant and increasing the funds of the school. We called attention some months since to the large testing laboratory that had been erected, in the main as the result of his energy and persistence. The plant stands nearly idle because the funds to make it useful have been refused. This illustrates excellently the inevitable result of a changing policy dictated, not by the needs and purposes of the school, but by the assumed necessities of distribution of state funds to meet local political demands. The whole situation is a sorry one, and may well make engineers question whether it would not be wise to have fewer but better schools. Mr. William G. Haldane, who goes in as acting president, has our sympathy. He is young, capable, and energetic, but he comes from a divided faculty to a difficult position. Appointment of Mr. Chauvenet as President Emeritus is, we presume, an empty honor; one that even Mr. Chauvenet's friends may well regret. It is always a doubtful expedient to try and turn back the hands on the clock, and the appointment suggests an unwelcome complicity in intrigue that comports but poorly with his high standing among engineers. We hope this honor has come to him unsought, but we fear that his name is being used by those who have ulterior purposes.

The other school that is in difficulties is the Missouri School of Mines, which, while an organic part of the State University, maintains a separate staff and plant at Rolla. Always small, it has done good work and some of the leaders of the profession look back with gratitude to life within its doors. Mr. D. C. Jackling may be mentioned as one. This school was long the football of local partisan politics, and the president, Mr. L. E. Young, has resigned as a protest against the apparent purpose of the present Governor, Mr. Elliott W. Major, to thrust it back in the mire from which it has been climbing. The particular incident is minor, the difficulty arising over the award of the position of architect for a new building to Mr. H. H. Hohenschild. Mr. Hohenschild represents the county in the state senate and is the local Democratic 'boss.' He is no better or worse than many other political bosses. His calibre is perhaps sufficiently indicated by the fact that he regards the School of Mines as a local establishment, one of the counters in the political game, rather than an educational institution belonging to the state at large. Such a concept is medieval. We know that it does not accord with the best thought of Missouri, but the incident lends color to the gibes that are constantly thrown at citizens of the great middle state.

Such situations as are here discussed are perhaps inevitable incidents to evolution of popular government. That they represent but temporary stages in that evolution is evidenced by the independent position of the educational institutions of most of the states. They can not last long. We have much faith in the ultimate good sense and high purposes of the people of Colorado and Missouri, but it is an unwelcome revelation that civilization is so shallow in these states, which rank so high in mining. On behalf of mining men in and out of these states, we protest. It is no disgrace that a state school be small; its buildings may be inadequate, and its faculty need not necessarily be large; but the school must be free or it is a failure.

Sandstone Copper Deposits at Bent, New Mexico

By Sydney H. Ball

A brief examination of the property of the Tularosa Copper Co., made some time ago, resulted in certain conclusions regarding the origin of bedded copper deposits in sandstone, which perhaps are sufficient to justify the publication of the following notes. E. T. Kern, president of the Company, has kindly permitted their publication. An interesting account of this deposit has been recently published by L. C. Graton.[1] The conclusions arrived at by Mr. Graton and myself are, however, somewhat at variance.

W. Lindgren,[2] in a general article upon orebodies

MAP OF NEW MEXICO.

in sandstone, states that the characteristic metals are copper, lead, vanadium, and uranium, and that while ores of several metals sometimes occur together, "they are more commonly segregated into separate deposits in which one predominates." He recognizes as primary ores, chalcocite, bornite, chalcopyrite, pyrite, galena, roscoelite, and carnotite. Gangues are inconspicuous, consisting of a little calcite, barite, and gypsum, the last probably of secondary origin. A little silver is usually present. Oxidized ores develop from the original ores. "The deposits are rather conspicuously confined to certain formations within the Permian, Jurassic, or Triassic. * * * More rarely the ores appear in fissures in the same formation * * *." He mentions that the sedimentary rocks are either shallow marine or continental deposits. It has been my experience that such ores, when occurring in 'red beds', are usually confined to the gray or white interstratified members, and do not occur in the highly ferric stained strata. As to their origin, Mr. Lindgren states: "In their present form the ores are assuredly epigenetic, but the evidence equally points to their having been concentrated by atmospheric waters from small quantities of metals disseminated in the rocks. It is believed, though the evidence of this is less direct, that the metals were carried down as sediments and solutions from older ore deposits in the adjacent continental areas." At the Tularosa mine, however, I believe that similar deposits have a dual origin, in part being derived directly or indirectly from the erosion of copper-bearing sediments, and in part being deposited through replacement by magmatic waters. As well known examples of deposits of this type may be mentioned the copper mines west of the Ural Mountains in the Government of Perm, Russia, once important producers, but now practically abandoned; the Atbasar copper mines on the Kirghese Steppes, Siberia; the Coro Coro mines in Bolivia, and numerous deposits in the 'red beds' of New Mexico, Arizona, and Colorado.

Tularosa Copper Company

The property of the Tularosa Copper Co. is situated at Bent, Otero county, New Mexico, on the Tularosa river. Bent is twelve miles northeast of Tularosa, a station on the El Paso & Southwestern railroad, lying about one hundred miles northnortheast of El Paso, Texas. The Company owns 307 acres of patented land, and in addition 670 acres on which sufficient work to patent has been performed. The property lies in the foothills of the Sierra Blanca range, which rises steeply to the east. Bent post office (elevation about 5570 ft.) is situated in a wide flat from which low broadly rounded ridges rise to the east, south, and north; to the west are steep hills 400 ft. high, succeeded farther on by an intricately dissected mesa sloping gently to a broad desert valley. The climate is delightful; timber is available within 6 miles, and the Tularosa river flows about 660 cu. ft. of water per minute. Unskilled Mexican labor is at hand, but miners must be brought in, for although scattered copper deposits occur for some 6 miles to the west, 12 miles to the north, and considerable distances to the east and south of Bent, no other mines were being worked in the district at the time of my visit.

The original location was made in 1870 by Andrew Wilson, upon a chalcocite-barite seam exposed in an arroyo, and shortly afterward a small furnace was erected. In December 1904, George Bent obtained an option on the property and in the following March the Tularosa Mining & Milling Co. was formed, which a couple of years later was reorganized as the Tularosa Copper Co. The 100-ton mill has recently resumed operations. The gross production to date has been about $52,000; some $11,000 was produced prior to 1905, and some $40,000 by the Company largely from 1905 to 1907. The amount of develop-

[1] 'The Ore Deposits of New Mexico,' by Waldemar Lindgren, Louis C. Graton, and Charles H. Gordon, Prof. Paper 68, U. S. Geological Survey, pp. 187-190.

[2] *Economic Geology*, Vol. VI, pp. 568-581, September 1911.

ment work is not large. The Virginia mine consists of an open cut or glory hole 120 by 60 ft. in plan 35 ft. deep. From the open cut the workings of the first level extend, and 25 ft. deeper are those of the second level. In addition, there are a number of shallow shafts and twelve diamond-drill holes from 88 to 400 ft. deep.

Geology of the Deposit

Perhaps the oldest rock of the region is a dense white (less commonly pink) quartzite, outcropping about a mile east of the mine buildings and encountered at the bottom of several diamond-drill holes. It resembles what elsewhere in New Mexico is Cambrian quartzite, but at the one point where a poorly exposed contact was seen, the diorite appears to be intrusive in it. The quartzite is, therefore, probably of pre-Cambrian age. Of the four considerable areas of diorite of supposed pre-Cambrian age, three are situated near the Virginia mine. The rock when fresh is a dark reddish gray to green, medium grained, quartz-diorite. The texture under the microscope varies from granitoid to porphyritic, the constituents being plagioclase, hornblende, biotite, augite, magnetite, orthoclase, and quartz. At the open cut the upper 20 to 40 ft. of the diorite is soft and of a light gray or pinkish color. This phase is probably in part due to magmatic differentiation, but largely to mineralization and weathering, the latter not only being that of the present day, but also that of an ancient time when the diorite was before exposed to the elements.

Lying unconformably upon the evenly worn surface of the diorite is 50 to 85 ft. of sandstone, a section of which from the top down may be generalized as follows:

	Feet.
White or yellow fine-grained sandstone, containing locally a lense of limestone; frequently cross-bedded	30 to 50
Yellow sandstone, blotched with brown	10
Brownish gray sandstone	5
Green sandstone with lenses of green shale, fossil shell fragments locally present, frequently contains malachite	5 to 18
Dense brown blotched sandstone, locally absent	1 to 2

This sandstone series, presumably of Carboniferous age, is overlain unconformably by a series of 'red beds' which, within the company property, situated as it is well up in the foothills, are but 90 ft. thick. They consist of red conglomerate containing well rounded pebbles and boulders (6 in. or more in diameter) of diorite, quartzite, sandstone, and a porphyritic rock; of fine and coarse-grained arkoses of yellow and red color; of soft red sandstone; and purplish brown shale. Some 5 miles west in the deeply carved mesa, between the foothills and the desert valley, the 'red bed' series reaches a thickness of at least 500 ft. The relative amount of arkose and sandstone increases westward at the expense of the conglomerate. Platy gray limestones and limy shales, believed to be of Cretaceous age, lie presumably unconformably, on the 'red beds.' These rocks, which are at least 400 ft. thick, form the hills enclosing the basin within which the orebodies occur.

Of still later age are an old talus and a residual formation of coarse partly consolidated conglomerates (Quaternary or late Tertiary in age), and the loam, sand, gravel, and clay (recent) of the present Tularosa river.

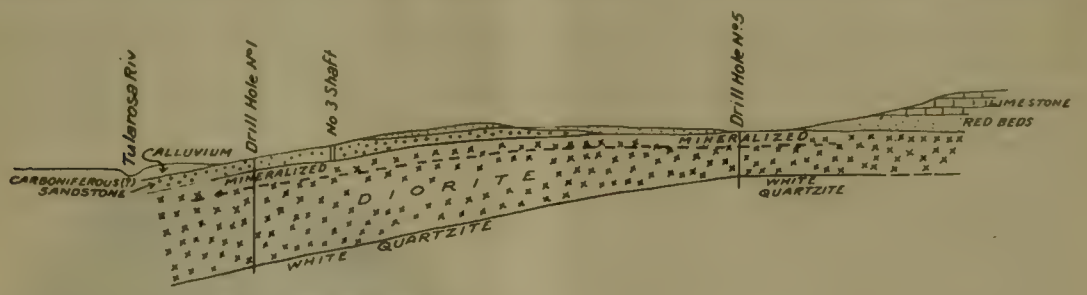


FIG. 1. SECTION NORTH OF OPEN CUT, SHOWING RELATION OF ROCK TO ORE.

An igneous rock of similar mineralogic and presumably chemical composition to the supposed pre-Cambrain diorite, is probably of Tertiary age. It is a light gray hornblende andesite, sometimes porphyritic, composed largely of hornblende and plagioclase with some orthoclase, augite, and magnetite. It intrudes the Cretaceous rocks around Bent in a complex laccolith consisting of a number of approximately parallel intrusive sheets and it cuts as dikes the 'red beds,' not only of the company property, but also of the mesa to the west. The Cretaceous limestone near the larger andesite masses is metamorphosed to a marble, and at one place magnetite, probably derived from the andesitic intrusion, replaces a calcareous shale.

Geological Structure

In pre-Tertiary times, in the vicinity of Bent, there appears to have been a canoe-shaped anticline coursing slightly north of west. The contact of ancient diorite and the underlying quartzite, dips north of west about 11°. The apparent thinning of the pre-Cambrian diorite sheet-like mass to the south of east, as indicated by drill-holes, is perhaps due in part to erosion prior to the deposition of the Carboniferous sandstone, but largely to erosion between the periods of deposition of those beds and the 'red beds' (see Fig. 1.) The intrusion of the Tertiary andesite laccolith pushed up the younger rocks with the mine workings as a centre. The 'red beds' and Cretaceous limestones, therefore, dip away from the glory hole. Near the intrusive masses these dips amount to 45°; one-half mile west the dips are reversed. Some of the ore lenses are displaced by horizontal faults.

The copper deposits are of several varieties, including: (1) lenses in the upper part of the

diorite; (2) ore stringers, extending from the diorite into the Carboniferous sandstone; (3) bedded ores in the Carboniferous sandstone; (4) detrital ores in the wash above the ore lenses. In addition, bedded deposits and veinlets occur in the 'red beds' west of Bent.

The stockwork of lenses which occurs in the upper portion of the pre-Cambrian diorite is the most important commercially. As developed to date, these lenses are on and slightly to the south of the nose of the anticline mentioned. The lenses are from 2 to 18 or more inches wide and strike in all directions. Many are practically vertical, standing at right angles to the upper surface of the diorite mass. Most of them occur in the upper 25 to 40 ft. of the diorite and with depth they become fewer and narrower and contain less copper. Fresh diorite from a depth of several hundred feet, however, shows stringers of ore. Between these lenticular bodies, in the upper 55 ft. of the ore-bearing diorite, is considerable finely disseminated chalcocite, which resembles that of the 'porphyry' coppers. The diorite between the lenses is usually soft and altered, with some masses of hard and unaltered rock. In depth the altered rock is replaced by fresh diorite and below 30 to 55 ft. the altered form only occurs along fractures.

At the time of examination (early in 1912) the more highly cupriferous area appeared to be tabular in form and to lie at and below the top of the diorite. It dips 30° to the west, averages 35 ft. thick, and in plan is triangular, being 350 ft. in one direction and 200 ft. in another. Unfortunately, cores from holes outside of the above area have been lost, but fragments indicate that the commercially mineralized area may be considerably larger. It is reported that further drilling will soon be begun. These lenticular bodies consist of chalcocite with little gangue, and, in many instances, show an incipient crustification. One vein has from the walls in (1) one-half inch of banded quartz, (2) one-quarter inch of chalcocite, (3) 3 inches of barite in the centre.

Chalcocite

Chalcocite, which is believed to be original, is by far the most important ore, although malachite is also present. Azurite, chalcopyrite, zincblende, and pyrite are sparingly present, and native copper and cuprite are reported. The copper ore in the lenses is associated with considerable barite, and some quartz, calcite, dolomite, and siderite. Secondary gypsum is found near the surface. Molybdenite was noted at several places. Calcite usually appears to be distinctly younger than chalcocite, and barite is usually younger, although sometimes older. Veinlets of chalcedony in the diorite do not appear to be connected with the ore deposition. Vugs occur in these lenses and both this ore and that of the veinlets in the Carboniferous rocks, to be described later, were deposited in open spaces.

The ore contains about $3.50 in precious metals to the ton of copper. The silver value is about 0.138c. per pound of copper, and the gold 0.04c. Silver is presumably contained in the chalcocite. The copper and silver contents increase and decrease together.

The following are smelter returns upon typical hand-picked ore from the lenses:

Copper.	Silver, oz.	Insoluble.	Silica.
10.75	....	41.2	26.6
32.90	1.90	17.7	...
51.30	2.75	7.4	...

Iron.	Lime.	Alumina.	Sulphur.
4.4	11.0	9.6	2.8
2.8	10.7	...	8.6
7.7	...	...	13.9

These larger lenticular bodies appear to stop with the upper contact of the diorite, and no large bodies of ore are known to extend into the overlying sandstone. There are, however, veinlets of barite and chalcocite in the diorite, and a black lustrous hydrocarbon is found at the contact and extends upward into the overlying Carboniferous sandstone. The hydrocarbon, which appears to have been much more abundant when L. C. Graton visited the camp, is probably confined to these veins. These veinlets are believed to be younger than the lenses. The younger age is indicated by the fact that in blocks of an intraformational (?) limestone conglomerate, presumably part of the same sandstone members, are pebbles of mineralized, green, shaly sandstone and cupriferous diorite, the limestone itself being cut by stringers of barite, calcite, and chalcocite.

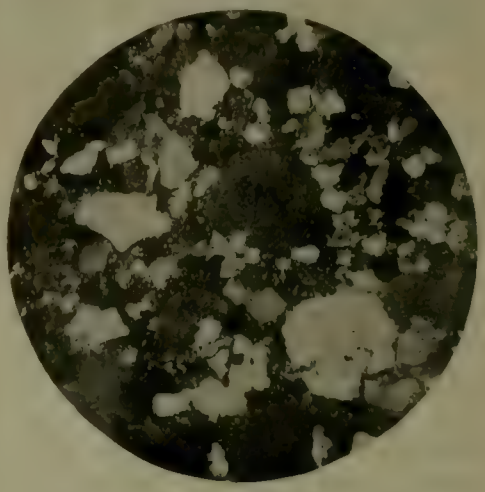


FIG. 2. SANDSTONE WITH GRAINS OF MALACHITE.

In the green shaly sandstone at or near the base of the Carboniferous (?) sandstone is malachite and some chalcocite, particularly in the more clayey laminae. This appears to replace the argillaceous lenses and the calcareous cement of the sandstone. There are also in the sandstone beautifully rounded grains of malachite (see Fig. 2), which were presumably chalcocite grains originally, or perhaps malachite grains derived from the erosion of the chalcocite lenses in the pre-Cambrian diorite. This shaly sandstone, where mineralized, carries from 0.1 to 6% copper, and portions of it will be a good milling ore if the malachite changes to chalcocite with depth.

Malachite and azurite in irregular blotches replacing the calcite cement or along bedding plane and vertical fractures, occur in the light colored sandstones at the top of the supposed Carboniferous

rocks. The malachite and azurite are locally concentrated in globules the size of peas, a frequent texture in such ores in sandstone.

The 'Red Beds'

The 'red beds' within the Company's property contain no known commercial copper, although some of the diorite boulders in the arkoses are malachite-stained, probably as a result of the earlier period of mineralization. In the 'red beds' of the mesa about five miles west of Bent, along Coyote cañon, however, are typical sandstone copper deposits, occurring at least at three horizons, one of which is 10 ft. thick. The copper minerals are almost wholly confined to the gray sandstones and conglomerates interbedded with the 'red beds.' The extent of these copper deposits is unknown, but they are probably lenses of comparatively small lateral extent. The copper ore, chalcocite with some malachite, occurs as small bodies, usually one-quarter inch in diameter, replacing the cement (frequently calcite) of the sandstone. Chalcocite also replaces fragments of vegetable matter, a pulverulent lignite, which are fairly common in the gray beds. Gypsum is associated with chalcocite, and at one place a little lustrous hydrocarbon similar to that occurring at Bent was observed. The 'red beds' are cut by dikes of hornblende andesite, and along one of these is a thin vein composed of barite, calcite, and chalcocite, and secondary malachite. This veinlet is either contemporaneous with or younger than the andesite dike and presumably its genesis is connected with the andesitic intrusion. It is probable that none of these beds are workable, but they are of interest in interpreting the probable genesis of the copper ores of the region. Partly rounded masses of copper glance, coated by malachite, occur in the wash above the diorite on the southwest side of the glory hole of the Virginia mine, and some ore was sorted from the soil here.

Genesis of the Ores

The above data are believed to indicate that the Tularosa copper orebodies are complex in origin. It is probable that copper minerals were deposited by heated waters from two rocks of rather similar composition: the one a diorite of pre-Cambrian age, and the other an andesite of Tertiary age. Further, that the copper ores of the Carboniferous sandstone and the 'red beds' are of different origins, that at the base of the Carboniferous series being at least partly of detrital origin, and that in the 'red beds' the copper minerals were probably deposited by replacement through waters dependent upon the intrusion of the Tertiary andesite.

The supposed genesis of the orebodies may be outlined as follows: The diorite in pre-Cambrian times was intruded in some rock which has since been removed by erosion, the ore horizon being approximately the original top of the diorite mass. When the rock cooled, fractures were formed at this horizon and magmatic waters deposited therein, chalcocite with some barite, quartz, calcite, dolomite, and siderite; simultaneously these waters saturated the diorite between the fractures, and not only altered it, but also deposited therein, by replacement, some disseminated sulphides.

When the cupriferous diorite was bared by Paleozoic erosion, it was weathered and copper, either as clastic chalcocite, malachite, or native copper grains, was probably concentrated at the base of the Carboniferous sandstones in the green shaly sandstone member. Some of the well rounded malachite grains are larger on the average than those of the associated quartz grains, but as the sea was probably comparatively shallow and the deposition presumably rapid, sorting may not have been carried far.

Copper Placer Deposits

Certain gold deposits are known to be ancient placers, and it appears highly probable that copper deposits may be of similar origin, although presumably they are of less common occurrence. Certainly, modern copper placers exist on a small scale. Well rounded pebbles of native copper occur in streams draining the country in which the orebodies of the Chino Copper Co. at Santa Rita, New Mexico, lie. About five years ago Mexicans mined a considerable quantity of copper nuggets from the stream west of Romero hill, and work only stopped because the foundations of houses on the stream banks were being undermined. At Bogoslovsk, in the Northern Urals, Russia, beautiful rounded pebbles of cuprite, partly altered to malachite, and with a core in many instances of native copper, are frequently found in sluicing gold. Pebbles of native copper are fairly frequent in streams in many parts of the world, having been reported from the Copper river, Alaska; Malaguit river, near the Paracale goldfield in the Philippine Islands; at Santa Catalina, in the northern part of Argentina; in several creeks in British Columbia; and in Turkestan. The presence of residual masses of chalcocite in the soil above the glory hole at Tularosa demonstrates the possibility of the concentration of copper minerals in sedimentary rocks by erosion. Later, waters accompanying the Tertiary andesite intrusions apparently formed the veinlet observed along one of the dikes in the 'red bed' mesa to the west of Bent, and presumably also deposited the copper ores of the gray sandstone layers in the 'red beds.' It is also probable that the same waters mineralized for a second time the rocks at Tularosa, forming the smaller chalcocite-barite-carbonate-quartz-asphaltic veins which extend from the diorite into the Carboniferous sandstone, for this was a plane of maximum movement in pre-Tertiary time. They probably increased the copper content of the green shaly sandstone. Since then chalcocite has been altered superficially to malachite and to a less extent to azurite. By the erosion of the chalcocite lenses, fragments of that ore have in recent time lodged in the soil immediately above bedrock at the open cut.

Of the $420,447 in gold and 842,018 oz. of silver in bullion produced in New Mexico in 1912, the cyanide process yielded $383,698 in gold and 841,575 oz. of silver, the remainder being recovered by amalgamation.

Coke output of West Virginia in 1912 was 2,465,986 tons, valued at $4,692,393.

Slow-Speed Chilean Mill Data

By Erich J. Schrader

The following data were obtained through correspondence with actual operators of the Lane type of slow-speed Chilean mills. The use of the mill was being investigated in connection with the remodeling of a cyanide plant in Nevada. The present plant consists of a 100-ton dry-crushing and leaching installation, which did not prove successful for various reasons, but chiefly because the sets of Humphrey rolls employed did not crush fine enough. Clay in the ore prevented leaching, and so it was planned to install a grinding machine to be fed by a coarse roll product, and to classify the pulp from the grinder into sand and slime and treat these separately in accordance with the best modern practice.

All-Sliming Mill

However, extensive tests proved that the best extraction could be obtained by 'sliming' everything, and it was decided to erect this type of mill. In the meantime letters had been written to numbers of users of the Lane mill, which was one type of grinder under consideration, and replies were received from most of these giving results with some details. These all tend to show that the Lane would be an efficient machine where an extremely fine product was not desired.

It is necessary that the mill be set on a good concrete foundation which has been carefully leveled. One manager stated that by settling the pulp and using the water over and over again he had a loss of only 180 gal. per ton of ore treated. It is apparent from this and other letters received, that the capacity and the fineness of product is directly proportional to the quantity of water used up to certain limits. Another writer stated that he had milled 7000 tons without any repairs and the tires were still in good condition.

Unfortunately for my purpose, all the replies were from operators that used the mill chiefly as an amalgamator. In one plant, however, the mill was fed with a 1-in. product of a Dodge crusher and the pulp from the Lane mill went directly to cyanide vats.

All of the operators heard from advised feeding the Lane directly from a crusher, and those who were still using stamps stated that they contemplated discarding them and feeding the Lane mill from a crusher. One operator stated that he had not been satisfied and could not get the capacity required, and that the mill made too much slime for his purpose. Unfortunately, he did not go into details as to his experience with the mill.

Only two operators used screens; the fineness of product was entirely regulated by height of discharge.

All agreed that the Lane type of mill was an excellent amalgamator, a good fine-grinder, and that the cost of repairs was low. Others stated that the installation cost less, the water consumption was less, and the first cost was lower than stamps of the same capacity. It seems evident that there is a field for Lane mills as intermediate grinders between crushers and tube-mills, and I would be glad to know if it has been used for that purpose in modern cyanide plants.

Tabulated results obtained from the operators heard from are given below.

Lane Slow-Speed Chilean Mill Data

Data.	[1]	[2]	[3]	[4]	[5]	[6]	[7]
Size of mill, in feet	7	10	10	7	7	10	10
Time in actual operation	A	2 yr.	3 yr.	G	8 mo.	18 mo.	K
Capacity, tons in 24 hours	24	40	55	14	20	30	45
Horse-power required	7	10	12	?	7	10	8
Gallons of water used per minute	M	B	D	?	?	15	few
Height of discharge, inches	4	4	7	?	6	7	7½
Mesh of screen, if any	30	8	..	..	..	..	..
Character of ore	med.	hard	soft	hard	?	hard	med.
Mesh of discharged pulp	44	40	E	H	I	J	L
Time shut down for repairs	5 dy. p. mo.	C	2 hr.	?	..	..	..
Cost of repairs per ton	5c.	5c.	F	?	3c.	5c.	4c.
Size of feed, inches	½	1	½	½	½	1	1

REMARKS

A—Total crushed is 8500 tons.
B—Same as a 10-stamp mill.
C—Repairs made while cleaning up.
D—Have an unlimited supply of water. No record kept of consumption.
E—90% is minus 100 mesh.
F—Lower than stamps.
G—90 shifts to date.
H—80% is minus 100 mesh.
I —95% " "
J —68% " "
L—73% " "
K—Milled a total of 7000 tons to date of writing.
M—16,000 gal. per 24 hours.
Where not otherwise stated, no screens were used.

[1]In Arizona. Considers Lane better than stamps. Feed direct from crusher to Lane mill.
[2]In southern Nevada. An excellent fine grinder and amalgamator.
[3]In Idaho. An ideal amalgamator; 81% caught in the mill itself.
[4]In California. Not satisfied. Grinds too fine. Capacity limited.
[5]In Idaho. Better than stamps as a crusher; less wear and less water needed.
[6]In Nevada. Ore extremely hard; free milling; 80% of pulp through 60 mesh.
[7]In Texas. An excellent machine for fine grinding.
The above data were obtained in August 1912 from correspondence with companies actually operating the mill.

The value of the mine output of gold, silver, copper, lead, and zinc in New Mexico in 1912, according to Charles W. Henderson, of the United States Geological Survey, was $8,527,955, as against $2,704,843 in 1911, an increase of $5,823,112.

Sulphur production in the United States was 3147 tons in 1900, or 2% of the quantity consumed. In 1912, the domestic output was 303,472 tons, or 91% of the consumption.

Hoisting at a Chinese Mine

Wherever possible, the Chinese work their coal mines through entries, which sometimes extend for great distances underground. In some cases head-frames after the foreign model are used, as shown in the accompanying illustration of the head-frames at a North China coal mine. The shafts are 300 ft. deep, 9 ft. in diameter, and are lined with cut stone masonry. One small double-drum hoist serves the two shafts. From one shaft is hoisted coal, in baskets containing 300 lb. and from the other water in raw-hide bags, as shown in the illustration to the right. At mines which are more primitive in their equipment, a Chinese shaft windlass is employed. From sixteen to twenty men are used to turn these. The heavy blocks of wood on the handle frames act as counterweights. The lower picture shows a Chinese hoisting and underground transport system. Each coolie carries from 150 to 250 lb. of coal, in baskets slung on a pole over his shoulder, and walks, continually bent over, along narrow passages. This photograph was taken at the mouth of the mine. It might be supposed that this is an expensive method of handling the material, but as a matter of fact it is the cheapest that can be employed. In the construction of railway embankments, for example, it has been found that a gang of coolies provided with baskets and the *lan-tze* or carrying pole, will move earth at a lower cost per cubic yard than any form of mechanical equipment. Where the mine can be opened through adits and the ground stands well enough to allow openings of sufficient size to be made, this is an excellent method of hoisting and transport combined, as the coolies walk up inclines. Where the dip is steeper a single basket, carried on the back, is employed. Rehandling has to be avoided as much as possible in the case of coal, as nearly all Chinese coals are rather friable, and lump coal is at a premium. It must be remarked that the upper illustrations are scarcely typical, since it is only rarely that timber is used so freely in Chinese mining practice. Except in Manchuria large timber is scarce and expensive, and as a result methods of mining have been developed requiring but little timber.

Underestimating the Cost of Milling Plants—II

By A. Sydney Additon

At the next property visited, operations were upon a somewhat smaller scale, but at this plant also the management had had experience in plant installation. Here the superintendent was a part owner; an intelligent man who had been successful in developing the mine, and who had some experience in the operation of gold mills. He was well pleased with himself and what he was doing; was an excellent host and talked freely about his property, results, and costs. He told me what the plant cost, but did not offer any explanation when I expressed surprise at the amount. My curiosity was aroused, and I secured the information wanted from one of the other owners the next day.

Preliminary Work

For six months prior to the building of this plant, the superintendent had been writing to dealers in mining machinery, getting catalogues, blue-prints, and prices of various equipment. He discussed milling and milling equipment with everyone who came his way, and secured opinions by letter from a number of mill men he knew, as to the best appliances to use. He secured prices of cement, iron, and pipe, and also conducted, with the aid of the assayer, numerous treatment tests on the ore, checking the results by sending a carefully selected sample to a reliable metallurgical laboratory. He visited two or three cyanide plants, in every way posted himself regarding the building of a plant, and then estimated exactly what such a plant as he wanted would cost, ready to run. A meeting of the co-owners was held, everything gone over carefully, and they decided that the plant was within their means and should be built at once.

The superintendent then placed orders for the machinery with the manufacturer of each individual piece, and ordered the lumber, cement, iron, tanks, and plumbing supplies required. In selecting the site he carefully determined the difference in elevation between the mouth of the adit and the flat by the river with a carpenter's spirit-level, straightedge, and plumb-lines. The horizontal distance was also determined. Then by figures taken from blueprints, and tables in catalogues of dimensions of machinery, he determined how much horizontal and vertical room was needed. From these two sets of figures he found that he had just room, by allowing no height at the end of the grizzley on the breaker floor, to put the plant in where he wanted it, above high water. Excavations were started and the cement retaining-walls and mortar-block built. He had neglected to ask to have the holding-down bolts for the mortar sent ahead of the mill shipment, so he bought iron locally and made them, improvising pocket washers in order not to delay the work on the mortar block. This, and the use of nearly double the lumber and labor expected for forms for retaining-walls and mortar-block, were the first items of excess cost.

In framing the ore-bin there was considerable waste of lumber and labor, especially in the lining, on account of the 2 by 12 and 1 by 12-in. lumber having been ordered by so many thousand feet, without specifying lengths necessary. When the rock crusher had been set it was found that the feed opening was 18 in. higher than prepared floor level, due to the height of breaker being 6 in. more than was expected and a set of sills across the ore-bin caps to carry the breaker having been overlooked in original figures. So to avoid having to lift all the ore with a shovel to feed the crusher, and also to avoid an up-hill tram from the mine to the mill, an equivalent amount was cut off the grizzley. The bars had to be taken down, carried to shop, cut, and drilled, the frame rebuilt, and the grizzley replaced.

Next, when the mortar was moved to its place on the block, it was discovered that the template used for setting the bolts had been incorrect, or at least did not correspond with the holes in the casting, and also that the base of the mortar was heavier than expected, so that the bolts were too short by an inch. Many plans were discussed for getting over this trouble, but it was finally decided that the best thing to do was to blow the block out and make a new one. Miners skilled in the use of explosives were brought from the mine and put at the task and cement was ordered, while the construction crew went on with the rest of the plant. The taking out of the mortar-block was accomplished with but a few hundred dollars damage to building, walls, and ore-bin foundations. While the new block was setting, work was pushed elsewhere.

Floor Levels

Below the plates was placed a set of spitzkasten for classifying the pulp for concentrating tables. In establishing the level of the concentrator floor below the plates the fall allowed below the spitzkasten was barely sufficient to cause the stream to flow to nearest table. As the tables were all placed to one side of the centre line, an additional 2 ft. was necessary. Hence the stream must be raised or the tables lowered, and as the first was impossible without pumping, the latter was done. As the wooden concentrator floor had already been laid and the tables set up, this necessitated moving the machines to one-half of the floor while the other half was torn up, excavation deepened, and the floor relaid. The same was then done to the other half. The expense of doing this was heavy, as the excavation was mostly in rock, much lumber was wasted in tearing out the floor, and the building had to be patched at the bottom of the walls. The alteration meant that all the levels below the concentrator floor had to be lowered a corresponding amount. Fortunately the leaching vats had not yet been erected, although their foundations were in. These foundations had to be lowered; the settlers for the slime plant, already erected, knocked down and their foundations

lowered; the grade for the leaching vats cut down, not a small job, and in fact nearly everything that had been completed below had to be done over again. By the time the sump level was reached it was found that an excavation of nearly 3 ft. had to be made below the high-water mark of the river, and as the flat extended up stream some distance, a levee 500 ft. long had to be built to hold back the water from flooding the sump level. A cement floor and a 2-ft. wall were also built to protect the sump and pumps. A third order of cement was made for this purpose.

Timber Framing

The mortar-block once more ready, the battery frame was erected, when it was discovered that an error of 1 ft. had been made by the carpenter in framing the posts for the ore-bin, on account of not having detailed drawings to work from, so that the knee-timbers did not take the battery posts where they should. This also affected the fall from ore-bin gates to the ore-feeders. The battery posts were reframed to fit and a new opening made in the ore-bin, 1 ft. higher, thus lessening the capacity of the bin. In constructing the building, lumber and corrugated iron had to be ordered three times, not having been carefully specified in orders. This was not only on account of shortage of amounts, but on account of shortage of the sizes and lengths necessary. The bookkeeper told me that at least 14 orders for pipe and fittings had been filled during construction, and that the light team had been almost constantly on the road between the plant and the railroad, bringing in rush orders of small items. The item of freight for this installation was astonishingly large. Each piece of machinery had been ordered from a different house, so that all except the stamp-mill itself had to come in less-than-carload shipments. This was also true of two of the lumber orders and two cement orders.

The excess cost of this mill is hard to specify. The extra labor and material used in alterations can be easily computed, but this was but a portion of the added cost. The time lost in discussing the best way out of the difficulties, the shifting of work from one part of the construction to another nearly every day, the extra cost of hauling and handling material, telegraphing, teams on road all the time, and so on, are all items of cost which are hard to estimate. An idea of the amount of these unmeasurable losses was obtained by adding the cost of additional material purchased, labor employed in alterations, and the excess labor cost on regular construction to the original estimate. The actual cost of the completed plant exceeded the corrected figures by more than $2000, the difference representing this, that, and the other items that could not be otherwise estimated. The original estimate of the cost of this plant was $56,200; its actual cost was $69,860. Here nothing could be blamed for the excess cost except the lack of carefully prepared plans and working drawings from which to build, and from which to order material and equipment. The conception of the plant was good, the equipment purchased was all right, and its cost came within the estimated cost, but the failure to spend a few hundred dollars in properly preparing for construction work proved expensive.

At the next property I arrived at a most opportune time. A cyanide plant had just been completed, but no satisfactory results could be secured. The owner and general manager were, when I arrived, in heated argument with the engineer in charge. They were denouncing him in the strongest manner, and though he seemed to have some defence, nothing would satisfy the owner. My first impulse was to pass on, not wishing to be drawn into an argument which gave every sign of becoming of a personal nature. I was interested, however, for here seemed to be a chance to secure good data for my investigation. Therefore, when the owner said he would like to have me run down the trouble, an arrangement with which the engineer seemed particularly well pleased, I agreed to do so. I first looked over the plant, which consisted of a stamp-mill, concentrator, and cyanide leaching equipment, well arranged and built. I soon found the difficulty to be a mechanical one; the pulp simply would not leach. Upon examination of the pulp and the ore in the mill, the trouble was apparent enough; so apparent that I could not understand how such an error had been made. The engineer I knew by reputation, and had no reason to doubt his ability as a metallurgist. The company was supposed to have plenty of money and would not be apt to construct an inefficient plant simply because it was cheap. (This, by the way, is often done.) The fact that the ore was of such a character as to require regrinding and sliming was obvious, and I felt as though I had been employed simply to verify the owner's opinion of the engineer.

Mill Design

However, my curiosity was aroused and I determined to run down the cause. I asked who had devised the treatment and designed the plant. The engineer had designed the plant, or specified the equipment, basing his work on the report of a reputable metallurgical laboratory after testing of a 2-ton ore sample sent them by the owner. I examined the report, which was complete and thorough, but the ore tested could not possibly have been the same as was then in the mill. I called their attention to this, whereupon I was advised by the owner that there could be no doubt as to this point, for, being desirous that no error be made, he and his manager had personally taken and shipped the samples, using the greatest possible care in so doing. I then proposed a trip to the mine. When we reached the first heading I found the solution of the problem, but visited other parts of the mine before voicing my opinion. The sampling had been done in the following manner: at ten places in the mine, some headings, some stopes, the ore had been well cleaned down, a floor of plank laid, a round of short holes shot in each place, and a 400-lb. sample sacked. The owner explained just how they had done this, and how careful they had been. At many of the places no work had been done since the sample was taken, and the floors, covered with what ore they left, was still to be seen. This is what had happened. The vein, which was 6 to 10 ft. wide, carried streaks

of nearly pure clay, some 1 in. wide and some as wide as 9 in. At one place where the vein was 80 in. wide, the added width of these clay seams was 19 in. After the cut had been made they had put the ore into the sacks with their hands, as evidence of this, masses of clay, which should have gone into the sacks, were lying on the floor. They had taken only the nice clean ore, and such clay as might stick to the pieces or be gathered up when they took an occasional scoop of the fine ore which, by the way, would contain very little clay, it being too sticky to break up small. Hence, instead of having to treat an ore, which, according to the test made, could be crushed to 30 mesh with only 18% of slime, they had an ore which when crushed to 30 mesh yielded 40% of slime.

Testing the Ore

The owner was, of course, greatly chagrined at this disclosure, and although he said that he saw the point, he did not like to talk about it. Next morning he asked me what he had better do. Of course I told him that an examination of his ore would be necessary before it would be possible to specify just how his plant could best be remodeled. One of two things was necessary: either sliming of everything with a proper plant for treatment, or separating the slime from sand, using the present equipment for the sand and adding a small slime plant. The knowledge that he had himself to blame for his present trouble, added to the fact that he was about out of funds, did not tend to put the owner in the best of spirits. He was inclined to blame everyone in sight, discharged the manager, and started East to raise more money with which to remodel the plant. I afterward learned that he had later tried one or two patent schemes, with the usual results, and finally built a first-class plant. I have never seen this, but have noticed in the mining journals that it is operating successfully. The plant at the time when I was there had cost approximately $30,000 (exclusive of the stamp-mill). The plant that he should have had in the first place would have cost approximately $60,000, no doubt about what the present equipment cost, reckoning the first construction as a complete loss. This together with the cost of experimenting with the untried, between times, doubtless ran the excess cost of the plant up to $40,000.

This is an example of excess cost due to employing an engineer to design and install a plant for the treatment of ores that he has not personally tested. To insure success where it is necessary to depend entirely upon an engineer's advice, a competent man should be engaged, who will examine the ore for treatment and design and erect the proper plant. It is then up to him, and the owner has eliminated all chance of failure except one, the selection of the right man. By proceeding as in this case, two chances for error are directly invited, and indirectly many more. The engineer was also to blame, since he should never have accepted an engagement to design and construct a plant without making a personal examination of the ore to be treated. This case may also serve as an excellent example of excess cost, due to unintelligent sampling of the ore to be treated.

Second-Hand Machinery

The next case was interesting on account of the way I happened to come in contact with it, although it has been, and probably always will be, a common one. While traveling on the train one day I met a mining operator and owner with an engineer whom he had just engaged to construct a plant. We engaged in a discussion of mills and milling practice, during which I chanced to make some remark about the inadvisability, as a rule, of installing second-hand machinery, and soon found out that I was being drawn out on this subject. Not being adverse to giving reasons for my opinions, I acquiesced. Finally the owner said I might be right in some cases, but that he was then taking his engineer to look over a mill that had been closed down for some time, in order that he might determine what additional machinery would be necessary to add to this equipment, which he intended to buy to complete his own plant. He believed that my reasons would not hold good in this case. I agreed that they might not. In speaking of this mill they were going to examine he said there were, of course, a number of parts for which he had no use, others that would require overhauling, and still others that would have to be 'adapted' (how little he knew the meaning of 'adapted'), but he was getting it all so cheap that he was making a great saving in the cost of construction. The engineer did not altogether share his employer's views, and frequently took my side of the arguments.

Recently I had an opportunity to learn the history of this installation. The engineer had refused, after inspection of the old mill, to use it as a part of the new plant. Another engineer was secured, who was willing to build anything that suited the owner. The mill was bought, wrecked, and moved to the new site. The freight charges on this material, owing to the situation of the mill and the quantity of junk moved that was not wanted, was nearly double the amount that would have been charged on new material. In addition to this equipment there had been purchased from wreckers and second-hand dealers, a tube-mill "as good as new," two sets of rolls, designed for roughing, "but could be speeded up," a classifier, several large tanks of various sizes, "that would work in," pumps, gasoline engines, a job lot of shafting, pulleys, belting, pipe and fittings from another old cyanide plant, and so on. The only new equipment purchased was two thickeners and a filter.

Crushing Plant

The crusher, after securing new shoes, dies, liners, and toggles, and re-babbiting the bearings, was all right. In tearing out the ore-bin they found that the frame had been put together with so many drift-bolts that it cost nearly as much to wreck a stick of timber as it would to buy it new, so that only a part of such timber was saved, and practically none of the lining. The mortars were of such an old design that when they sent to the dealers (each of the two mortars being made by a different iron works) for parts, they found that these would have to be made to order. The patterns also had to be made,

for since the iron works had abandoned that model of mortar they had destroyed the patterns and carried no stock of the parts. The stems had to be turned to fit heads and tappets that could be purchased from stock. The rolls had been designed for dry crushing, and had to be 'adapted' to use as regrinders by having a new water-tight housing designed and built. The classifier had been left, when last used, filled with pulp, and all the submerged parts were destroyed, requiring new.

Changes and Renewals

The tube-mill was of an old design, so that the new liners and feed-end casting, which were necessary, were obtained only at considerable expense and loss of time. The agitators were found, after trial, to be unsuited to the ore and had to be taken out and replaced by new ones, including the compressor plant for same. The odd tanks which were to "work in" for pulp storage and solutions were found, on account of their size or depth, not to be of as much use as counted on. Much labor was wasted in trying to work over old pipe and fittings, shafting, pulleys, and belting to suit the requirements, resulting in increasing the size of the junk pile and making the purchase of new material necessary. It not infrequently proved that the cost of labor expended in trying to straighten a sprung shaft, or to make some other piece of junk fit for use, is greater than the price of new material, plus the freight and cost. The centrifugal pumps all had to have new runners, shafts, and liners. It was estimated that three-fourths of the building material could be used again, but after wrecking and handling it three times in shipping, less than 40% was accounted for by the time it was used. The cost of taking apart and cleaning the pumps, engines, and other machinery with their rusted nuts and bolts was a large item that had not been counted upon.

The plant was finally finished and started. One of the first things that happened was the breaking of the cam-shaft, the steel having crystallized. Then the main mill motor burned out the first time its capacity was taxed. Numerous other smaller accidents occurred before the plant was really in full operation. The time and labor expended in 'adapting' and 'working in' various parts of the equipment is not easy to estimate, but was great. No details of these items of excess cost were obtainable, but the owner has made the statement that the plant cost him exactly double what he had estimated and a little more than what a new plant would have cost. He has now a second-hand plant, the maintenance of which is a heavy item of expense. The junk pile on the hillside beside the plant represents the money that should have gone into new material and equipment. It is quite possible, sometimes, to pick up at low cost a piece of machinery that has been used that will prove efficient in service, but when it comes to thus equipping an entire plant, especially building material, the task is impossible, and is bound to result in a great excess over the estimated cost.

Installment Method

At another property I found the superintendent very proud of how he had put the mine on a paying basis in spite of the opposition he had to contend with in his company. This method, as he explained it to me, is an extremely dangerous one, and following it is a common reason for excess cost. He had been developing the property for a company, the resources of which were limited. For some time individual stockholders had been advancing money necessary for continuing work. When the end was in sight, these stockholders did not care to carry the company further, and other ways of raising money were about exhausted. The superintendent told the directors that if they would raise a certain sum of money he could erect a milling plant that would net enough out of the small amount of ore they had developed, to carry on development work. The sum he asked for seemed small, but he explained how it could be done. It was finally decided that they would make this one last effort. They raised the amount and construction work was started, but it was soon found that certain costs had crept in that had not been counted on, and that additional money was necessary. The stockholders must 'dig' again, as they could not stop with the partly completed plant, and thus lose what they had already strained themselves to put in. They raised the amount "necessary to absolutely complete the work," which was, by the way, 30% of the original amount asked for on beginning to build. The plant was finished, but it was found that the results obtained were not those anticipated, and in order to make a profit at all on the ore certain alterations and additions must be made. Again the stockholders were at the point where they must either lose what they had put in or raise more money. After a considerable delay they succeeded in getting together an amount which was 35% of the original sum. One more delay to raise still more money followed, but the money was secured and the plant finally completed at a cost nearly double the amount first estimated to be necessary to put the mill in operation. The owners were not out of the woods yet, however, as the machinery houses which had already extended the time of final payment on equipment refused to wait longer, and a fourth 'dig' had to be made by the stockholders with which to meet this indebtedness. Events such as these have been the history of so many installations that some may wonder why they are recited here. But they illustrate another reason for excess cost.

Lack of Coöperation

The superintendent knew at the time he first went to the directors that the amount he was asking for would only be about half the amount required, but attempted to justify himself by saying that had he asked for the whole amount at the start, the mill would never have been built. It is astonishing to learn how many plants have been built or are being built in just such a way as this. Sometimes the directors are in collusion with the superintendent in deceiving the stockholders, sometimes an engineer desires to extend the period of his employment, but in one way or another this cause for heavy excess is exceedingly common. During my trip of investigation I came across five cases of this kind, and the worst is that four of the five did not end as success-

fully as the one described, as the companies could not raise the additional sum required and had to shut down, losing what they had put in. In this case, the superintendent was extremely fortunate; in the first place, that the stockholders staid by him and were able to raise the additional sums of money, and, secondly, that in his partly developed mine he was later able to develop an orebody which finally justified the plant.

Superficial Examination of the Ore

I next visited a plant that was quite a model of construction and found that it had been built at about the estimated cost. They were, however, having difficulty in getting the hoped-for results. It was a stamp-mill furnished with a cyanide plant; the sand and slime being separated and each treated in a department of its own. It had been built following the design and detail of a neighboring plant, of which it had been possible to get the construction costs. This accounted for its having been constructed within the original estimate. The results, however, were not alike, although the ore was given "exactly the same treatment" and the "ore was the same." One of two things was evident; either the neighboring plant was not yielding the results claimed (which is by no means a rare case), or the ore was not amenable to the same treatment. In this case it proved to be the latter, and upon investigation it was found that the sand must be reground in order to secure good extraction. This meant the remodeling of the plant, purchase and installation of much additional equipment and material, and the tearing out of much that had been installed. This was done, resulting in an excess cost amounting to 80% of the original. This serves as an example of an excess cost due to a too superficial examination of the ore to be treated. Because it looked and assayed like that in the neighboring mine it was thought that a plant like the neighboring one was what was wanted.

On approaching another property, the panorama of junk-heaps and badly constructed buildings told its story. I thought I had probably come across another case of a second-hand plant, but I was partly mistaken. The superintendent, who was a half owner and had full charge of the property, in taking me through the plant, excused the general appearance of things by remarking that the mill, having cost nearly double the estimate, he had not been able to do any fixing up outside, as yet. I asked him why the mill had cost so much more than expected. He recounted the longest list of reasons it had ever been my lot to listen to. It seemed as though everything had been 'agin him' from the start. Everyone in his employ had made mistakes, others had lied to him, and he had had innumerable "unforeseen accidents." After I had about made up my mind as to the real cause of this excess cost, I asked who had designed the plant. He replied that at the time he had decided to build the plant he "did not see any use in hiring one of them experts and paying him big wages for doing nothing but bossin'." He knew the treatment necessary for the ore and there were a lot of mills around to "get ideas from," some of which he had worked in, but he finally conceded that it probably would have been just as well if he had hired someone to "make a draw'n" for him. I said I supposed he realized now that some of the errors for which he blamed his employees were due to the lack of some plan to work from. "Yes," he said, "that is probably true, as I see it now, but I wanted to save the expense; I wanted to build the plant just as economically as I could. You see, my partner is a city man and does not know much about the cost of such things, and is not very wealthy, so I wanted to cut out all the expense I possibly could, as he has had to put up most of the money we have spent on the property." I asked him what his 'city man' thought of his success, but got no reply. In his efforts to economize he had incurred all the added cost of both a mill made without plans and one made with second-hand machinery. He had succeeded in combining both reasons for excess cost in the one mill, from no other reason than that of desire for economy, and not from necessity, as I later learned that his partner would have advanced all the money required. Economy is certainly commendable in any enterprise, but to successfully practice it in the building of a milling plant requires the exercise of the knowledge born of experience.

The Machinery Question

A case investigated later is so closely similar that I will mention it as well. The property was an individually owned mine, capable of producing a fair tonnage of low-grade ore. The grade and character of the ore were such, however, as to call for the best efforts of a capable man, and the use of the most efficient equipment in order to insure a profit. These facts were known to the owner and had the effect of convincing him that he must have equipment which would do a little better than that ordinarily in use, and could be operated more cheaply. When a man starts actually to hunt for such devices, he has but little difficulty in finding plenty "peculiarly adapted to his particular case." The result was, in this case, that after much discussion with sellers of the "very thing he wanted", he estimated what the plant he wanted would cost, and proceeded to install a lot of machinery, most of which had never been tried on a commercial scale. Some had been tried and found deficient, "but had never been given a fair show, on account of certain conditions which were unfavorable." After fooling along with these devices, adding costs every day, for some time, he decided that he did not have just what was required. Then one appliance was replaced by another "just the thing" machine and another appliance had been replaced by some other wonderful contraption of genius. A 'revolutionize metallurgy' device had also been substituted for another machine that was not giving satisfaction. Finally one or two standard pieces of equipment found their way into the plant, and its operation was made possible, although not yet profitable. More than three times the original estimated cost had been spent, and the owner was out of funds. After a year's delay he parted with an interest in the mine to another man who supplied the money necessary to remodel the

plant and put it on a profit-paying basis. This had just been accomplished at the time of my visit. This attempt to use unproved devices rather than following standard metallurgical practice is a common cause of excess cost.

High Installation Cost

The next plant visited, while not exactly an instance of excess cost, furnishes an example of abnormally high cost of installation, which may as well be mentioned here. Most engineers have in their mind what they conceive to be an ideal plant. They long for the chance to construct it. Opportunity does not often come for this, as idealism is generally associated with prohibitive cost, but opportunity did present itself in this case, and an attempt was made to utilize it. A large plant was elaborately designed; every device known was incorporated in the plan. Standard practice and methods of treatment existing in plants from South Africa to California were provided for in different portions of this mill. An elaborate power equipment was also provided. Nothing was left out, everything was perfect when plans were submitted, not accompanied by estimate, this being left to bidders on the work. Bids were received and all were rejected on account of the high cost. The 'idealizing' had been overdone. The plans were then put into the hands of other engineers for revision to cut the cost. No time or money was allowed for these engineers to examine the ore and working conditions, in order to enable them to perform their task intelligently. They simply had to cut here and eliminate there, without knowing whether or not the result would prove to be a plant efficient in treating the ore. They succeeded, however, in getting the cost cut down to a point where the installation was ordered.

Power Service

Of the various additions and alterations found necessary upon starting operations I shall not attempt to speak in detail here. Sufficient to say that the company was certainly fortunate in that more were not necessary. One item deserves mention. It was found that because of the price of coal it was costing considerably more to operate the power-plant than power would cost if furnished from a local power company. So the $40,000 power equipment was abandoned. I do not know that the dealers and railroad companies refused to quote prices on coal before building the power-plant, but it is hard to otherwise account for such an error. This plant has been in successful operation for many years and has netted large sums to the company. It did not cost more than the estimate, but that it ultimately cost more than the company expected that it would, and much more than it should, is without question. Such instances only strengthen the belief in the impossibility of constructing a plant without exceeding the estimated cost.

Another case of idealizing or "keeping abreast of the times" was found at another property, where a new plant had just been put into operation. This plant was most complete, and a profit was being made which was satisfactory. The plant had been built without any preliminary estimate, but had cost nearly double the amount that another plant of same capacity and treating the same ore had cost, and the operating cost was greater than that of the cheaper plant. The reason for this was that the designer of the new plant had built an ideal plant, not ideal as to the treatment of the ore, but ideal as to the latest devices in cyanide plants. The 'up-to-date' expensive plant was not required in this particular case. The same net recovery could be made with an 'old-fashioned' simpler plant. New methods and practice yearly widen the scope of metallurgical processes, especially in cyaniding, but it is not always necessary to adopt such methods and practices when old ones will give the same results. It is no crime to be considered 'out of date' if the plant is 'delivering the goods' and saving capital expenditure. This point is worthy of discussion in a separate article.

Recovery v. Operating Costs

A small plant was visited, where everything was apparently running nicely. The equipment was new and the engineer who had built the plant had gone. The metallurgist in charge told me that the plant was good, but the recovery was low. He had conducted exhaustive experiments since he had taken charge, and determined that a higher percentage of the metal content of the ore could be saved by adding to the plant certain machines and altering the method of crushing and treatment. He had ordered what he wanted and said he would soon be making a higher saving. It later developed that he was correct. The plant was remodeled, was quite successful, and the higher recovery was made. In doing this, however, he had allowed his technical knowledge to overbalance his practical knowledge, and while he made a higher recovery he also incurred a higher operating cost, to which could also be added interest on additional investment, until the net was only about equal to the net made by the original plant. The remodeling and adding to this plant was an excess cost due to an attempt to make a metallurgical success, when a financial success was what was most important to the company.

I have mentioned only the most interesting and common cases of excess cost met, though I encountered each of these instances more than once; some of them many times. I saw many abandoned plants, the history of which would show the relation of excess cost to absolute failure, but its relation would add no additional information. I found a number of plants where the excess cost had been caused by such reasons as lack of knowledge of treatment by the designers of the plant; equipment selected and purchased by officers and directors of the company; installations directed by company officials, without making use of the knowledge of their superintendent or engineer; plants rushed to incomplete completion, on account of short funds, or on account of stock-market operations; plants built on low estimates of superintendent, who knew that if he got it started the rest of the money would be raised, thus prolonging his job; plants built for large stock companies by unscrupulous officials, where large portions of the excess cost went into their own pockets.

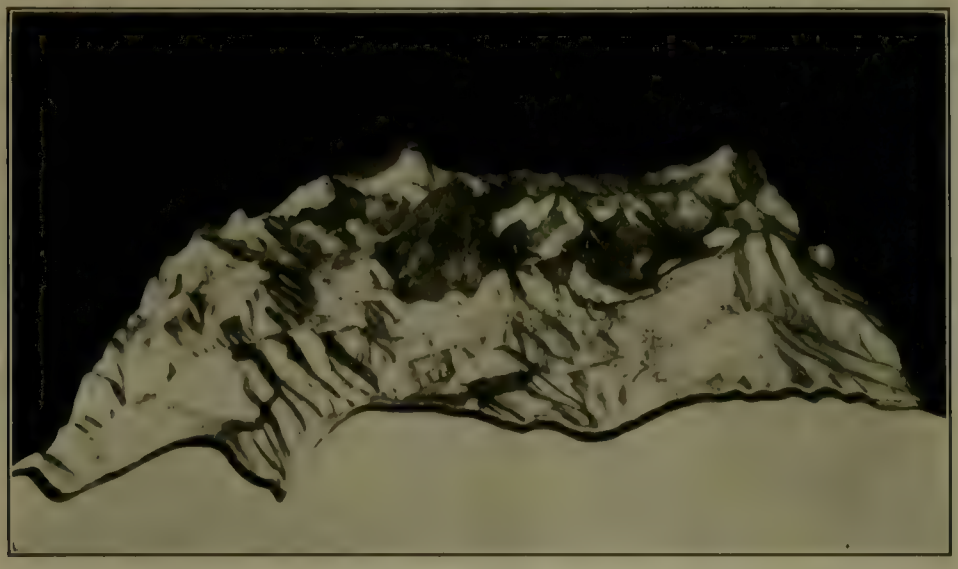
Topographic Model of Cripple Creek District

By E. A. Byler and Lee W. Davis

The half-tone presented here is of a topographic model of the Cripple Creek district which has been made embracing the territory covered by the U. S. Geological Survey special sheet of this district.

The model is made on a vertical scale of 400 ft. to 1 in. and a horizontal scale of 1000 ft. to 1 in. The data for the topography were taken from the Geological Survey sheet, and enlarged to the scale of the model.

The original model was made of poplar boards of such thickness that each represented an elevation of 150 ft. Each board was cut to contour with a scroll saw and then placed and glued in its proper position, after which the whole was dressed to conform with the contours. The small changes were interpolated in the topography between these elevations, and some small portions made with putty. The railroads were represented on model by wire placed in the proper position.



TOPOGRAPHIC MODEL.

Plaster Model

From the wooden model a plaster mold was made, from which in turn a plaster model was cast, thus making a reproduction of the original wooden form. This final cast was painted in various colors and lettered to represent the features which it was desired to indicate. For the purpose of more closely identifying positions by comparison with a map of the district, the section lines were indicated on the model in black and the number placed in the centre of the section. Railroads, positions of the principal mines, towns, and other artificial features, together with the lettering, were in black.

The surface geology, as given by the U. S. Geological Survey sheet, is represented by various colors, following as near as practicable the colors used on the sheet. In the photograph these colors have taken as shades and, as will be seen, some of these show quite clearly, while others do not, and they have the effect of confusing to some extent the natural shading due to topography. In the lower left hand corner of the photograph will be noticed a dark strip representing a dike of considerable extent; many such are found in the area covered.

The photograph was taken from the south end of the model and gives, in effect, a birds-eye view of the district looking from a high point at its southerly end. The main producing portion of the district is about in the centre. In looking at the photograph a large reading glass is an aid in bringing out the perspective.

A difficult problem in designing the model was the selection of a relative vertical-horizontal scale to properly represent to the eye and mind the topographic features, the difficulty being that the steep slopes would appear to the eye as exaggerated, and the more gentle ones too flat. Numerous combinations of scales were tried, and it was finally decided to adopt a vertical scale of 400 ft. to 1 in. and a horizontal scale of 1000 ft. to 1 in., it being found to be the best average and conveying the most natural impression to the eye.

Sulphur deposits of Park county, Wyoming, according to D. F. Hewett, in Bulletin 540 of the U. S. Geological Survey, lie at an elevation of 6700 ft. along Sweetwater creek, two miles north of its junction with the north fork of Shoshone river. The area does not exceed 20 acres. The superficial rocks nearby are wholly igneous, and constitute the lower portion of a great thickness of lava flows. The sulphur occurs as bands of crystalline aggregates which fill the interstices between the fragments in the bank of the stream where it cuts part of an alluvial 'fan.' Under the present condition of the American sulphur industry, the deposits are not profitable.

Smelting in Shaft Furnaces at Great Altitudes

By Vincente Pazos y Sacio

*The numerous failures made in Peru in attempts to smelt raw copper ores seem to result from lack of knowledge of the behavior of shaft furnaces at the great altitudes at which they are generally worked. The following hints, deduced from observation and proved by numerical results, perhaps may be found useful by those who have to manage furnaces in such places.

The Problem

The solution of the following problem will give a practical insight on the vital point.

Problem.—What will be the temperature of a water-jacket furnace in Cerro de Pasco where the atmospheric pressure is 8.75 lb. per sq. in.,[1] when the same furnace at sea-level (15 lb.) gives 1365° Centigrade?

By the laws of combustion,

$$C + O_2 = CO_2, \text{ developing 8100 calories} \quad (1)$$
$$1 \text{ kg.} + 11.56 \text{ kg.} = 12.56 \text{ kg.}$$

or 1 kg. of carbon combining with the oxygen of 11.56 kg. of air gives 12.56 kg. of heated gases which produce 8100 kilogram-calories.

Assuming that the coke contains 10% ash; the carbon in each kilogram of fuel will be 0.9; and equation (1) will reduce to:

$$C + O_2 = CO_2 = 7290 \text{ kg-cal.} \quad (2)$$
$$0.9 \text{ kg.} + 10.4 \text{ kg.} = 11.3 \text{ kg.}$$

If the above reaction did not produce heat, the volume of the gases at 0°C. and 76 cm. (15 lb.) pressure, would fill:

$$10.4 \div 1.3 = 8 \text{ cu.m.} \quad (3)$$

But the reaction generates a great quantity of heat, which it may be supposed raises the temperature to 1365° Centigrade.

This temperature has been assumed because it gives an even expansion of the gases, and it is near the minimum at which raw copper ore can practically be smelted.

Since air at 8.75 lb. pressure is lighter than at 15 lb., and as the temperature depends on the relative weights of carbon and air combined in a given time, to burn 1 kg. of 10% ash coke, which at the coast needs 8 cu.m. of air, at Cerro will need in the same time and at the same initial temperature:

$$8 \times (15 \div 8.75) = 13.71 \text{ cu.m.} \quad (4)$$

It is seen that if a furnace is designed to burn, at sea-level, a certain quantity of coke, to fit this to burn the same quantity at Cerro, the capacity of the blowers, air conduits, and the area of the tuyeres must be increased about 70%. If these changes are not made, but the blowers are only run faster, the blast-pressure will increase, introducing evils of which I will treat later, and at the same time the blowing engine will be forced to do a great deal of useless work, increasing leakage at a ratio which will surprise men who have had no experience in operating furnaces at such high altitudes.

The problem of the volume of air, which now looks so simple, was solved on a scientific basis about 30 years ago. Before this the greater part of those who tried smelting in the Cordilleras blew too little, although some went to the other extreme and blew too much air; but none could tell in a scientific way the amount that should be blown. As up to that time results of shaft-furnace smelting had been unsatisfactory, it became an axiom that "smelting in shaft furnaces is impossible in the high cordilleras of Peru." Engineers of almost all nations had tried it and failed. Percy, in the older editions of his 'Metallurgy,' treats of this subject.

The question now arises, does the same amount of carbon burned in the same time at Cerro de Pasco afford the same temperature as at sea-level? If one cubic metre of the eight (equation 3) is taken, formed by the combustion of 1 kg. of 10% ash coke, and enclosed it in a prism one metre square,

At	0°C.	the gases will fill	1	metre of	the prism.
"	273°	" "	2	"	"
"	546°	" "	3	"	"
"	1365°	" "	6	"	"

Thus the assumed temperature of the furnace expands the gases to six times their volume at 0° and 15 lb. pressure.

If this is plotted (see diagram) taking the origin of coördinates at O, which represents absolute zero, and making Oy, Ox, represent respectively the absolute volumes and pressures, then the point t_{15} can be made to represent the temperature 1365°C., since the line Ov_{15} represents the absolute volume of 6 cu.m., and the line Op_{15} the absolute pressure of 15 lb. at sea-level. The subfixes of p, v, and t, in the diagram, represent the pressures in pounds to the inch, to which the different pressures, volumes, and temperatures correspond. To find the relative values of temperature, pressure, and volume at any other point, pass a curve of expansion through the point t_{15}.

Rate of Combustion

Since a furnace made for sea-level work by increasing the volume of the blast, can be made to burn the same quantity of coke at Cerro, the rate of burning is the same. As the heat of combustion inside a furnace continually replaces the heat spent, and as the number of heat units, no matter at what temperature, will always be constant, the curve must be an isothermal, no matter how much the atmospheric pressure may vary. In other words, what is desired is to find the quantity of coke necessary to keep a fixed temperature of 1365° at a pressure which varies from 15 to 8.75 pounds.

An isothermic is an equilateral hyperbola

$$p\ v = P\ V = \text{constant.}$$

In this case P = 1 atmosphere = 15 lb. per inch = 10,333 kg. per square metre.

V = 6 cu.m., which is the starting volume at

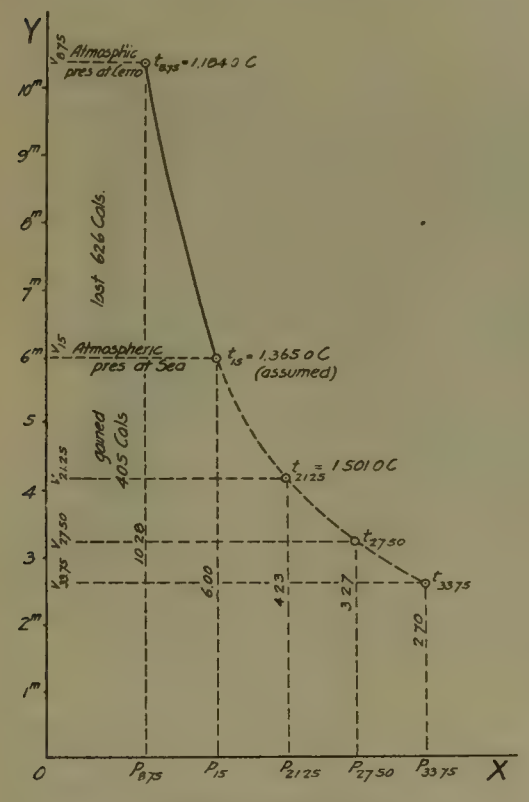
*Excerpt from the *School of Mines Quarterly*, July 1913.

[1]This is the pressure at the American smelter near Cerro de Pasco.

sea-level pressure and at 1365°C. temperature. From the nature of the curve of expansion, it is quite easy to find as many points as wanted. Since $p\,v = P\,V$, $v = P\,V \div p$.

The work done is represented in the diagram by the area bounded by the lines $(t_{15}\ldots.v_{15})$, $(v_{15}\ldots.v_{8\cdot75})$, $(v_{8\cdot75}\ldots.t_{8\cdot75})$, and $(t_{8\cdot75}\ldots.t_{15})$, which represents a given volume displaced by a certain varying pressure. From the nature of the curve, this area is the same as that enclosed by the lines $(p_{8\cdot75}\ldots.p_{15})$, $(p_{15}\ldots.t_{15})$, $(t_{15}\ldots.t_{8\cdot75})$, and $(t_{8\cdot75}\ldots.p_{8\cdot75})$, which represents a varying volume displaced between two pressures.

As the first area is the more natural representation of the expansion of the gases, between two given pressures, it can be evaluated by arithmetic. Of course, this valuation, although good enough for practical purposes, is only a rough approximation, for the hyberbolic arc $(t_{15}\ldots.t_{8\cdot75})$ is considered as a straight line.



PRESSURE-VOLUME DIAGRAM.

Rate of Expansion

Thus 1 cu.m. of the gases of combustion, in expanding from 15 lb. to 8.75 lb. pressure, is found to have done 36,260.16 kg-m. of work. As there were 8 cu.m. of gas (Eq. 3) formed in the combustion of 1 kg. of 10% ash coke, the total for 1 kg. of coke will be:

$$36{,}260.16 \times 8 = 290{,}081.12 \text{ kg-m.}$$

As 425 kg-m. = 1 kg-cal., the loss of heat will be as follows:

$$290{,}081.12 \div 425 = 682.54 \text{ kg-cal.}$$

If closer work is wanted, then the true value for the curve has to be used.

The efficiency of the furnace at the tuyere zone, and under a pressure of 15 lb., is found to be 60%, equal to 1365° Centigrade.

At Cerro, under a pressure of 8.75 lb., owing to the heat lost by the expansion of the gases, the same furnace, with the same weight of air, which means 70% more volume blown in the same time, and with the same weight of fuel, will give only 52.1% efficiency, equal to 1184°C. Thus the furnace at Cerro has lost about 13% calorific capacity, as compared with the same furnace at sea-level. This is on the assumption that the air is perfectly dry. To obtain closer results, it will be necessary to make an approximation to bring the respective temperatures nearer to their true value.

Atmospheric Moisture

At sea-level, owing to the greater pressure and temperature, the air, especially in tropical latitudes, contains a quantity of water vapor which cannot be disregarded; while on the high altitudes of the Andes, the low pressure and temperature make atmospheric moisture very small. At sea-level, the air will be blown at a mean temperature of 25°C., while at Cerro the mean will be 6°, varying during the day from 1 to 11°. Not taking into account the initial temperature of the air at the two places, one can estimate the moisture which, at the coast, has to be heated to the required temperature of 1365° Centigrade.

It is computed that the diminished pressure at Cerro is equivalent to a lowering of 20° in temperature; and the moisture in the air will correspond to that of –14°C., at 76 cm. pressure.

From Renauglt's tables it is found that at this temperature 1 kg. air contains 1.7 gm. water vapor; then the water in the air required to burn 1 kg. of coke at Cerro will be 17.68 gm., or nearly 9% of the water contained at the coast.

Thus nearly 0.9 of the heat units used at sea-level, to heat the water of the air blown into the furnace, is saved at the higher altitudes. As the number of heat units at the coast was 112.7 kg-cal., at Cerro these will be reduced to only 10.1 kg-cal., leaving 102.6 which are saved to be added to the efficiency of the furnace. Allowing 2.6 calories for the heat necessary to bring the water vapor from 6° to 25°, there will be, in round numbers, 100 calories to be added to the efficiency of the furnace at Cerro. The corrected efficiency will be 53½%, as compared with an efficiency of 60% at the coast. In other words, if the furnace at the coast smelts 100 tons per day, the same furnace at Cerro, under the best conditions, will smelt only 89; for the fuel has lost 11% of its calorific capacity. At this temperature only copper ores that have been roasted, and of which the slags are very fusible, can be smelted.

The next question is regarding the effect of a high-pressure blast. Suppose that the blast is 2.19 lb., and assume this pressure is necessary to blow the required weight of air, 10.4 kg. (Eq. 2).

If 1 cu.m. of air at 8.75 lb. is taken and an outside pressure of 2.19 lb. (¼ the atmospheric pressure), applied, the cubic metre will be compressed to 0.75 its original volume; this compression generates heat, but as it is gradual, and as the wind-pipe which

connects a blower to a furnace is generally long the heat generated by this compression is lost through the thin iron shell of the pipe, and when the air reaches the furnace it has the same temperature as the surrounding atmosphere. When the air passes the tuyeres and expands again, practically to atmospheric pressure, for the ore column of the copper furnaces is so low that this factor can be disregarded, the 0.75 cu.m. will not fill its original volume. The heat lost in the compression has reduced its elasticity. In order to get 1 cu.m. in the furnace, one must take 1 metre raised to the 1.4 power, and for any volume r inside the furnace, one requires $r^{1.4}$ from the outside, as expressed in the equation for adiabatic expansion.

Air Required

Equation (4) gives 13.71 cu.m. of air necessary to burn 1 kg. coke at Cerro. The pressure 2.19 lb., which is ¼ the atmospheric pressure, will give: $13.71 \times \frac{3}{4} = 10.28$ cu.m. air at an absolute pressure of 10.94 lb. Expanding back these 10.28 cu.m. from a pressure of 10.94 (pressure at Cerro, 8.75 + pressure of blast, 2.19) to a pressure of 8.75, the volume required is 11.78 cu.m. of air.

The work of the gases in this expansion is 29,181.3 kg-m.; and the heat units, $29{,}181.3 \div 425 = 68.6$ kg-cal., which makes the relative efficiency 52.56% = 1195.5°C. Two pounds of blast additional at these high altitudes will lower the temperature of the furnace about 20 degrees.

At sea-level the furnace has given as sensible heat 4539.4 cal., some of which is lost in the escaping gases. If the gases escape at 500°, 22.8% is wasted and 39.4% is utilized. Then it follows that

2750.6 cal. vanished as radiation, etc....	37.8%
1662.8 cal. wasted in escaping gases.....	22.8
2876.6 cal. avail. for melting (efficiency).	39.4
7290.0 cal.	100.0

To find how much ore this furnace will smelt, and to make the calculation simpler, suppose that only slag is produced. Assuming the average copper slag to melt at 1150°, requiring for this 316 cal., and 90 cal. more to fuse it, the slag at 1220°, which is the probable temperature in the crucible, will take up 419 cal. per kilogram; but each kilogram produces around 43.4 cal. heat of formation.

Amount of Slag

If x represents the number of kilograms of slag formed, then:

$43.4x$ = heat of formation of x kg. of slag.
2876.6 = heat available for making x kg. of slag.
$2876.6 + 43.4x$ = heat at hand for formation of slag.
$419x$ = heat wanted for formation of slag.

Equating:

$43.4x + 2876.6 = 419x$, whence $x = 7.6$ kg. slag formed.

Smelting matte, the proportion of coke to ore will be more advantageous; and if the proportion is 3 of matte to 7 of slag, 1 kg. of coke will smelt 10 kg. of ore.

Perhaps this treatment of the formation of the slag may be thought arbitrary by many readers; but a moment's reflection will show that the slag and the gases of combustion cannot have the same temperature. As soon as the slag, in this case, rises to 1150° and gets the 90 cal. necessary for its liquation, it drops into the crucible, and whatever excess of temperature it obtains above this is due to the transfer of heat from a hotter to a cooler body. From the nature of the furnace, once the slag is in the crucible, the ratio of temperature between slag and hot gases must be more or less fixed, since the constant tapping of the slag does not give enough time for equalizing the temperatures.

In estimating the efficiency of the furnace in the higher altitude, it may be assumed that the radiated heat is the same (37.8 per cent).

Effect of Moisture on Efficiency

In the course of this article it has been seen that 100 cal. is gained by the furnace in the higher altitude, by saving the heating of the water vapor; but there is a loss of 626.1 cal. due to the expansion of the gases; thus the net loss is 526.1 cal., or 7.2%. Keeping the same relation between the wasted and available heat, the heat distribution is as follows:

2750.6 cal. vanished as radiated heat.....	37.7%
526.1 cal. vanished in expanding gases ..	7.2
1466.2 cal. lost in waste gases	20.1
2544.2 cal. avail. for melting (efficiency).	34.9
7287.1	99.9

Equating as before:

$43.4x + 2544.2 = 419x$; whence $x = 6.7$ kg. slag.

By roasting and careful fluxing, more fusible slags can be made, thereby increasing the output of the furnace; but this is expensive, and only rich ores can stand it. This is what is done by successful smelters; the ores are carefully prepared before going into the furnace; and to have a safe margin of heat, the quantity of coke, as well as of air blown in, is somewhat increased, for it is seen that the temperature of the furnace has fallen from 1365° to 1215°, which is not sufficient for the regular operation of smelting copper ores.

It would be tedious to enter further into these details, but the calculations are sufficient to show that, even with the necessary amount of air, smelting is much more difficult at the Andean altitudes than at sea-level; and the man who at these altitudes wishes to work with open eyes must not forget the laws of the expansion of gases.

Pyritic Smelting

To apply the same process of reasoning to pyritic smelting, assume an ore having 70.84% FeS and 29.16% SiO_2.

To make this case as nearly as possible like the one already examined (using coke), consider 1 kg. of fuel, which in this case is the ore itself, and suppose it is converted into slag. From the chemical equation,

$$2FeS + 6O + SiO_2 = (2FeO)SiO_2 + 2SO_2$$

From thermophysics it can be deduced that a total of 931 cal. are available to run the furnace.

In coke smelting, the furnace gave a certain dis-

tribution of heat, which will be more or less the same in pyritic smelting; this is:

Per cent.		Calories.
37.8	vanishing heat	352
22.8	wasted heat	212
39.4	efficiency or melting capacity	367
100.0		931

The slag of the equation will heat up and melt with an expenditure of 395 cal. per kilogram, and most likely, at the crucible of the furnace, will have consumed 406 cal.; thus, $406 \times 0.87 = 353$ cal., is the heat necessary in this case to melt 0.8712 kg. As there are 367 cal. in the furnace, there is an excess of heat above what is necessary to run the furnace.

Distribution of Heat

The heat produced is almost equally divided between the Fe which gives the solid product FeO, and the S, which gives the gaseous SO_2. The O necessary to burn these elements is 0.3864 kg., which represents 1.288 kg. additional N, giving 1.6752 kg. of air, or 1.2886 cubic metres.

The principal data are now available to find the heat loses of this furnace working at Cerro de Pasco, as an atmospheric pressure of 8.75 lb. to the inch. The item lacking is the relative radiation between the two pressures; but as it cannot be had, its value will have to be approximated.

The gases and the solid products of combustion, while gradually losing their temperature in doing the work of heating and melting the slags, will consume, as has been seen, 62.2% of the total heat, or 577 cal. If the temperature to which this 577 cal. will raise its own products is computed, and the heat lost by the gases in expanding from 15 lb. to 8.75 lb. is deducted, there will result the sensible or temperature-making heat which the furnace gives at Cerro.

It can be computed that the fuel constituents of the ore, if not allowed to lose their heat in melting the slag, would, at sea-level pressure, raise their own temperature to 2325°C. The work of expansion is 52,720 kg-m. per cubic metre of gas formed. But as there are 1.20 m., the total work will be 63,264 kg-m. Reducing work to heat, $63{,}264 \div 425 = 148.8$ kg-cal. Therefore the sensible heat has been reduced by 148.8 cal., and the temperature must be lowered 25.6 per cent.

Making a new distribution of the heat:

Per cent.		Calories.
37.8	vanishing heat of radiation and convection	352.0
14.9	vanishing heat of expansion	142.0
16.9	wasted heat in gases	158.3
29.3	melting heat (efficiency)	278.7
98.9		931.0

This distribution of the heat is rather arbitrary, for the vanishing heat of radiation is kept the same in both cases. Decreased temperature seems to demand decreased radiation; but, on the other hand, the decrease in atmospheric pressure increases radiation. Not having data on this point, I have thought convenient to let increased radiation balance the decreased temperature; and if the results are not absolutely true, they will, at least, be relatively so. At any rate, ordinary practice confirms that this assumption cannot be far out of the way.

From the new distribution it is seen that at the higher altitude the smelting heat has dropped from 366 cal. to 278.7; or, reducing to kilogram of slag, from 420 to 312 cal. With this heat no pyritic copper slag can be melted and made to run.

To secure the heat that would be available at sea-level, so as to be able to smelt, add about 4% coke with the corresponding amount of air to burn it; but this addition tends to make poor mattes, for at high temperatures oxygen has a very strong affinity for carbon, as is proved by the bessemer converter, where 2 and 3% carbon is burned without any great oxidation of the iron through which the air blast is made to pass. To counteract the reducing action of the coke, a great excess of air has to be blown; this excess and the consequent increase of the pressure of the blast, cools the furnace, and to remedy this, more coke has to be added. As a result, I have never seen in Peru a shaft furnace trying to do oxidizing smelting and consuming less than 10 to 15% of coke. In Cerro de Pasco, copper ore containing from 6 to 8% Cu is reduced to matte of 40 to 45% with an expenditure of from 10 to 12% coke. At Yauly, the same quality of ore was concentrated to 28 or 30% with a minimum of 12%; and in the smaller furnaces through the country, the concentration is only 2 or 3 to 1, with an expenditure of 15% coke and an immense amount of air blown in. In fact, oxidizing smelting in Peru today is nothing but pot roasting carried to fusion at the expense of fuel. This is but natural since the altitude reduces furnace temperatures, as has been seen, by 11 to 25%, according to the fuel, quantity of air, and intensity necessary for the operation.

Artificial Pressure

In view of all that precedes, I believe that all efforts to do oxidizing smelting in the Cordilleras will be useless so long as they are conducted at atmospheric pressure. But if artificial pressure were put on the furnace, and the fuel were forced to burn at higher pressure, not only oxidizing but real pyritic smelting could be done in the Cordilleras as easily as at lower altitudes. If this were aided by a hot blast, then even ores that at present are thought unfitted for this work could be profitably reduced directly, perhaps with the addition of some coke inside the furnace.

It is true that heavier blowing engines would be required, but although these would have to do more intense work, it is likely that, on the whole, not much more work would be done. At present, the quantity of hot unburned air that escapes up the furnace, due to the small ore columns which are indispensable while working on the present system, must represent a large amount of fuel and power, which, if saved, would be enough to run the heavier machines, while a much cheaper and abundant product would be obtained than at present.

The diagram gives the theoretical temperatures

of a furnace at -6.25 lb. and +6.25 lb., on the assumption that at sea-level the temperature is 1465° C. From this it will be seen that ores which cannot be smelted at an absolute pressure of 8.75 lb. will be easily smelted at an absolute pressure of 21.25 lb., with the same amount of coke and air used in both cases. In pyritic smelting, on account of the greater quantity of air and the higher temperature necessary for the work, the difference will be still greater in favor of the higher pressure, as has already been seen.

Increase in Temperature

There are several ways of increasing the temperature of a furnace:

1. Reducing to a minimum the heavy losses of radiation and conduction; men who are going to use a shaft furnace in the Cordilleras should not overlook this point. The crucible and the jackets where the loss is the greatest should receive their special attention.

2. The direct use of fuel inside the furnace is the readiest and easiest way to increase temperature, but in copper matting, every pound of carbonaceous fuel inside the furnace tends to make poor matte; and poor matte is nothing but a reduction of the output of the furnace.

3. The use of hot blast. The well known properties of hot blast make it unnecessary to point out the advantages of its use at high altitudes where the heat losses are so great.

4. The use of back pressure on the furnace, in such a way that the fuel is forced to be burned at the pressure desired for its most economical working.

The combination of all these conditions favorable to high temperature in a single and easily worked furnace would be the ideal for high altitudes.

Two important Broken Hill mines produced the following in May:

	Proprietary.	South.
Ore milled, tons	.....	27,960
Lead concentrate, tons	.....	4,548
Lead content, per cent	.....	68.7
Zinc content, per cent	.....	6.9
Silver, ounces	.....	22.3
Zinc concentrate	7,115	.....
Zinc content, tons	3,281	.....
Lead content, tons	529	.....
Silver, ounces	91,540	.....
Silver from mine and purchased ore, ounces	354,340	.....
Lead, tons	6,667	.....

The production of pyrite in the United States in 1912 was 350,928 long tons, valued at $1,334,259. This is an increase in quantity of 49,470 tons, and in value of $169,388, compared with the production in 1911, which was 301,458 tons, valued at $1,164,871, according to the U. S. Geological Survey.

Metal production of the Mt. Lyell mines, Tasmania, during the period ended April 16, was as follows: Ore and fluxes smelted, 14,617 tons; blister copper content, 162 tons; gold, 414 oz.; and silver, 17,770 oz. The tonnage from the North mine is now increasing rapidly.

The Precipitation of Gold by Manganous Salts

By A. D. Brokaw

*Some interesting occurrences of gold associated with manganese dioxide led to the suspicion that manganous salts, under certain conditions, might react with solutions of gold salts to bring about mutual precipitation: the gold in the free state and the manganese as hydrated manganese dioxide. A search for literature on such reactions was without avail, and experiments were undertaken with a view to ascertaining if such reaction is possible, and, if so, under what conditions it can take place. The reaction in question is in a sense the reverse of the series of reactions involved in the well known 'chlorination process' of extracting gold from its ores:

$$MnO_2 + 4HCl = MnCl_2 + Cl_2 + 2H_2O$$

and

$$3Cl_2 + 2Au = 2AuCl_3$$

The reaction is doubtless much more complex than the summary equations, but it will be seen that a reversal of the series would lead to the formation of gold and manganese dioxide.

Gold-Chloride Solution

Auric chloride solutions of varrying concentrations were mixed with solutions of manganous chloride with concentrations ranging from 0.5/N up to saturation, but no reaction was detected even when the mixture was boiled for several minutes. The addition of a small amount of alkali to the mixtures, in the cold, caused an immediate precipitation of a dark brown mass resembling manganese dioxide in the hydrated form commonly precipitated. The precipitate was collected, carefully washed to free it from the gold solution, and then treated with standard oxalic acid, containing a small amount of sulphuric acid. The solution thus obtained was divided into equal portions: one was analyzed for manganese and the other titrated for loss of oxalic acid. The results showed that for every equivalent of manganese an equivalent of oxygen had been taken up by the oxalic acid, proving the precipitate to be manganese dioxide. In a check experiment the precipitate was taken into solution with the standard oxalic-sulphuric acid mixture, which was titrated for loss of acid. The manganese in solution was then reprecitated as hydrated manganese dioxide by a standard method, and the precipitate was again treated with the standard acid mixture. The same loss of acid as before showed the original precipitate to be manganese dioxide.

Gold was left by the solution of oxalic acid and was readily recognized as such.

Gold chloride solutions are notably acid in their reaction, due probably to hydrolysis in part, and in part to the ionization of an addition product with water. Hittorf and Salkowsky showed by electro-

*Paper presented at the Milwaukee meeting of the American Chemical Society.

lytic experiments that gold chloride solution is ionized as follows:

$$\overset{+}{2H} + \overset{-}{AuCl_3O}$$

Solutions of gold chloride show marked acid properties toward indicators, and apparently the acidity thus developed is sufficient to suppress the reaction,

$$2Au^{+++} + 3Mn^{++} = 2Au + Mn^{++++}$$

If one postulates the intermediate formation of $MnCl_4$ in minimal amounts, he is justified in assuming that the salt would be largely hydrolyzed, since tetravalent manganese is a very weak base. This hydrolysis would be suppressed by the presence of acids, but on reducing the acidity, hydrolysis might become effective, forming the very slightly soluble hydrated manganese dioxide, and with this removed from the equilibrium system by precipitation, the reaction might proceed until concentrations were diminished to equilibrium conditions.

It is of interest to note that the precipitation began long before the solutons were entirely neutralized as shown by indicator tests. This was shown in another way by placing a crystal of iceland spar in the mixture of gold and manganous chlorides in solution. A slight effervescence occurred, and after a few hours the crystal was covered with a brown coat of manganese dioxide in which flakes of gold were plainly visible. The precipitation of gold was practically complete when an excess of $MnCl_2$ was employed, though this solution had at least the acidity of saturated carbonic acid.

An interesting reaction of similar nature was found to take place between auric chloride solution and manganous carbonate. The precipitated carbonate (doubtless amorphous, in part, at least) reacts at once and is turned to the dark brown hydrated dioxide. The crystallized carbonate, that is, the mineral rhodochrosite, reacts slowly, but, after a day, a crystal was coated with dark brown and flakes of gold were plainly discernible.

Summary

If we suppose manganese tetrachloride to be an intermediate product, present only in very minute traces, we may find in it some basis of explanation. Suppose

$$2AuCl_3 + 3MnCl_2 \leftrightarrows 2Au + 3MnCl_4$$

Since tetravalent manganese is an exceedingly weak base it should be little ionized, but it may be subject to two other sorts of dissociation, namely:

1. A molecular dissociation,

$$MnCl_4 = MnCl_2 + Cl_2$$

2. Hydrolytic dissociation,

$$MnCl_4 + 4H_2O = Mn(OH)_4 + 4HCl$$

Theoretically we should have the hydrolysis constant

$$\frac{Mn(OH)_4 \times 4HCl}{MnCl_4} = K$$

assuming hydrolysis according to the above equation. It is obvious that the presence of acid would tend to cut down the hydrolysis and allow the tetrachloride to become sufficiently concentrated to make its molecular dissociation appreciable—the greater the concentration of acid the greater this tendency—and we may, in this way, easily obtain conditions under which free chlorine is liberated, as in the chlorination process.

If, however, the acid concentration is reduced below a certain figure the concentration of the tetrahydroxide will reach saturation. Any further reduction of acidity must result in the precipitation of the hydrated dioxide. It will be seen that such an adjustment may be very delicate indeed—and this seems to be supported by the lack of success in preparing the tetrachloride, subject, as it would be, to both hydrolytic and molecular dissociation.

An Automobile Hoist

The picture presented here was taken at the Banner mine near Randsburg, and shows a small automobile being used for hoisting purposes. A 600-lb. bucket is being used and is easily raised by this new type of hoisting machinery. As the shaft is deepened the road is lengthened and so the work

AUTOMOBILE HOIST.

goes on. From the work which has been accomplished to date by this new three speed forward and one reverse, direct-drive hoisting machine, the owners are planning to sink to a depth of 500 ft. When the hoist is not in use, it is a great convenience for hauling supplies and water and for bringing the miners to and from the property.

The Low gas-engine consists of a producer gas-engine with a compact producer attached to the end of the cylinder. Coal is fed into a hopper, from which it is conveyed by four screws through heater tubes. These pass through a gas chamber, connected with the engine inlet valve, the exhaust-heated chamber, the combustion chamber, and open into an ash and soot chamber. The latter admits air or steam to the tubes, which is drawn over the fuel by the engine suction. Tar has given no trouble. A 100-hp. unit only consumes ½ lb. of coal per brake horse-power hour.

Fume from the Sumitomo copper smelter, at Yotsuzakajima, Ehime Prefecture, Japan, is still giving trouble, and the residents of nearby villages have asked that the payment of damages be continued. Compensation up to the end of 1910 was $170,000, after which it was agreed to pay $38,500 annually to the end of 1913. Hence the renewed agitation for further payments.

The Amakie Sapphire Fields of Queensland

By Lionel C. Ball.

*This district covers an area of 30 square miles. There is room for far-reaching economy in the breaking down and rough concentration of the wash, but no inducements are offered men of large ideas and resources, it being tacitly understood that the field is reserved for the small claim-holders. The employment of labor under such circumstances is at a minimum, as only the claim-holders in the richest ground can afford to pay miners the ruling wage of $14.40 per week of 44 hours.

The digging consists in: (1) surfacing, or simply

MAP OF QUEENSLAND.

removing and treating the soil; (2) deep surfacing, which necessitates removing several feet of overburden that may or may not carry gem stones; and (3) sinking shafts through the overburden into the wash, the boulders and large pebbles of which are packed behind to prevent caving and to save unnecessary haulage.

As mapped by Mr. Dunstan, government geologist, who has exhaustively dealt with this field, there are five main 'runs' of wash. The following notes will show the character of the workings: At the Black Soil claim, 'wash' is found in the valley bottom. At Elwood's Grave, 13 men are hand-raking and sieving the surface soil. In one part of the area 'deep surfacing' is the practice, a 3-ft. overburden being removed to expose 18 in. of wash on bedrock. Some men average $5 per day. At Grave Hill, the wash is 8 to 13 ft. below the surface, and 2 to 3 ft. is mined as 'pay.' One man can 'tub' three-quarters of a load (say 3000 lb.) per week, yielding 0.5 to 3 oz. of first 'blues.' Some large stones, including a 16½ and 28-dwt. 'blue', were recently obtained west of this place. Iguana Flat is noted for the large size of its fancy stones. The Little Bessie wash is notably ferruginous, quite distinct from others being worked here. The successful treatment of the 'sands' in Retreat Creek has led to activity here, and several men make from $3 to $3.50 per day. A second bed of wash was proved at Ruby Vale, and on one claim 1 to 4 ft. of wash is being mined at a depth of 27 ft., yielding 0.5 oz. 'blues,' 0.5 oz. 'machine,' and 2.5 to 3 oz. corundum per load, with a few 'fancy' stones. The Queenslander claim has produced $43,000 of gems in three years. The wash is 5 ft. thick and has yielded 4 oz. 'blues' per 'load.' On the Reward claims, the richest of them all, wash occurs on a low ridge, the deepest stripping being only 5 to 6 ft. The best gems come from near the surface, but the large dark violet stones mostly come from the deeper ground. Some are up to 3 oz. weight, and worn crystals of corundum up to 1½ in. diam. and 5 to 6 oz. weight are found.

Treatment of the Wash

Where, as on the Reward claim, practically all the gemstones are of large size, mechanical treatment of the wash is obviated by what is known as hand-raking, which consists in passing all the material broken down under the hand and examining it in the dry before throwing it back among the headings. Radical improvements have been introduced of late years, especially adaptation of South African diamond and corundum washing practices. The finer and lighter material is now treated in rotary machines. These consist of a circular iron pan, 5 ft. diam. and 12 in. deep, with circumferential feed and central discharge. The thoroughly moistened wash, as fed in, is stirred up by blades, each 10 in. long and 2 in. wide, attached to four arms driven from a central shaft making 7 r.p.m. The blades are set diagonally, with the object of throwing back toward the wall of the pan all heavy material including the gemstones, while the slush is allowed to escape through a central trap, passing thence by way of a launder to waste. It is stated that an essential for the successful working of the machine is that the wash during the pan treatment be in the form of a thick 'slurry,' to which clear water must on no account be added; but this is diametrically opposed to the ordinary laws of concentration. The capacity of Bradford's machine is estimated at 25 loads per day, but there is seldom more than 10 loads available at a time. The concentration, of course, varies with the nature of the wash, but usually a load is reduced to three or four sieves of gravel; that is, in the ratio of something like 50 to 1. Neither is the time required a constant, but a load of ordinary wash can be put through by three men in a quarter of an hour. The owners make a composite charge of $1 per hour for carting the wash from the mine, if within a radius of two miles, and for putting it through the machine, in which, however, the claim-holders undertake the greater part of the labor of puddling.

*Abstract from *Queensland Mining Journal.*

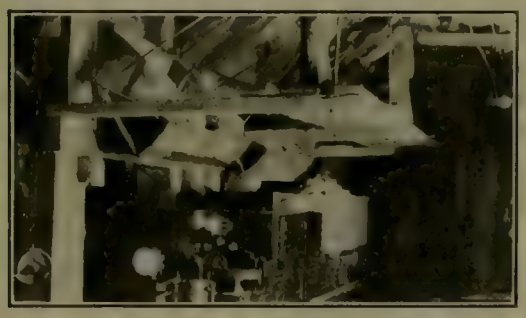
and the whole of that of sieving the 'concentrate.'. The heavy material saved is then roughly classified by hand in an ordinary circular sieve, with 1/5 to 1/10-in. mesh and a small removable perforated hopper having ½-in. holes. The 'hopperings' are thrown aside and the 'fines' neglected, but the gemstones in the middlings are concentrated on the bottom of the sieve by subjecting it under water to peculiar vertical and side shakes. It then remains only to invert the sieve on the ground and to pick out the sapphires from the other pebbles on the surface of the truncated cone of gravel so formed.

During 1912 the total production was valued at $192,000. The demand for the gems is regulated by the lapidaries of Germany, who sell the cut material throughout Russia. The German firms have agents on the gemfields. In examination of a stone, the sky must be cloudless, for deep violet blues appear quite opaque in dull weather. Prices are as follows: fancy stones, $1.25 to $24 per dwt.; largest blues, $28.80 per oz.; large blues, $12 to $16.80 per oz.; parcel blues, $8.40 per oz.; small blues, $1.80 per oz.; machine stones, 75 to 87c. per oz.; corundum (over 1 oz.), $1.50 to $2 per oz.; corundum (under 1 oz.), zircon, and spinel, unsalable.

A New Ore Gate

By Grant H. Tod

At the Perseverance mine, Juneau, Alaska, H. J. Jackson, the superintendent, has recently devised a new gate which shuts off the run of ore from the



ORE GATE IN OPERATION.

chute to cars from the bottom upward. This allows the operator to stand above the chute line all the time, saving many accidents. The ore gate is counterbalanced and works with ease. The accompanying cut shows the chute, cars, and electric locomotive.

According to an English contemporary, the first round in the legal fight between the Golden Horse-Shoe and the London & Hamburg Gold Recovery Co. over the bromo-cyanide process, has been indecisive. A cable announces that judgment has been given in favor of the Horse-Shoe on the question of the Sulman and Teed patent, but against them on the Goepner and Witter patent. It seems likely that there will be an appeal.

Coke output of Indiana in 1912 was 2,616,339 tons, valued at $12,528,685.

Mining Methods at Broken Hill

*A series of papers on this subject at the meeting of the Australasian Institute of Mining Engineers held at this centre in May, was preceded by a valuable general statement of the peculiarities in the mode of occurrence of the orebodies which resulted in the adoption of the various methods afterward described. Of these peculiarities, the most important are:

1. The shape of the orebodies, which are stated to be irregular in shape, of tremendous width in parts, and enclosed within poor walls. Developments at depth indicate that the lodes will be narrower and more regular, but it is a strange fact that even in the deeper levels the walls are often weak.

2. The physical properties (texture, etc.) of the ores, which vary from dense strong sulphides to porous friable sulphides and loose soft carbonates. In addition to the natural variations in texture is that induced by the crushing of blocks of ore as a result of previous mining operations.

The evolution of the methods characteristic of the field as a whole is put clearly by the authors as follows:

The first method of stoping employed was on the open principle, involving the use of 'clap-me-down' sets of local eucalyptus timber. This was found unsuitable, on account of the weakness of the ore, the walls, and the size of the deposits.

Then came the Deidesheimer square-set from Comstock, and with it a number of United States engineers to supervise its use. It was employed in overhand stoping, was used in horizontal floors, and was reinforced with angle bracing and bevel pieces, features of the original design. But so long as the timber was relied upon as the only support for the depleted ground, the stopes continued to fall in. Then came the winzing system, and the filling of the sets with waste quarried at surface. That modification made the square-set method a success, and enabled many thousands of tons of friable ore to be extracted. The square-set system is still being used extensively, and is not likely to be displaced for opening crushed and broken ground, although, on account of the greater attention being paid nowadays to filling, the angle-bracing is rarely seen in its completeness. An important change, however, in the manner of using the sets has been made on the field. In the picking-up of bottoms, in crushed workings, and in the mining of old pillars, the sets are now used in conjunction with underhand stoping. In this system of mining, the trouble with a weak back is minimized, the work rendered more safe, and the cost per ton reduced.

With increase in depth the ore changed from the oxidized to the sulphide minerals, which at shallow levels were in the friable condition, but at greater depths were hard and compact. The alteraton to sulphides meant a lower-grade ore and a concentrating charge. Still, under the disadvantages of metallurgical difficulties and unfavorable metal market, the friable stopes showed profit on square-set work;

*Abstract from *Australian Mining Standard*.

but when the hard ground was properly entered, it was noticed that, in addition to the sets being too expensive, they were also unsuitable. Then came the introduction of the open stope proper, embracing the use of timbered gangways on the sill floor only, filling of depleted ground with waste, and the utilization of 'pig-sties' or cribs in the working place. And, although many changes have been made in detail, the same system, in principle, prevails to a considerable extent today.

Individual Companies

The special characteristics of the underground operations of individual companies are described as follows:

South Blocks.—This at present is working a narrow orebody, practically vertical, and having only one wall. The conditions are such that rill stoping, combined with filling from continuous passes, skip haulage, and fathomage contracts, is possible, and is successfully accomplished.

South Mine.—This is operating open stopes in large, irregularly shaped shoots on the 970 and 1070-ft. levels; and above are picking up bottoms, and working away old pillars, with heavy square-sets on a cross-cut system.

Central Mine.—This mine on the deepest levels is open stoping a new orebody east of the one previously worked; but higher up is mining with square-sets old workings and old pillars that have 'crept,' and are still slowly subsiding.

Block 10.—This mine is the deepest on the Barrier, and, as the lode is narrow at depth, the stoping operations are on an open-rill system. There are many problems here, though similar to the Central mine, the 'creep' having affected both properties, and they are dealt with in a similar manner by square-setting. This work is going on under old workings, on both an underhand and flat-floor system.

Proprietary Mines.—This mine is also open stoping at the deepest levels, but upward its problems are, perhaps, more varied than those of any other company. The square-set method predominates, and is employed in all classes of ground, including hard ore in deep levels, crushed ore in 'crept' stopes and 'bridges,' and loose running material partly oxidized underneath the open cut and in proximity to an old fire.

Block 14 Mine.—This company is engaged in the recovery of carbonate ore from old stopes on shallow levels with the aid of square-sets, and in the stoping of compact sulphides at depth in open workings.

British Mine.—This is distinctly an open-stope mine, mainly on account of the hardness and strength of the ore. Both the lower portions of a lift, and the bottoms as well, are worked on the bulk system, booms, of course, being freely used for the last slice. Only in the case of friable ore are square-sets called into requisition.

Junction Mine.—This is re-working old stopes left unfinished, and re-entering others that had 'crept,' with the aid of square-set timber. On the deeper levels the strength of the ground warrants the use of the filling and bulk system.

Junction North Mine.—Here, again, the strong nature of the ground allows of the employment of open stopes until the lower levels are approached, when a change is made to set timber. At present the 1200-ft. level is open; but above it, bottoms are being secured on the usual system.

North Mine.—This mine has two ore-shoots having good walls and pitching with remarkable uniformity downward in a northeasterly direction. The strength of the ground allows of open stoping, and the regularity of the deposit generally makes possible a standard system of drifts, cross-cuts, and winzes, and the installation of an efficient and cheap method of handling filling.

Utilizing Sulphuric Acid Cinder

Nearly $18,000,000 worth of sulphuric acid is made yearly in the United States, being used in the manufacture of superphosphates, explosives, in refining crude oil, and in a great variety of chemical industries. Much of this is made from pyrite, which is treated in roasters to liberate the SO_2, which is then made into sulphuric acid. The calcined residue, still containing about 2% sulphur, sometimes contains enough copper to make its extraction, by leaching or otherwise, profitable. Except for its sulphur content and fine state of division, the calcined residue resembles a good grade of iron ore, and a good deal of effort has been devoted to utilizing this residue in iron smelting, especially since it is commonly low in phosphorus. By nodulizing the calcine in kilns the residue can be brought to a low sulphur content and at the same time so agglomerated as to make it a desirable addition to the iron blast-furnace. In the case of residues which contain about 1% of copper, this is first extracted by leaching, after which the cinder is nodulized. If the copper is less than ½ to ¾%, its extraction is not profitable. The cost of nodulizing is also so nearly equal to the value of the resulting product that this operation is not very profitable. At the plant of the Pyrites Co., Ltd., which is engaged in the manufacture of sulphuric acid from Rio Tinto pyrite, there has just been put into operation a 150-ton Dwight-Lloyd sintering machine for sintering the cinder. About 8% of coke-dust is mixed with the cinder; the cost of the operation is considerably less than in nodulizing in kilns, the sulphur being reduced from 2 to 0.04%. There is a tendency at present to use copper-bearing steel for rails for railway service, and if the use of steel containing copper should increase, it is not at all improbable that the burning of copper-bearing pyrite for the manufacture of sulphuric acid, nodulizing the residue, and smelting in the blast-furnace to yield a copper-bearing pig iron will become an important phase of future practice.

Asphalt and bituminous rock production in the United States was 449,510 short tons, valued at $4,620,731 in 1912. That of Trinidad was 189,496 tons, and Venezuela 65,875 tons.

Mt. Morgan, Queensland, in May returned the following: Ore smelted, 21,911 tons; blister copper, 662 tons; and gold, 9169 oz., valued at $374,000.

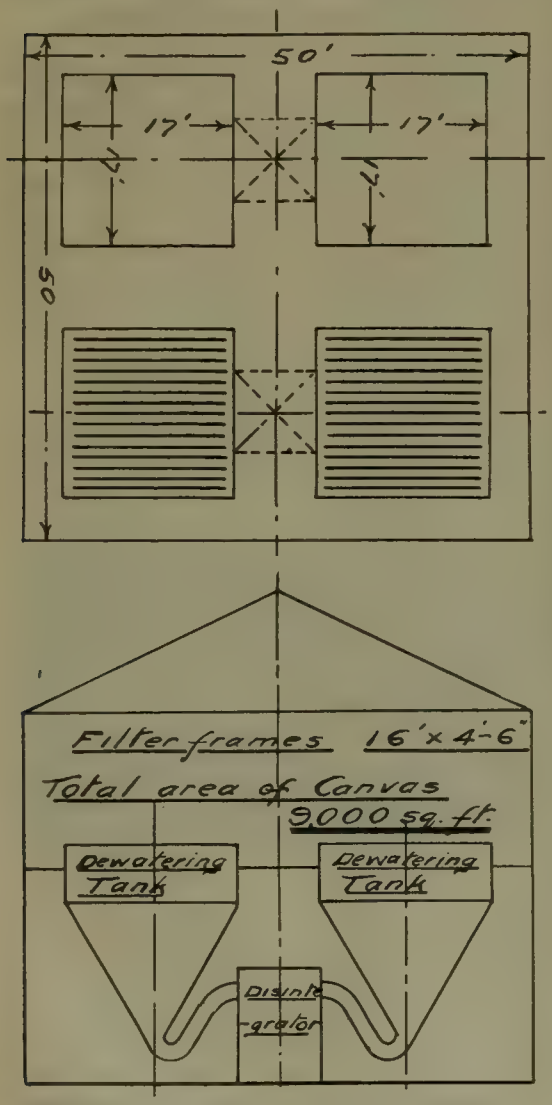
Discussion

Readers of the MINING AND SCIENTIFIC PRESS are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment. Insertion of any contribution is determined by its probable interest to the readers of this journal.

Dewatering Tank

The Editor:

Sir—In your issue dated June 21, 1913, C. F. Spaulding has an article on 'Continuous Agitation with Barren Cyanide Solution,' in which he gives a drawing showing 'Young's Dewatering Vat.' Upon reading this article one would conclude that this idea for dewatering slime was something new. I would like to state that the Waihi Gold Mining Co., Ltd., of New Zealand, completed a plant in 1908, on these identical lines, for dewatering about 700 tons of slime per day. The plant works well, and gives a thick discharge of slime, at an extremely low cost.



DEWATERING PLANT USED BY THE WAIHI GOLD MINING CO.

The plant consists of four conical bottomed tanks, each 17 ft. square and the cones of each pair of tanks, are connected up to a disintegrator. The dewatered slime is churned up with weak cyanide solution in the disintegrator, and from there it is elevated to agitators. Each tank contains 15 Moore filter leaves; each leaf being 16 ft. long and 4 ft. 6 in. deep. The total filtering area in the four tanks is about 9000 sq. ft. The dewatering operation is simply a matter of collecting and discharging cakes. Care has to be exercised in regulating the outflow of the thickened slime, otherwise the thin slime, in the upper part of the tanks, may break through into the disintegrator.

CHARLES A. BANKS.

Greenwood, British Columbia, June 28.

Lead Salts in Cyanidation

The Editor:

Sir—The following example of the effect of lead salts on the extractions by cyanide of the gold and silver in an ore which I was testing recently, may be of interest. The ore, assaying about $7 Au and 5 oz. Ag, consisted of a mixture of clean oxidized quartz and vein material (mostly calcite), the last carrying some of the metal. An analysis of the ore revealed no constituents prejudicial to treatment by direct cyanidation, except the presence of traces of manganese, which might possibly retard the dissolution of the silver. Agitation with solution produced a 95% extraction of the gold in 20 hours, but after 60 hours, even with solution titrating as high as 0.25% KCN, the silver extraction reached only 58%. The addition of lead acetate (0.5 lb. per ton of ore) at the start of the agitation caused the gold extraction to drop to 65%, and that of the silver to rise in 24 hours to 75%. By agitating for 20 hours and then adding the lead acetate and continuing the agitation in the same solution for a further 24 hours, the gold extraction reached 96% and the silver 89%. No appreciable increase in extraction of either the gold or silver was obtained by decanting the solution after the 20 hours and replacing it with fresh solution, before adding the lead acetate. Finely ground litharge had exactly the same effect as the lead acetate. The tests were conducted with precipitated solution from a plant where lead acetate, at the rate of 0.6 lb. per ton of ore, is added to the solutions.

VYVYAN C. BENNETT.

El Oro, Mexico, May 26.

The Franklin Furnace zinc mines, in New Jersey, continue their large output of zinc ore, producing an increased tonnage for 1912. The concentrating mills treated 363,588 short tons of crude ore, producing 298,901 short tons of concentrate. In addition, 95,997 short tons of crude ore was shipped. The total crude tonnage sold or treated was therefore 459,585 short tons, against 374,064 tons in 1911. The total recoverable zinc output in 1912 (figured as spelter), was 139,510,008 lb., against 154,890,900 lb. in 1911.

Diamond production of German Southwest Africa is growing. Shipments in June are estimated at 170,000 carats, one property yielding an average of 50,000 carats per month.

Special Correspondence

DENVER, COLORADO

COLORADO LOOKING FOR MINES.—PLATORO.—BIG PRODUCTION AT CRIPPLE CREEK.—NEW MILL AT IDAHO SPRINGS.—PITCHBLENDE IN GILPIN COUNTY.—EAGLE AND THE NEW SILVER MINE.—HOPES IN THE NORTHWEST.

Public interest in mining is low at present in Colorado, and the business is suffering its full share of the general depression that is being felt. It is true that it is not in so bad a way as that of real estate, which, as one ex-dealer expressed it, has "died a natural death," and yet it is hard to stimulate much local interest in mines and mining. So true is this that the somewhat forced publicity that Denver papers have given Platoro and Eagle has but served to create a prejudice against those two promising districts. Platoro is an old district, not far from Creede, that is being revived as a result of discoveries made last fall and described in the *Mining and Scientific Press* months ago. It is too soon to give a final answer to the question as to the value of the district. The first hopes of abundant high-grade ore have yielded disappointment, but that there is a considerable tonnage of ore of a grade now workable in other districts of Colorado, seems demonstrated. Whether it will pay to build the transportation lines and other utilities necessary to market it, is still uncertain; but the matter is being studied by men of experience, and it is at least hopeful. Cripple Creek is now a great low-grade camp, and is turning out a tonnage that is impressive. It is to be remembered that, in the main, the money made in Colorado mines has come from relatively high-grade ores, and the work done by Philip Argall at Stratton's Independence, G. M. Taylor, Thomas Crowe, and their associates at the Portland, and the active staff of the Golden Cycle, has demonstrated that, right in Colorado, in known districts, much money is to be made by proper efforts. There is no reason why a profitable low-grade mine must be as far away as Alaska or even the Black Hills. This new mining may be less dramatic, but to the state as a whole is likely to be profitable as gouging rich streaks. If local capital is not ready for the task, foreign money apparently is, as has been shown by the success of A. L. Burris in making a market in Europe for El Paso stock. His later and larger consolidation of Cripple Creek properties is being watched with great interest and much hopefulness.

In the meantime, other old districts jog along at about the same rate. At Buena Vista, George Collins has the Mary Murphy producing at a satisfactory rate, and seems to have tamed, at least temporarily, the wild Irish lady who has been the cause of much anxiety and grief. Perhaps Mary's days are numbered, but at least she is giving an edifying exhibition of a dignified old age. At Idaho Springs there is, as usual, a new mill. This is the long-promised one at the mouth of the 'Newhouse tunnel,' built by a subsidiary of the Argo company. It is in charge of A. H. Roller and is run on a custom basis, buying ore from the various mines operated in the tunnel. It is interesting as an application of cyanidation to ores long treated by amalgamation and concentration. Crushing is in solution with stamps. This is followed by concentration, fine grinding in tube-mills, and agitation. The mill is said to be giving excellent results, though detailed records have not been made public. Granted that it makes a good recovery, as is entirely probable, there is still a question whether it is not a forced attempt to get away from smelting rather than a real development in the technical practice of the district. Since the North American smelter at Golden closed, the Globe affords the only market for Clear Creek and Gilpin county ores. With only two furnaces running, it would not seem that the output was large enough to warrant much division of field—if only there was a better understanding between the miners and the smelting company. The conflict of interest cuts deep in Colorado, however, and it is doubtless too soon to expect complete harmony.

Gilpin county, while not deserting gold mining, is developing an interest in other minerals. The pitchblende is found in the German and Belcher mines, and described by Forbes Rickard in the *Mining and Scientific Press* of June 7, is attracting serious attention from medical men. Dr. H. E. Kelley, of Johns Hopkins Institute, has recently visited the property. It is known that no new sources of supply are being found in Austria, and that, in fact, the radium that comes from that country is derived from accumulated residues. Carnotite, while used as a source of radium, is proving a trifle disappointing. The refinery at Pittsburg has not, as yet, succeeded in keeping up the grade to the expected figure, and altogether the pitchblende of Gilpin county seems likely to prove of large humanitarian value, whatever may be the financial outcome. It is understood that the enterprise is being financed by an Eastern man without hopes of return, but as a measure of scientific and humanitarian interest. This gentleman, who prefers to remain unknown, is, by the way, one of the 'trust

MAP OF COLORADO.

magnates' whose company is in the public press. The company concerned has added the Wood and another property to its holdings, and is steadily piling up ore. If a sufficient amount to justify the venture be found, a refinery will be built at Denver or some suitable point. Mr. Rickard is managing the property.

Eagle continues to receive much notice in the local papers, and while the actual amount of ore so far found is not large, it is by no means certain that the district does not deserve the attention given it. The significance lies in the fact that silver ore of good workable grade occurs in the midst of a country so far devoted to ranching, and in a situation easily and long overlooked. It raises the natural question of how many similar bodies of ore are still to be found, not only in that vicinity, but in others in which the same conditions obtain. The geology of the district has already been noted in the *Mining and Scientific Press*. Briefly, the silver occurs as a replacement in a certain favorable bed of mesozoic sandstone, at the intersection of this bed by fissures, that are not especially conspicuous, and which do not mark faulting, though there are faults near by. In the sandstone are specks of copper carbonate, both malachite and azurite, and on its surface are small blotches of a lemon yellow mineral resembling the common alteration product of carnotite. The silver is in part in the form of chloride, and in part possibly that of argentite. It occurs not on 'facings' of the rock, but in the mass, and on freshly broken pieces may be seen as silver gray specks. Individual specimens assay as high as 3000 oz. per ton. The outcrop assayed 18 oz. and carload shipments assay 100 to 120 oz. There is only a trace of gold, and no noticeable lead, zinc, or pyrite.

So far, 19 cars have been shipped. The ore goes direct to the smelters at Leadville and Salida. Along the main fissure, mining has continued about 90 ft. A cross-cut to the east shows other fissures, and stoping, both up and down and along the dip of the favorable bed, shows groups of parallel fissures that contain ore. In the workings of the Lady Belle Syndicate lease, the only one shipping, the sandstone bed in which the ore occurs is five to six feet thick and dips about 15° at right angles to the strike of the fissures. The mineralization has extended from fissure to fissure, so that the whole body is workable from the outcrop down the dip 50 or 60 ft. Not all the fissures, of which there are three prominent groups, have been followed along the strike, and the main group still showed eight inches of high-grade ore in the face when visited. The favorable bed of sandstone is dark, earthy in appearance, and seemingly contains organic matter or ferrous iron compounds, or both, either of which may well have acted as a precipitant for the mineral of the invading solutions. It forms one of a series of beds of ordinary-looking Mesozoic sandstone. The talus in the vicinity shows fragments of a fine-grained dark igneous rock, and dikes are reported to occur in the district, though none have been found in or near the workings.

The Lady Belle mine was discovered last fall by prospectors who originally had been looking for copper, and who were grubstaked by a rancher and the postmaster, E. E. Glenn. In February, the value of the ore became generally known, and there was a rush into the district with a lot of staking of claims on the snow. There are now about 75 people in the camp, which is eight miles south of Eagle, and the number includes several experienced prospectors. There is a large territory, which, to superficial examination at least, offers hope of the finding of ore, and there would seem to be good prospects of the finding of additional orebodies. In the meantime, the Lady Belle should make money for its owners, as no mill and only the simplest equipment is needed. It has by no means been demonstrated that 'another Aspen' has been found, but the district is worth watching.

Northwestern Colorado remains a luring land of mystery, and despite repeated disappointments, there are many who retain hopes of finding there another big district. The region is now being studied by an experienced and successful engineer, who has had enough faith to grubstake a prospector for some months. Ore assaying $70 has been found, and the engineer is now in the district verifying the reports of his prospector and attempting to learn how much of such ore is present. It is greatly to be hoped that the venture proves successful; but at any rate, it is evident that the day of the prospector in Colorado is not yet done. Mining has naturally centred on the outcropping bodies of easily recognized ore, but sharper eyes and more trenching may at any time open bonanzas as rich as any yet found.

MELBOURNE, AUSTRALIA

TROUBLESOME MINERS.—A CASE OF SALTING.—TASMANIAN MINING DEVELOPMENTS.—DREDGING IN VICTORIA.

The miners of the Commonwealth seem to be bent on rendering it impossible for the mine-owner to carry on operations profitably. In Queensland, one of the principal fields, Cloncurry, is practically at a standstill because the union has decided that work is to be paid for at so much per day, instead of by results or by contract. Those who have had much to do with the local workman know the outcome of substituting day labor for contract labor or for piece work—it means, in two words, less work. In Victoria, on the Bendigo field, a strike is threatened unless the mine-owners refuse to employ non-union labor. This was the demand made by the Broken Hill, New South Wales strikers, recently, which, as may be remembered, failed. Undaunted by this example, the Bendigo men are pushing along to the same end. The employers have given them clearly to understand that they do not mean to give in on this matter; but it is difficult to say what the end will be. So far, the threatened strike has not taken place, and if the men have any wisdom it will not eventuate.

J. E. Carne, of the New South Wales Geological Survey, has issued a remarkable report on a recent alleged discovery of mineral oil at Diamond Head, in the northern part of the state. He has not minced matters, but says plainly that 'salting' (should we not say 'oiling'?) has been resorted to. The first announcement or 'find' had reference to the presence of oil floating in the water of a creek, and to seepage from the banks. Afterward, two small drill-holes were put down in the black sand rock sloping down the creek, the deeper of them being 7½ ft. In this, at the time of Mr. Carne's examination, there was about 5 ft. of water, and in the sand and mud of the drill-hole, were seen small globules of crude or residual oil. A drill-hole was put down 8 ft., within 4 ft. of this oil-showing hole, and yielded nothing at all, though, if the occurrence had not been faked, the water seepage would have shown traces of oil. Mention is also made of the fact that the first sample taken to the Mines Department consisted of sand saturated with refined kerosene—"Nuff said."

Tasmania has been excited more or less by a discovery of osmiridium, and a company has been floated in Melbourne, Victoria. There have been two or three good discoveries, all in the Waratah district, but the people who expect great things as a result, are probably doomed to disappointment, as the *Australian Mining Standard* says not much need be expected of an industrial metal that is mined in ounces. It is claimed, by the way, that one of the nuggets unearthed by one of the successful prospectors weighs 2 oz., and that it is considered the largest specimen in the world. In one case, the alluvial, in which the metal occurs, has been traced to a large iron outcrop, and it is believed by the prospector that this is the source. Some interest is also being taken in a new nickel-copper field in the Zeehan district, which is being examined by two of the Broken Hill (New South Wales) companies. The result of their operations has not been made public, but from what can be heard it has not been entirely satisfactory.

Tasmania has yet another chance of achieving fame in the production of a mineral of which that island has not yet produced any great quantities, the state's assistant government geologist, Mr. Hills, having reported that the Previenna field contains 5,000,000 tons of coal of excellent quality available for mining. He recommends the construction of a tramway for getting to the railway the coal and timber, of which there is a considerable quantity. Much satisfaction is felt from the fact that the independent report upon the disaster at the North Mt. Lyell mines, last year, when 43 men lost their lives, has resulted in the complete exoneration of the Mt. Lyell company. The examination was made by Alexander Montgomery, the state mining engineer of Western Australia, at the request of the Tasmanian government. He finds that the disaster was abnormal, and could not have been foreseen or prevented. Mr. Montgomery is of the opinion that, even if there had been a second exit from the mine, there might have been no less loss of life. As a result of the accident, the Mt. Lyell company lost $182,000 on its operations during the six-month period, and the usual dividend was accordingly not paid.

The Victorian daily press has been making a great outcry about the great injury done to agricultural areas, pastoral areas, and scenic areas by what it sees fit to describe as 'the devastating dredge.' In consequence of its efforts, a commission has been appointed to inquire into the damage done by gold-dredging operations in the rivers of the state. The inquiry has shown that the industry has a much greater amount of public support than the Melbourne papers had supposed. At Bright, for instance, a town which was supposed to have suffered severely, a public meeting carried resolutions protesting against the unfair and biased statements that had been made, and declared that the stopping of the industry would cause heavy loss to the residents of the district. The report of the commission will be awaited with interest.

NEW YORK

COPPER MARKET—THE MEXICAN SITUATION AND THE NATIONAL RAILWAYS OF MEXICO REPORT—TONOPAH AND COBALT STOCKS

Resumption of the buying of copper was a leading feature of the New York market during the week ended July 19. The nominal quotation for the metal continued shrinking until, on July 15, large purchases for export shipment were made on the basis of 14¾c., and the bookings during the remainder of the week are estimated at over 50,000,000 lb. The sales were so heavy on July 16 and 17 that producers advanced the price to 14⅞c. and the week closed with it firm at that figure. Domestic buyers began to come into the market at the end of the week, and it may be expected that the price of copper will continue to advance for the time being at least. The European sales were for August-September delivery, but the domestic buying is for August delivery. Exports of copper for the first 17 days of July were approximately 34,500,000 lb., which is taken to indicate that the total for the month will reach 62,000,000 lb. The foreign statistics on July 15 showed a decrease in the European metal stocks for the first half of the month. Stocks in England, France, and afloat were given as 29,358 tons, an increase of 1186, but the stocks at Rotterdam, Hamburg, and Bremen decreased 2109 tons, to 7944. The London market is reported as strong, and sellers in the country predict that the price of copper will advance to 15c. within a few days.

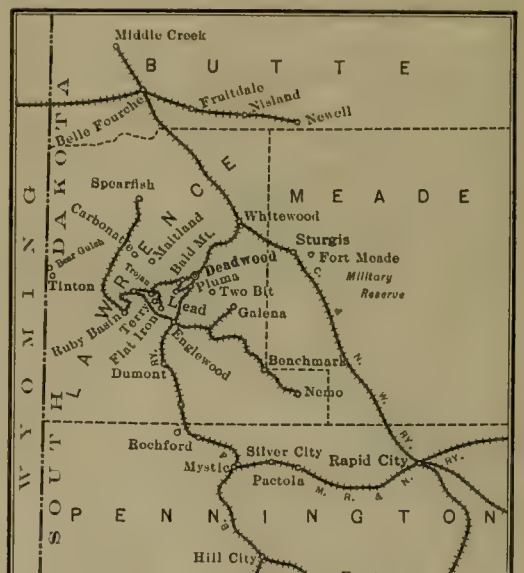
The greatest topic of public interest has been the Mexican situation. Undoubtedly it is bad, everybody has known that for a long while, but there is some doubt as to whether recent developments have or have not been engineered in order to force the hand of the Wilson administration. H. L. Wilson, the ambassador, has been instructed to proceed to Washington for a conference with Mr. Bryan, who has unwillingly temporarily abandoned the Chautauqua platform for that purpose, and by the time this is in print some vigorous action may have been taken. There is in many quarters the feeling that, following the representations made by the European nations at Washington, the Wilson administration must either offer to let them take any action they desire in Mexico, or else intervene to secure order and protect foreign lives and property. The administration obviously planned to put the Mexican question in cold storage for the summer, but it seems to have melted all the ice. Just what happened is difficult to learn, but it is reported that Germany demanded protection for her citizens in Mexico and for their property, on the ground that the Monroe Doctrine precludes the intervention of Germany to secure their protection. It is stated that similar requests have been or will be made by other European powers. British investments in Mexico are estimated at $320,000,000 in value, while French interests have $140,000,000, and the United States over a billion dollars worth of property. E. N. Brown has definitely resigned as president of the National Railways of Mexico, stating that Governmental interference in the management of the railway made it impossible to attain success under present conditions. The gross earnings of the system for the year ended June 30 show a shrinkage of 10% as compared with the preceding year. The total net income is expected to be about $22,400,000, which, after providing for fixed charges and reserve funds, will leave a deficit of $214,000. Considering that nearly half the system has been shut down for over half of the year, the showing is not as bad as it might have been expected to be. It is expected that a number of other American officials will follow Mr. Brown's lead in resigning.

On the Curb market, Tonopah and Cobalt shares continue to be the focus of interest. By the aid of strenuous boosting Tonopah North Star has been advanced from 17c. to nearly $1.10 per share, and a number of other minor Tonopah issues have profited by its advance. The most active Cobalt stock is Canadian Gold & Silver Mining, a property which is well situated and is said to exhibit promise in the development in progress. This property has the backing of Catlin & Powell, but Tonopah North Star enjoys no such evidence of respectability. Alaska Gold Mines is reported to be about to depart from the Curb to the 'Big Board,' a change which it has already made in Boston. Alaska shares recently advanced to 18½, or, more accurately, declined, since the half-paid certificates sold at nearly the same quotation some time ago. The La Rose recently gave out its half-yearly report, which shows gross earnings of $811,588, net earnings $476,968, and dividends of $396,010. During June 233,724 oz. of silver was produced. The Cobalt Lake has declared a dividend of 2½c. per share payable August 15. The Peterson Lake has declared its fourth dividend, payable on the same date, of 10c. per share. The Crown Reserve will also pay its regular monthly dividend of 5c. Speculation is rife as to what the dividend declaration of Buffalo Mines will be, and whether Temiskaming will pay a midsummer dividend following its meeting, July 26. June production at the McKinley-Darragh was 185,182 oz., which shows a decline from last year's rate.

DEADWOOD, SOUTH DAKOTA

VALUATION AND TAXATION OF BLACK HILLS MINES.—OPENING TITANIC AND ELLIPTIC MINES.—HOMESTAKE EQUIPMENT AND DIVIDENDS.—LEASING AT THE GOLDEN REWARD, MINERVA AND IRONSIDES.—WASP NO. 2.

Taxation of mining properties has been a matter which has recently claimed the attention of Black Hills operators, since a decision was arrived at to place the valuation at a figure more nearly the actual worth. In the past, the rule in this section has been to make the valuation at a



BLACK HILLS MINING DISTRICT.

figure greatly below the actual worth, but a state tax commission, created by the last legislature, has ordered large increases. The assessed valuation of the Homestake, typical of Black Hills properties, has been increased three-fold, and many items not previously listed have been added. For instance, bullion on hand on July 1 was listed at $125,000. Other properties have been increased in like proportion, and in some instances non-productive property has been valued at an almost exorbitant figure. It is promised that the tax levy will be reduced far below former figures, so that the gross taxes paid will be about the same as formerly; but, as is the case every time a radical change is made in a system of taxation, and an earnest effort is made to ascertain the true value of taxable property, much dissatisfaction is expressed.

Cleaning out the old single-compartment shaft, enlarging it to two compartments and timbering with substantial square sets, is going rapidly forward at the Titanic in the

Carbonate district. The old shaft is a little over 100 ft. deep, and is repaired and enlarged nearly to the bottom. In addition to sinking to the 300-ft. point, the company will cross-cut from each 100-ft. level. The work is being done on the Carbonate claim of the Iron Hill company, about 200 ft. west of and 50 ft. lower than the mouth of the Iron Hill shaft. From the latter shaft, during former operations, an immense quantity of ore was extracted. The work now being carried forward by the Titanic company is destined to explore a virgin territory along the main ore making fault of the camp. A commodious shaft-house has been erected, and arrangements made for the installation of a hoisting engine as soon as it is needed.

At the Elliptic property, men under the management of F. S. Stratton have unwatered the 700-ft. shaft and installed a diamond-drill at the bottom. Former drilling is stated to have exposed a body of remarkably rich free gold ore at a depth of 600 ft. below the shaft bottom. Mr. Stratton and associates are seeking confirmation of these results, and should they be able to open anything similar, will continue the shaft and develop the property thoroughly. A great deal of interest attaches to this work, as it is in a country outside of the recognized productive district, and success will mean the stimulation of prospecting over a wide territory.

The Hill City Mining & Development Co. is working energetically on its property in the Hill City district, and is securing results of a highly encouraging nature. The ore is largely free milling, and from present indications is of large extent. It is planned to erect a mill at an early date.

Differences among the stockholders have been adjusted and the following directors elected by the Cumberland company at Hill City: F. C. Crocker, president; Jackson Crocker, vice-president; J. W. Fowler, Jr., secretary-treasurer; Alex Madill and F. L. Livingston. The warring interests have had a long siege in the courts, but now that peace again reigns it is proposed to resume work. The property has in the past been a heavy producer, and is equipped with hoist, compressor and a small stamp-mill.

Twenty stamps have been added to the Homestake equipment, making a total of 1020 stamps now dropping at this great property. Production is up to the normal, and for the first half of the present year, from January to June inclusive, $936,000 has been paid in dividends. The present monthly dividend, since the increase in capitalization, is $163,254. In common with all securities on the New York exchange, Homestake has settled to a point where it is an attractive investment, and local parties are buying when they can get the stock around $100 a share.

W. T. Boley is making an examination of the Republic property in Blacktail gulch, and will outline plans for future work. During last winter and spring considerable development was done, but operations were suspended in April. Officials of the company, residents of Chicago, are at the property. It is reported that Mr. Boley will have charge of work upon resumption. The property contains several good shoots of ore, and a mill is among the possibilities of the near future.

The leasing system is proving successful at the Golden Reward, where it has been followed for upwards of a year. There are at the present time 44 lessees at work at various points, and a large proportion of the mill supply is produced by them. Some of the leases are yielding smelting grades of ore as well, and the work is responsible for prosperity in the Bald mountain district almost equal to the boom days of the camp.

Peterson & Co., leasing on the Minerva in Blacktail gulch, are getting encouraging results, and are preparing for a mill run. The Esmerelda mill has been secured, and may be repaired for their use. The property is in the conglomerate belt, and the present tunnel is following a course destined to intercept, should it continue, a shoot that produced some fabulously rich ore some years ago.

Lessees at the Ironsides, in Squaw creek, are getting out high-grade smelting ore, and as soon as the wagon road to Maurice station, on the Burlington, is repaired, shipments will commence. The ore is the richest sylvanite ever found in the Black Hills. The property laid idle for over 10 years. The present lessees have been working about three months. Their work is being confined to drifting and cross-cutting 15 ft. below extensive lateral workings opened by the former operators. This is an illustration of how easy it is in mining to miss a good thing by a narrow margin.

Owners of the Rattlesnake Jack mine, in the Galena district, have purchased the Saginaw mill at Custer, and will move it to the property and equip it with a cyanide department. The plant contains 20 stamps, and is practically new and up-to-date.

Wasp No. 2 continues to yield dividends, the disbursement made on July 14 being at the rate of one cent per share. A system of belt conveyors will be installed under the tanks for removing the tailing, thus doing away with hand tramming, and also reducing the time consumed in dumping.

BRITISH COLUMBIA

RESULTS OF THE FIRST HALF OF 1913.—OPERATIONS OF MINES IN THE EAST AND WEST KOOTENAY, ROSSLAND, BOUNDARY, SIMILKAMEEN, AND COAST DISTRICTS DETAILED.

Metal mining in the East Kootenay district is still restricted almost altogether to the Sullivan group of mines, operated by the Consolidated Mining & Smelting Co., which has sent from here to its smelter at Trail, during six months to July 1, between 17,000 and 18,000 tons of lead ore. A few hundred tons have been sent from the same Company's St. Eugene mine, but there has been no other ore production in the main part of this district. Coal mining has continued generally active, and in the extreme southeastern part, in the Flathead country, drilling for oil is in progress.

In the Ainsworth division of West Kootenay the Bluebell has shipped to Trail about 4000 tons of lead concentrate this year, and No. 1, Silver Hoard, and Utica have been smaller shippers. Other operators were the Florence company, on Woodberry creek, and Retallack & Co. at Whitewater. In Slocan, the Lucky Jim has shipped zinc ore, while silver-lead has been sent out by the Rambler-Cariboo, Standard, and Van-Roi in considerable quantity, and by several others in much smaller lots. Work has been continued on the Payne, developing at depth, and the Ruth-Hope, Richmond-Eureka, and Slocan Star, all near Sandon, continue to be active, with the last mentioned now in good ore and making preparations for a resumption of shipping after a long period of non-productiveness. About Cody, the more important operations are those of the Noble Five company and on the Surprise. In the vicinity of Alamo, the Idaho-Alamo group is shaping well for resuming production, while mines tributary to Slocan lake, additional to the Standard and Van-Roi already mentioned, are the Hewitt-Lorna Doone group of the Silverton Mines, Ltd., the L. H. being developed by the British Columbia Copper Co., the Ottawa by the Consolidated company, and several others. About Nelson, the Queen Victoria is shipping to Greenwood, the Eureka and Silver King group are being developed, the Molly Gibson will soon be again sending out ore, and the Granite-Poorman soon be crushing gold ore. In Ymir camp, the Yankee Girl has shipped about 3000 tons of gold-silver ore during the half-year, while development at both the Wilcox and Dundee is reported to have opened good ore. About Salmo, the Emerald and H. B., both lead mines, have been shippers, and in Sheep Creek camp, the Queen in larger and the Motherlode in smaller quantity, have been mining gold ore. At Erie camp, the Arlington and Second Relief have also mined gold ore. In Lardeau district the Ajax and Silver Cup group have been worked this season, but there has been little production from other district properties. The only other mining camp in West Kootenay calling for mention is Rossland.

Aggregate figures from Rossland show an ore production of about 121,000 tons for the first half of 1913, in the following approximate proportions: Centre Star-War Eagle group, 72,000 tons; Le Roi, 29,000 tons; Le Roi No. 2, 10,800 tons first-grade shipped crude, and 9000 tons second-grade

concentrated; and small shippers, 200 tons. A small power-plant is being put in by the Richmond Consolidated Co. There is a general feeling of confident expectation, in the town, of long-continued and profitable production from local mines. Allowing for June an average of the five months ended May 31 in quantity of ore smelted at the Consolidated Mining & Smelting Co.'s works at Trail and gross value of metals contained in same, the figures for the half year are as follows: Approximate quantity of ore and concentrate smelted, 162,000 tons; gross value, $4,232,000. The figures for the whole of the last fiscal year were: Ore and concentrate treated, 296,458 tons; gross value of metal contents, $5,083,078. The monthly average for the expired part of the current year is higher by about 2300 tons of ore and nearly $282,000 in value of metals. Additions to buildings and plant are being made at these smelting works.

The aggregate of production from Boundary mines during the six months has been about 910,000 tons of ore, smelted at

MINING DISTRICTS IN BRITISH COLUMBIA.

the Granby and British Columbia Copper Co.'s works. Of this total, 612,000 tons was from the Granby company's mines and 291,000 tons from those of the British Columbia Copper Co. The No. 7 mine shipped 3600 tons to Trail and the Jewel crushed about half that quantity at its own stamp-mill. The remainder was contributed by several small shippers. In addition, some 30,000 tons from United States mines was received at district smelting works. The British Columbia Copper Co. is preparing to concentrate ore from its Lone Star mine.

The Hedley Gold Mining Co.'s production at Similkameen for the first half of 1913 shows a proportionately nearly similar quantity of ore crushed in its 40-stamp mill to that of last year. The actual figures for five months, to June 1, are 29,180 tons crushed, yielding gold valued at $377,483. The average monthly tonnage is, therefore, 5836 tons crushed, as compared with an average of 5872 tons per month throughout 1912. In recovered value, though, there has been an increase of between 15 and 16%, an average of $12.94 per ton, as compared with $11.19 last year. In his last annual report, to December 31, 1912, the Company's general superintendent stated that the minimum quantity of reserve ore, as shown by development and diamond-drill, was 413,000 tons, and that this ore will average at least $11.35 per ton. It will be seen that the recovered value during five months of this year has been $1.59 per ton higher than that general estimate. The New York Syndicate No. 2, comprising men largely interested in the Hedley company, is holding, under option of purchase, a group of mineral claims in the vicinity of the Nickel Plate group, and is prospecting these by diamond-drill, under the direction of T. Walter Beam, of Denver, Colorado. The British Columbia Copper Co. is continuing its exploration of several groups of claims on Copper mountain, 12 miles from Princeton, having five diamond-drills at work and doing underground development as well, with encouraging results thus far. Summit, which is the headwaters of Tulameen river, is attracting much attention, and there are some good showings of ore opened. This town has been called Leadville by a 'mining-on-paper' man, but is not officially recognized by that name.

Little information is made public now concerning the Britannia copper mine, near Howe sound, but at last advices it was being operated at full present capacity with non-union men, notwithstanding the published mis-statements of union sympathizers to the contrary. The Consolidated Mining & Smelting Co. has bonded some claims in the vicinity of the Britannia and commenced development work on them. The Tacoma Steel Co. continues to work its Marble Bay gold-copper mine on Texada island. The Surf Inlet Gold mines has done a lot of development work on Princess Royal island. Endeavors have been made to interest men with capital in copper claims on Moresby island of the Queen Charlotte group. Prospecting for coal and drilling for oil on Graham island of that group has been continued. In Hazelton district of the Skeena river country, a commencement has been made to ship silver-lead ore in quantity, ten cars having been sent out by the Silver Standard consigned to Trail, while two or three other properties are being prepared for shipping on a commercial basis. Placer-gold mining at Omineca, to the eastward, is attracting attention, as is also coal in the Groundhog district, to the northward.

PORCUPINE

DOME MILL EXTENSION.—THE JUPITER MINE.—KIRKLAND LAKE DISTRICT PROSPECTS.

At a meeting of the directors of the Dome Mines Co. held in New York last month, it was decided not to issue any part of the new capital for the purpose of making additions to the mill. They also decided to install only 40 additional stamps instead of 60 as was first reported, while some changes will be made in the treatment. The present mill is an all-sliming plant, the product being treated in Pachuca vats and Merrill filters. In the proposed addition, sand leaching will be used, and it is believed that the present slime plant will be sufficient to handle all of the product from the enlarged mill.

At the annual meeting of the Jupiter company, held at Montreal on June 26, it was shown that the Drummonds, at Montreal, had paid $300 cash and 50,000 shares for the property. In addition, there has been expended a total of $203,157, distributed as follows: development, $175,482; buildings, $9042; plant and equipment, $18,633. The balance-sheet shows $40,841 cash on hand and 157,214 unissued shares in the treasury, which will be issued to meet the cost of a new mill. Development to date has been satisfactory, and on the 300-ft. level of the main vein there is an ore-shoot 300 ft. long, which is expected to yield about $15 per ton. At the present time no work is being done on the other veins where the ore-shoots are smaller and the gold content more erratic.

The new gold discovery at Kirkland Lake continues to excite considerable interest, but so far very little work has been done on the various properties. The Foster, which is the pioneer mine of the district, is confining its attention to No. 2 vein, from which several shipments of ore assaying about $500 per ton have been made. A five-stamp mill is in operation, and good results are being obtained. Shipments of high-grade ore have paid for all expenditure to date. The shaft is down about 175 ft., but with the exception of a small open cut, about 75 ft. long on the surface, no lateral development has been done. The shoot will average about nine feet in width, and assays from $400 to $500 per ton, and it is stated that the country rock is profitable for a few feet on each side of the vein. Several other veins have been found on this property, but so far no work of any importance has been done,

General Mining News

ALASKA

The Koyukuk-Chandalar region, which includes the drainage basin of upper Koyukuk river and the Chandalar river, both tributary to the Yukon from the north, has been recently described by A. G. Maddren in Bulletin 532 of the U. S. Geological Survey. The winters are long and severe, while the summers, from May to the middle of September, average 55°F. There is a good deal of timber growing, a fair amount of animal life, and the population of whites and natives is about 820. The district is reached by the Koyukuk river, but is difficult of access. The most widely distributed bedrock of the region is a series of metamorphosed sediments, including some altered igneous rocks. The valleys are largely covered by boulders, cobbles, gravels, and silts left behind by melting glaciers. Placer gold was found in 1899, and the yield to the end of 1912 is about $2,700,000, the latter year producing $200,000. Some underground mining is done. Methods of moving gravel on the surface are by shoveling, sluicing, hydraulicking, scraping by horse or steam, steam-shovels, derricking, and dredging.

Cordova

Telegraphic advices from Cordova state that there is great excitement there and throughout the Copper River valley over the placer gold discovery on Shushanna creek,

MAP OF ALASKA.

a tributary of White river, and hundreds of persons are stampeding to the new diggings. Two prospectors who recently arrived at McCarthy to get supplies reported pans running from 75c. to $7 at bedrock on Bonanza and Eldorado creeks, and other streams that empty into Shushanna creek. Axel Walstrom, on Claim No. 6, Bonanza, states that his pans run from $4 to $5.

Nome

The shortage of water on this part of Seward Peninsula is serious, being only about 25% of that of last season, and the output of gold for the year may be appreciably reduced from the amount produced in recent years. In addition to this drawback, the frost last winter penetrated so deeply into the ground that it is thawing slowly, and this delays the progress of the dredges. This latter condition prevails in all parts of the peninsula. The Pioneer Mining Co. is only employing about 100 men. The Seward company is hydraulicking at the mouth of Shovel creek. All the dredges on this creek are operating.

Valdez

At the Gold King mine, rich ore has been opened, and the stamp-mill is nearly completed. Charles Crawford is superintendent.

ARIZONA

Cochise County

Gas has been troublesome in sections of the Copper Queen mine, especially on July 13. Great credit is due to Messrs. Hughes, Finnity, Sherman, and Moon, and others, who investigated the trouble and helped in rescue work. A pulmotor helmet was used.

Investigations into the gas trouble at the Holbrook shaft, of the Copper Queen, on July 13, have shown that the gas came from the old fire area of several years ago. Bulkheading has now shut off the flow, and a chum-drill is boring to open the gas pocket, and give it an escape to the surface. The new Nordberg compressor was installed in 20 days, and is working without trouble. The Sacramento shaft hoist is also in commission. On the hill south of the Lowell shaft, the new air-equalizing system is ready for installation, and will be of great benefit to the Copper Queen equipment. The slag dump at the old smelter has been almost re-treated.

Gila County

A group of copper claims in the Christmas district, partly in this and Pinal county, have been bonded for $1,000,000 to the Gila Copper Sulphide Co. B. P. Cheney, of Boston, is president, and Leo B. Mulhearn, assistant secretary of the Company. Rich gold-bearing ore has been opened in the claims of Claude Battallieur, in Powers' gulch, 16 miles from Globe.

The Inspiration Consolidated Copper Co. has ordered an electric hoist from the General Electric Co., capable of hoisting 10,000 tons in 14 hours from 630 ft. depth. It will be of the Ward-Leonard control type, and automatic in action. Thirteen air-locomotives for underground haulage have been ordered from the H. K. Porter company. Other contracts will be let as soon as possible. At the Copper Reef mine, 13 miles south of San Carlos, the main cross-cut adit is in 1400 ft., while the California drift has been driven 1000 ft., all faces being in ore. The winze is down 250 ft. from the adit. Fifteen tons of ore has been sent to Globe to be smelted in an electric furnace being tested there.

Greenlee County

The Detroit Copper Co. will shortly blow-in the new furnace. A large number of men are at work preparing for the start, construction work being carried on day and night. E. W. Honeyman is in charge of the reduction works.

Pima County

The zinc mines of the Spokane-Arizona company are regarded as promising. Extensive deposits, assaying as high as 40%, were opened recently and reports of competent engineers who have examined the ground state that the veins of the Mohawk silver mine, owned by the Lewisohns of New York, dip into the ground. The main adit of the Mohawk, reopened since the ore was cut in the Spokane-Arizona, is now within 200 ft. of the end boundary.

As the result of 2000 ft. of development work at the Arizona-Belmont, substantial ore reserves have already been proved and plans are under consideration for erecting a 200-ton mill. The 500 and 600-ft. levels are reported to show higher grade ore than the upper workings. On the 600-ft. level the vein has widened to over 10 ft., carrying $16 ore. It is stated that mining and reduction costs will average only $2 to $2.50 per ton. The ore contains between 10 and 15% lead with 8 oz. silver per ton. Tonopah people are interested in this property.

Yavapai County

The Swansea Consolidated Co. has let a contract to sink No. 6 shaft a further 1000 ft. This is where the highest grade of copper sulphide ores were proved some months ago. George Mitchell, president of the old company, has taken over the Boise & Swansea railway. Ore from the Humboldt Consolidated Co.'s mine will be sent to the El Paso smelter instead of the Needles plant.

Yuma County

(Special Correspondence.)—At the old Hedges mine, there is great activity, and the work of treating ore has begun. Fifty of the old stamps have been removed, and a new tube-mill, which will handle 150 tons of ore per day, has been installed. A large sum of money has been spent on the pipe-line and pumping plant. More than 100 men are employed. Work is being done on all the levels

of the old workings, and it is confidently believed by all concerned that the property is again on a permanent working basis. Preparations for the immediate working of the American Girl mine is shown by 14 cars of machinery standing on the side of the railroad waiting to be hauled by wagon to the mine.

Ogilby, July 17.

The big lime deposit in the Gila mountains, located by H. H. McPhaul, has been inspected. It covers six claims and analyses return 80 to 95% lime.

CALIFORNIA

Amador County

At Volcano, rich gravel has been opened by Grillo Bros., and there is much local interest. It is said that daily yields have been as high as $300 since the beginning of July.

Butte County

The Sky High mine, owned by G. W. Braden and Gordon Graham, of Oroville, has produced more gold this season than in previous seasons.

Eldorado County

The famous Blue Rock mine at Georgia Slide, which has been worked continuously for nearly 60 years, has been leased by five young men of Georgetown and Georgia Slide, namely, Leo and Thomas Flynn, Henry Miller, Peter Morgan, and Thomas Armstrong.

Mono County

The Rough Creek district, which was the scene of a boom during the eighties, is again causing excitement, ore averaging $17 per ton having been opened for a considerable distance, between Bodie and Masonic. Claims have been staked over a large area.

Nevada County

A large air-compressor has been ordered for the Golden Center of Grass Valley mine. The shaft and drifts, which were abandoned forty years ago, have been pumped out and work of cutting chutes and ore-bins is now progressing. The Truckee River General Electric Co., which has hydro-electric power-plants near Boca, and supplies power to several mining districts in Nevada, reports that Lake Tahoe is very low, and there is only 1.4 ft. to furnish water during the summer.

The North Star company paid its second quarterly dividend for the current year on June 28. This amounted to $75,000, making a total of $3,936,989 to date.

San Benito County

The production of quicksilver in this county was 9754 flasks, valued at $410,156, in 1912, against 9809 flasks, valued at $451,312, in 1911, and 10,804 flasks, valued at $502,494, in 1910, according to the U. S. Geological Survey. The New Idria treated 76,348 short tons of ore, and the furnaces were operated during most of the year. A good deal of development was done in the mine, and good shoots of ore were opened.

Santa Clara County

The quicksilver production of this county in 1912 was 8695 flasks, valued at $365,625, against 7533 flasks, valued at $346,593, in 1911, and 4038 flasks, valued at $187,807, in 1910. Both the New Almaden and Guadalupe mines made large outputs. The latter has two oil-fired fine-ore and two coarse-ore furnaces.

Shasta County

Zinc ore will be shipped to Utah from the Donkey and Baker mines at Ingot, it being carried by auto-truck from the mines to railroad cars.

On July 14 the 275-ft. brick stack at the Balaklala Copper Co.'s smelter at Coram was demolished. This stack cost $34,700, and since the smelter was shut down on account of fume litigation, has shown signs of weakness. Ninety-two holes, each charged with three sticks of dynamite, were drilled on the northwest side, but instead of falling in that direction it simply collapsed about the base. The charge was set off by electricity. H. F. Wierum, of the Tennessee Copper Co., Tennessee, is at Coram making investigations into the fume trouble. The Hall process is to be tried on one or two full-size roasting furnaces. There are at present 27 men employed by the Balaklala Copper Co., and the plant is being overhauled.

The Balaklala Copper Co. let a contract on July 19 for a brick smokestack, to replace the one razed recently by

BALAKLALA COPPER SMELTER.

reason of its dangerous condition. The new smokestack will be 230 ft. high, 20 ft. less than the old one. The work will be done by Holt & Gregg, of Redding.

Since writing the above notes, the Balaklala has let a contract for erecting a building for installation of the Hall process of fume prevention. The aërial tram-line to the mine is being overhauled, and the locomotive is again in service. Thirty-six men are now employed.

Sierra County

Sacramento people have recently examined the Squires lode and placer claims, in Secret cañon, above Forest City. The property is a promising one, and lies in a slate-porphyry belt between the Alleghany serpentine and the Old Ironsides slate-diorite belt. The Kinselbach quartz claims are being developed by Gardner H. Smith, of Pasadena. They are situated in the eastern dike of serpentine, near Alleghany. Rich ore has been opened in a claim above Goodyears bar, on the North Yuba river. A good tonnage of $10 ore has been opened in the North Fork mine, at Forest City. It is proposed to buy the 10-stamp mill at the Rising Sun mine, on Kanaka creek. An expenditure of $25,000 is necessary to place the North Fork on a paying basis.

The well known Twenty-One mine has been bonded to W. F. Bradley and N. H. Nieldnum, of Blair, Nevada. The Red Ledge mine, owned by the Bank Mining & Promotion Co., is having a 4-stamp mill erected at Scott's Flat. J. B. Moulton is in charge. The Kate Hardy is opening well, and a 3-stamp mill is busy. At the High Commission, near Downieville, the vein is 14 ft. wide. The shoot is about 200 ft. long, and will average $4.50 per ton in free gold, exclusive of pyrite. After 25 years, the Hawkeye gravel channel, at Howland Flat, is being re-opened.

Siskiyou County

Good ore is being mined at the Cub Bear, the Highland is employing about 25 men, the Black Bear is being pumped out and electric power connected, and the old King Soloman, on the South Fork of Salmon river, is being re-opened.

Trinity County

(Special Correspondence.)—The new 20-stamp mill at the Bonanza King is practically completed, and 10 stamps are now dropping, while the remainder will be in operation within a few days. The new mill is built on the site of the old one, which, together with the assay office and part of the tramway, was carried away by a snowslide last winter. The ore at present being crushed is a remarkably free-milling quartz, the tailing assaying only 20c. per ton. It is the plan of the management to install four Wilfley tables, in the near future, to save the sulphides from a body of ore at present being developed. This concentrate assays about $40 gold and a little silver. An adit is at present being driven to cut the mineralized zone at a depth of 1000 ft., and the completion of this work and subsequent driving is confidently expected to open valuable orebodies. A winze is also being sunk from No. 3 level in ore.

Trinity Center, July 18.

TUOLUMNE COUNTY

(Special Correspondence.)—At the Hope, which is situated less than one mile east of Sonora, an adit is being driven from a low point to develop the vein. The property has been intermittently worked on a small scale, and by means of a shaft, for many years, some of the former operators taking out considerable gold. It was once equipped with a 10-stamp mill.

A payment has been made on the Chilano mine, situated near Tuttletown, by Clint Manley, who proposes to fully prove the merit of the property by more extensive and systematic development. Mr. Manley will personally direct work. A number of assays were recently made of ore from the Hazel Dell, being developed under bond by a company represented by J. M. Rich, the returns showing an average of $40 per ton. Preparations are in progress for the further development of the property by adits. Some rich ore has been uncovered in the Sonnet mine, in the Columbia district, the quartz showing a good deal of free gold. The property is being developed by Davis, Lane, and others.

The Springfield Tunnel & Development Co. is to install an auxiliary pumping plant of 1000-gal. capacity in the new shaft, to help the pump now in use. The vein at the Wheal Rough mine, near Soulsbyville, has been intersected by the cross-cut driven from the bottom of the new 100-ft. shaft, and is being further opened by driving. The vein is 12 in. wide and the assays show the ore to be high grade. Assays of ore from the Gold Cliff mine, near Tuolumne, show as high as $66.50 per ton, the vein varying from a few inches to 2 ft. wide.

Pure white marble of fine texture, and said to resemble and equal the finest Italian marble, has been discovered about five miles south of Tuolumne, by Z. C. Ferris. Several claims have been located.

It is reported that work will probably begin this summer on an electric-power project in this county that will cost approximately $2,000,000, the surveys for which were made several years ago. A wealthy electric company of this state is said to be promoting the project. According to report, water will be conveyed from immense storage reservoirs in the high mountains to a point in the vicinity of Groveland, where a large power-plant will be constructed.

Suit for damages in the sum of $50,000 has been brought against the Harvard Mining Co. by the heirs of the late Domingo Gonzales, who was killed July 5, 1912, by falling down the mine shaft. It is alleged in the complaint that the fatality was due to negligence on the part of the mining company, in that the shaft was not provided with any safety contrivance to prevent a fall to the bottom.

Sonora, July 15.

COLORADO

LAKE COUNTY (LEADVILLE)

A large tonnage of low-grade ore has been opened in the Vega section by the Yak company, and metal contents are improving. The monthly tonnage from the Yak tunnel by company and lessees is nearly 11,000 tons. The Stars Consolidated is producing about 4000 tons per month. Lessees at the Chrysolite, Uncle Sam tunnel, Gilt Edge, Little Jonny, White Quartz and others are busy.

At the Iron Mask mill, Red Cliff, a new roaster has been installed and the capacity of the separator has been increased, which permits the mill handling a much heavier tonnage per day.

OURAY COUNTY

In the Mountain Top cross-cut, which is in 2155 ft., the vein has opened out to 5-ft. width, averaging $8 per ton in gold and silver, and is improving.

SUMMIT COUNTY

The *Summit County Journal* says that the second clean-up for June gave returns of $30,975 shipped by the Colorado Gold Dredging Co., French Gulch Dredging Co., and the Reliance Gold Dredging Co.

TELLER COUNTY (CRIPPLE CREEK)

The Portland Gold Mining Co. has declared the usual 2c. dividend, which amounts to $60,000, and will be paid in August. At the Portland mill, another Chilean mill is being installed driven by a motor, and the transformer station is being enlarged. A washer has been installed at the C. K. & N. mine, on Beacon hill, and it is the intention of Mr. Rapp to go over the entire dump, save the fines and sort the rock. This is considered one of the richest dumps in the camp. During July, mines of the district will pay $161,800 in dividends. The Strong shaft is down 30 ft. in hard rock, and is to be sunk to 100 ft. before opening out.

IDAHO

IDAHO COUNTY

(Special Correspondence.)—Mrs. Parr is shipping ore from her mine to the custom plant. This ore is mined from the stope under the shoot from which the high-grade ore was taken in the original workings. The American Eagle is sinking below the 200-ft. level, and driving on that level, opening the orebody before starting the mill. Development is under the ground which contained the rich ore mined by A. W. Boyd a few years ago. Stanley Litchfield is still driving on the vein in his adit, and the ore 'pans' well. The South Fork company has found the vein lost last year, and is driving on ore. It is also mining ore in a raise under the rich shoot worked by Mr. Espey four years ago. Frank Peck, at Orogrande, is developing his Knob Hill mine. Joseph Larsen is opening ore in readiness for a mill-run. The Golden Rule placer mine is opening good gravel. Teideman, Brown, and Murphy are opening a rich gravel channel with giants, and it is reported by them that results are improving daily. The New York & Georgia claim of the Smith Bros. is opening well, and they hope that a deal now pending will be successful. The North State at Dixies, is being worked under Frank Hyde, who is mining high-grade ore on this well known property. Machinery is arriving for the new mill of the Majestic. At Ramey ridge, across the Salmon, several properties are opening some soft porphyritic ore which assays over $19 per ton. Many prospectors are developing their claims in the hills. Walter Hill, assisted by James Frembeth, Charles Thompson, and R. Kemp Welch, is working the old Lacile placer, taking out some good gold in large nuggets. They are operating by drifts under the upper bench of Salmon river. Several others are also working placers in that old locality.

Elk City, July 6.

MICHIGAN

HOUGHTON COUNTY

Telegraph advice from Houghton states that the copper mines are shut down on account of a strike called by the Western Federation of Miners. One of the deputies sworn in has been killed. The monthly production of copper from this district is approximately 20,000,000 pounds.

MONTANA

SILVERBOW COUNTY

The results for the last ten days of June of the Butte & Superior mill again showed an improvement over anything previously recorded. During this period the company treated an average of 588 tons per day, with a recovery of 92.69%, the concentrate averaging 49.09% of zinc. For the entire month the company produced 6,713,881 lb., with an average recovery of 90.25%, and with concentrates averaging 49.10%. Considering that it was only three months ago that the recovery was less than 80%, and that the concentrate was running less than 46%, this performance is gratifying.

Troubles at the Bullwacker and Butte-Duluth leaching plants include the tailing, which cannot be washed clean without getting a lot of dilute solution, which is difficult to handle. Only 80% of the dissolved copper is recovered. It is suggested that the wash-water be run over scrap iron, but this is not practicable, as the free acid would eat the iron.

NEVADA

HUMBOLDT COUNTY

Ore production of Rochester to date totals 100 carloads, valued at $130,000. In a winze, below the adit level, the

Big Four lease has opened 2 ft. of ore averaging $45 per ton, while 3 ft. assays 919 oz. silver and $8 gold per ton. A railway has been constructed from Nenzel to the mouth of Limerick cañon, where it connects with the ore road previously made to the mines. The Rochester Hills Mining Co. intends to produce 200 tons of ore per day from now on. A double-drum electric hoist and 7-drill air-compressor has been ordered by A. A. Codd, the president.

Nye County

The Nevada-California Power Co., according to the *Tonopah Miner*, has taken every precaution possible to prevent the interruption of its power service through damage by electrical storms, which have in the past frequently caused a shut-off of power supply for hours and even days at a time.

Recently there was installed at the sub-station at Tonopah four new outside Westinghouse transformers, each of these having a capacity of 500 kw., with a special type of outdoor lightning arresters. One of these transformers will be kept in reserve, and the plant now has seven inside transformers and four outside, making the total capacity of the station 5000 kw. All oil-brake switches on the high-tension line have also been abandoned, and the latest type of safety brakes have been installed. The entire installation has cost $30,000. The Company is now delivering an average of 4300 hp. every 24 hours to the mines of the district.

The Kirchen-Schwab interests have acquired the Tonopah Extension Mining Co.'s stock owned by A. D. Parker, of the Florence Goldfield Mining Co. It is probable that the Extension mill will be increased to 300-ton capacity.

The new ore-shoot on the 1170-ft. level of the Merger has been opened in the west drift for 60 ft., showing 10 ft. of $56 to $85 ore, while a 15-in. streak on the hanging wall is very rich. Shipments amount to 50 tons per day. The West End made $35,015 profit in June. The Tonopah Mining Co. also made a profit of $89,127 from the treatment of 14,576 tons of ore.

White Pine County

The new manager for the Consolidated Coppermines Co., Edwin F. Gray, has arrived at Ely and is examining the properties. He was formerly with the Nevada Consolidated Copper Co. At present there is a contract with the Steptoe plant to treat Giroux ores, but a plant for the former company is most desirable.

John D. Tilford, who discovered the Bonita tungsten deposits on Snake creek, has arranged to install a 2-stamp mill and concentrating tables. The ore on dumps should produce two carloads of concentrate.

NEW MEXICO

Grant County

The application of the Chino Copper Co. for waters of the Lambrecht, or Lambright draw, has started a number of rumors concerning the intentions of the Company regarding water for use in its mill at Hurley. It is also stated that, if the request is granted, a large concrete dam will be constructed, to which certain people object.

UTAH

Juab County

The first cyanide plant to be erected in the Tintic district is now nearing completion and should be ready to go into commission within the next week. This plant has been constructed by Messrs. Griggs, Carter, and Castleton, and the first material to be treated will be several thousand tons of dump ore which has been purchased from the May Day company. The cyanide process is more or less experimental on Tintic ores, but good results are expected. Ore worth $35 per ton has been opened on the 500-ft. level of the Iron Blossom. This ore parallels the main vein formation. The Black Jack has been shut down for the present. Lessees are to work the old workings of the Opohongo mine. Miners at the Mammoth end of the Tintic district are asking for Sundays off.

Salt Lake County

A 6-in. pipe is being laid for the Utah Copper Co. at Bingham, to carry water from the Utah Metal Mining Co.'s tunnel. The pipe will be about five miles long.

Summit County

The Ontario mill is treating 150 tons of ore per day. The fume trouble is being investigated. The California Comstock shaft, in Thaynes cañon, is to be sunk 1000 ft. deeper.

BOLIVIA

The Arica to La Paz railway has reduced the established freight rate 50% on ores from the Corocora mining district consigned to Arica, and 50% on coal. The railroad company is considering the reduction of rates on petroleum. These reductions were the outcome of negotiations between the Bolivian government department of public works and the Company, according to the *Pan-American Union*.

CANADA

British Columbia

(Special Correspondence.)—Large benefits for Spokane operators engaged in the development of lead-silver and copper properties in the New Hazleton district of British Columbia are foreseen from the proposed erection of a smelter, the feasibility of which is being investigated by engineering representatives of English capitalists, according to a statement attributed to F. C. McKinnon. Paying $11.50 per ton for the transportation and treatment of their ore, the Spokane operators anticipate a cut of 50% on these charges with a smelter at hand. The English corporation has invested a large sum in the development of the Hudson Bay mine, on Hudson Bay mountain, 30 miles south of New Hazleton. Favorably impressed with the earnestness of the people, the Grand Trunk Pacific Railroad has sent engineers into the field to survey the route for a railroad to the property. The British Columbia Copper Co. will erect a mill at Boundary Falls to reduce the silver in the ore from the Lone Star and Washington mines, and in this way make a product more suitable for smelting with other ores of the district.

Spokane, July 20.

Walter J. Nicholls has closed a deal for four claims on North Star mountain, two miles north of the international boundary line in British Columbia and six miles northeast of the Idaho-Continental mine. Little development has been done on the properties, but the surface showings, together with the location, indicate that they may become valuable. Assays from outcroppings run 46.8% lead and 11.8 oz. in silver. The Granby smelter treated 44,658 tons of ore during the first two weeks of July, and shipped 610,000 lb. of copper. As a result of opening ore in the lower adit of the Ymir-Wilcox mine, 800 ft. of stoping ground has been added to the mine.

At the Hidden Creek mine of the Granby company, a large underground ore-storage and crusher station is to be arranged. On each level above this are to be bins, of a total of 10,000 tons capacity, while with those below the station the total capacity will be 16,000 tons. The crusher is to be of 200 tons per hour capacity, and from the crushed-ore bins below, the ore will be loaded into cars and taken to the smelter by way of the main working adit. On July 1, there were 1125 men on the payroll. A brick-making plant is being erected, and a machine-shop for all construction and future repairs. Steel for the furnaces and converter building is on the property. A hotel of 40 rooms is now open, and a hospital and recreation hall are being built. A model town is being laid out, with all conveniences.

The Standard Silver-Lead Mining Co., operating the Standard mine near Silverton, is earning $8000 per month in excess of the $50,000 dividend per month, which is at the rate of 24c. per share per year.

Ontario

During the week ended July 12, the Crown Reserve, Dominion Reduction, and Nipissing mines shipped 43,575, 59,943, and 139,492 oz. of silver, respectively. At the bottom of the winze, 40 ft. below the 575-ft. level of the Temiskaming mine, 6 in. of rich ore has been opened in the diabase. The veins in the diabase are not extensions

of those in the Keewatin formation above. On the 650-ft. level, good ore is being mined. During the four weeks ended June 17, the Hollinger reports the following results: The winze being sunk below the 300-ft. level, is down 74 ft. in ore. No. 7 vein is 30 in. wide, worth $16 per ton on that level.

Ore treated, tons	11,867
Average value per ton	$16.50
Extraction, per cent	95
Profit	$124,015

KOREA

(Special Correspondence.)—The June clean-up at the Oriental Consolidated mills was valued at $143,500. Details of the May output are as follows:

Ore treated, tons	26,107
Tabowie mill bullion	$ 36,399
Taracol mill bullion	28,479
Kuk San Dong mill bullion	4,815
Maibong mill bullion	22,798
Taracol tube-mill bullion	54,975
Kuk San Dong cyanide plant bullion	3,800
Kuk San Dong plant bullion	7,767
Total	$159,033

The Candlestick mill and cyanide plant was closed down during the month owing to lack of labor in the mine, but the plants are now running. The actual extraction obtained in the Taracol tube-mill plant was 86%. An improvement is being made in classification and grinding, and experimenting is being done as to the advisability of installing another agitator, in order to lengthen the treatment. At the Charabowie mine part of the water running into the mine from the river bed cracks has been stopped, and the work is being continued in the river bed, where it is hoped to shut off still more water. There has been no rain during the past 29 days, and everything is very dry. The power-plant furnishes lights only, and water for the mill has to be pumped.

MEXICO

Chihuahua

During May the Buena Tierra shipped 3700 tons of lead ore to the smelters, which returned $24,400 net.

Sonora

During May, operations of the Dolores mine resulted as follows:

Total revenue	₱60,242
Mining cost	16,337
Milling	19,692
Realization	5,115
General	3,283
Net profit	15,815

(Special Correspondence.)—The Democrata mine of Cananea was the scene of another rich find recently, when ore

PART OF SONORA.

averaging 7.5% copper and 5 oz. silver was discovered on the 200-ft. level. Up to the present 45 ft. of the ore has been penetrated which averages the foregoing value. A cross-cut was begun a week ago and is still working in the ore. The Company's smelter is operating with a 250-ton furnace at present.

Personal

Professional men are invited to send news of their engagements and travels. Such news is interesting to friends.

A. S. Dwight is in Utah.

R. L. Lloyd was in Virginia recently.

Ralph S. Rainsford is in San Francisco.

Jesse Simmons has returned from London.

John A. Church is at Great Falls, Montana.

F. D. Pagliuchi has returned to Los Angeles.

John H. Banks is in the West on professional business.

Gelasio Caetani has returned from northern California.

O. B. Hofstrand, of Wallace, Idaho, is in San Francisco.

Donald C. Catlin has returned to New York from Cobalt.

W. G. Rice, of the Superior & Boston company, is at Globe.

E. J. Valentine is on his way to England from the Malay states.

Edwin F. Gray is on his way back to Ely, Nevada, from Alaska.

F. W. Bradley will remain in Alaska until about September 1.

A. M. Boyle is now with the South American Mining Co., in Ecuador.

W. P. Alderson is local manager for the Mother Lode Sheep Creek Mining Company.

E. B. Tinker has been appointed superintendent for the Boston & Superior Copper Company.

T. K. Webster has resigned his position as president of the Webster Mfg. Co., at Tiffin, Ohio.

H. F. Fay has returned to Boston from a visit to the Lake Superior copper mining district.

C. M. Loeb, vice-president of the American Metal Co., sailed for Europe on the *Imperator*, July 19.

Charles W. Newton, general superintendent for the Butte & Ballaklava Copper Co., has gone East on business.

C. T. Nicolson is in charge of the dredging operations for the Andrada Mines Co., in Portuguese East Africa.

H. S. Kohlberg is assistant superintendent of the Kennedy mine of the East Nevada Smelting Co., Weedon, Quebec.

B. Britton Gottsberger, general manager for the Miami Copper Co., has returned to the property after three months absence.

Harry L. Huston, former manager for the Atbasar Copper Fields, Ltd., Siberia, has arrived in San Francisco, where he has opened offices in the Mills building.

J. L. Dobbins sailed on the *Mongolia*, July 16, on his way to Yunnan-fu, China, where he will be principal assistant engineer in the construction of railways in Yunnan.

H. F. Wierum, of New York City, consulting engineer of the Tennessee Copper Co., is at the Balaklala Copper Co. smelter investigating the Hall process as applied to the ores of this Company.

F. C. Lincoln has resigned as professor of mining engineering at the University of Illinois, to accept the position of resident engineer for the Bolivian Development & Exploitation Co., with headquarters at La Paz, Bolivia.

The United States Civil Service Commission will hold an open competitive examination for a male editorial clerk, on August 6 and 7, 1913, at certain towns in all states. From the register of eligibles resulting from this examination, certification will be made to fill a vacancy in this position in the Geological Survey, Washington, D. C., at a salary ranging from $1500 to $1800 per year, and vacancies as they may occur in positions requiring similar qualifications under certain conditions. The appointee to this position should have such a knowledge of English, printing, and book-making, elementary geology, and geologic nomenclature as will fit him to criticize and correct, acceptably to their authors, the manuscripts of the Survey's reports; to prepare them for printing; to carry along the work of proof-reading through all its stages, and to prepare satisfactory indexes to the reports. The examination will consist of these subjects. Applicants must be 20 and not over 40 years of age at the date of examination.

The Metal Markets

LOCAL METAL PRICES

San Francisco, July 24.

Antimony	12—13c	Quicksilver (flask)	$41
Electrolytic Copper	16—16½c	Tin	50—51c
Pig Lead	4.60—4.65c	Spelter	7—7½c

Zinc dust, 1400 lb. casks, per 100 lb., small lots $9.50—9.75; large $7.50—8.00

EASTERN METAL MARKETS

(By wire from New York)

NEW YORK, July 24. The copper market is showing a decided improvement. A large business is being transacted and a slight advance in prices is recorded. Increase in sales may be attributed in a measure to the strike which has been called by the Western Federation of Miners in the Houghton district. If the strike continues it will result in a decrease in the monthly production of 20,000,000 lb. The lead and spelter market is quiet but firm. Cables from London report a big demand for electrolytic copper at £66 15s. (14½c.), which is an advance of ¼c. over recent sales. Lead is quoted at £20 10s. and tin, spot, £190 10s. and futures £190.

SILVER

Below are given the average New York quotations, in cents per ounce, of fine silver.

Date.		Average week ending			
July	17	58.12	June	11	59.75
"	18	59.12	"	18	59.08
"	19	59.12	"	25	58.12
"	20 Sunday		July	2	58.20
"	21	58.75	"	9	58.29
"	22	58.75	"	16	58.43
"	23	58.87	"	23	58.79

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	56.25	63.01	July	60.67	....
Feb.	59.06	61.25	Aug.	61.32	....
Mch.	58.37	57.87	Sept.	62.95	....
Apr.	59.20	59.26	Oct.	63.16	....
May	60.88	60.21	Nov.	62.73	....
June	61.29	59.03	Dec.	63.38	....

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.		Average week ending			
July	17	4.34	June	11	4.33
"	18	4.34	"	18	4.33
"	19	4.34	"	25	4.33
"	20 Sunday		July	2	4.33
"	21	4.34	"	9	4.33
"	22	4.34	"	16	4.33
"	23	4.34	"	23	4.34

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	4.43	4.28	July	4.71	....
Feb.	4.03	4.33	Aug.	4.54	....
Mch.	4.07	4.32	Sept.	5.00	....
Apr.	4.20	4.36	Oct.	5.08	....
May	4.20	4.34	Nov.	4.91	....
June	4.40	4.33	Dec.	4.20	....

The attacks upon the market were not renewed during the week ended July 5. Prices advanced from day to day, up to £20 being again paid for early supplies, while the forward position also improved on some 'bear' covering. The closing price is £18 5s. to £19 15s. for foreign lead, and £19 5s. to £20 5s. for English.

ZINC

Zinc is quoted as spelter, standard Western brands, St. Louis delivery, in cents per pound.

Date.		Average week ending			
July	17	5.08	June	11	4.94
"	18	5.10	"	18	4.90
"	19	5.10	"	25	4.97
"	20 Sunday		July	2	5.07
"	21	5.10	"	9	5.10
"	22	5.10	"	16	5.08
"	23	5.10	"	23	5.10

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	6.42	6.88	July	7.12	....
Feb.	6.50	6.13	Aug.	6.96	....
Mch.	6.57	5.94	Sept.	7.45	....
Apr.	6.63	5.52	Oct.	7.36	....
May	6.68	5.23	Nov.	7.23	....
June	6.88	5.00	Dec.	7.09	....

The European Syndicate has adapted its price to the prevailing market quotations. The lower level thus established is generally considered attractive. Reports from galvanizing centres although bad as regards price are very promising. Prices on July 1 closed at £20 5s. to £20 10s. for ordinaries, and £21 to £21 5s. for specials.

QUICKSILVER

The primary market for quicksilver is San Francisco, California, being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending			July	10	41
June	26	41	"	17	41
July	3	41	"	24	41

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	43.75	39.37	July	43.00	....
Feb.	46.00	41.00	Aug.	42.50	....
Mch.	46.00	40.20	Sept.	43.12	....
Apr.	42.25	41.00	Oct.	41.50	....
May	41.75	40.25	Nov.	41.50	....
June	41.30	41.00	Dec.	39.75	....

Final and revised figures of the United States Geological Survey give a domestic production of quicksilver of 25,064 flasks, valued at $1,053,741 in 1912. Of this, 20,524 flasks was produced in California, and 4540 flasks was produced in Nevada and Texas combined. The total error in estimate for the new year's figures was therefore only 0.3%, and the credit for this must be given chiefly to the producers, who, without exception, promptly, courteously, and accurately gave their early figures and estimates to the Survey. Complete figures for the rest of the world are not yet available. In 1911 these were as follows, in metric tons:

United States	723
Austria-Hungary	793
Italy	931
Spain	1486
Mexico and others	150

COPPER

Quotations on copper as published in this column represent average wholesale transactions on the New York market and refer to electrolytic copper. Lake copper commands normally from 1-5 to 1-4c. per lb. more. Prices are in cents per pound.

Date.		Average week ending			
July	17	13.80	June	11	14.79
"	18	13.80	"	18	14.70
"	19	13.90	"	25	14.47
"	20 Sunday		July	2	14.43
"	21	14.05	"	9	14.25
"	22	14.10	"	16	13.81
"	23	14.20	"	23	13.97

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	14.09	16.54	July	17.19	....
Feb.	14.08	14.93	Aug.	17.49	....
Mch.	14.68	14.72	Sept.	17.56	....
Apr.	15.74	15.22	Oct.	17.32	....
May	16.03	15.42	Nov.	17.31	....
June	17.23	14.71	Dec.	17.37	....

TIN

New York prices control in the American market for tin, since the metal is almost entirely imported. San Francisco quotations average about 5c. per lb. higher. Below are given average monthly New York quotations, in cents per pound:

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	42.53	50.45	July	44.25	....
Feb.	42.96	49.07	Aug.	45.80	....
Mch.	42.58	46.95	Sept.	48.64	....
Apr.	43.92	49.00	Oct.	50.01	....
May	46.05	49.10	Nov.	49.92	....
June	45.76	45.10	Dec.	49.80	....

The visible supplies at the end of June, amounting to 12,903 tons, show a decrease of 875 tons, according to Henry R. Merton, on July 5. This market has again been the centre of unusual excitement with wide fluctuations and a very heavy fall in prices. At first the tone was rather better, in response to good consumptive purchases, and prices improved to £195 10s. for three months, but the failure of a Continental firm engaged on the 'bull' side caused some forced liquidation which unsettled the market for practically the rest of the week, at the end of which prices were firm at £186 15s. cash, and £187 5s. for three months.

The visible supply of copper in England, France, and afloat thereto, on July 15, was 29,358 tons, an increase of 1186 tons in the past fortnight. Stocks at Rotterdam, Hamburg, and Bremen decreased 2109 tons.

The Stock Markets

SAN FRANCISCO STOCKS AND BONDS.

(San Francisco Stock and Bond Exchange.)

BONDS.

Listed.	July 23. Bid	Ask
Associated Oil 5s	$ 97	—
E. I. du Pont 4½s	83½	—
Natomas Con. 6s	79½	—
Unlisted.		
Ass. Oil 1st ref	70	80
General Petroleum 6s	—	61

Unlisted.	July 23. Bid	Ask
Natomas Dev. 6s	94	100
Pac. Port. Cement 6s	99	—
Riverside Cement 6s	77	79
Standard Cement 6s	91½	—
Santa Cruz Cement 6s	—	85
So. Cal. Cement	70	75

STOCKS.

Listed.	July 23. Bid	Ask
Associated Oil	40½	—
Amalgamated Oil	81¼	85
E. I. du Pont com	—	135
Pac. Coast Borax, pfd	90½	—
do com	—	118
Pacific Crude Oil	—	30c
Sterling O. & D.	70c	95c

Unlisted.	July 23. Bid	Ask
Mascot Copper	1½	—
Noble Electric Steel	—	3
Natomas Consol	—	7
Pacific Port. Cement	59	—
Riverside Cement	45	55
Standard Cement	—	21
Santa Cruz Cement	—	36

NEVADA STOCKS

(By courtesy of San Francisco Stock Exchange.)

San Francisco, July 24.

Atlanta	$ .16	Mizpah Extension	$ .50
Belcher	.27	Montana-Tonopah	1.07
Belmont	6.10	Nevada Hills	.93
Big Four	.40	North Star	1.00
Con. Virginia	.12	Ophir	.17
Florence	.38	Pittsburg Silver Peak	.48
Goldfield Con	1.67	Round Mountain	.57
Goldfield Oro	.09	Sierra Nevada	.09
Halifax	1.50	Tonopah Extension	2.45
Jim Butler	.79	Tonopah Merger	.85
Jumbo Extension	.14	Tonopah of Nevada	4.12
MacNamara	.15	Union	.12
Mexican	1.05	West End	1.32
Midway	.44	Yellow Jacket	.23

COPPER SHARES—BOSTON

(By courtesy of J. C. Wilson, Mills Building.)

	July 24. Bid	Ask
Adventure	$ 1¼	2
Allouez	32	32½
Calumet & Arizona	63½	63¾
Calumet & Hecla	415	420
Centennial	10¾	11
Copper Range	38½	38¾
East Butte	11½	12
Franklin	5¼	5½
Granby	60½	60¾
Greene Cananea	6¾	6¾
Hancock	16¾	17½
Isle-Royale	19½	19¾
Mass Copper	3	3¼

	July 24. Bid	Ask
Mohawk	$ 43	—
North Butte	27	27½
Old Dominion	46½	47
Osceola	76	76½
Quincy	57	59
Shannon	7	7½
Superior & Boston	2½	2¾
Tamarack	27½	28½
U. S. Smelting	36½	36¾
Utah Con.	8¾	9
Victoria	1	1¼
Winona	1½	2
Wolverine	44½	45

NEW YORK QUOTATIONS

(By courtesy of E. F. Hutton & Co., Kohl Building.)

July 24.

	Bid.	Ask.
Alaska G. M.	17⅞	18
Braden Copper	6¾	7
B. C. Copper	2	4
Davis-Daly	1⅞	2⅛
Dolores	2	4
El Rayo	1	2
Ely Con.	8	10
First Nat.	2¾	2⅞
Giroux	1½	1⅝
Green Can.	6½	7
Hollinger	16	17
Kerr Lake	3⅜	3½
La Rose	2¼	2⅜
Mason Valley	6	7
McKinley-Dar.	1⅝	1⅞

	Bid.	Ask.
Miami 6s	168	173
Mines Co. Am.	2¼	2½
Nipissing	8⅜	8½
Ohio Copper	½	⅝
San Toy	21	23
Sioux Con.	2	4
S. W. Miami	5	7
So. Utah	¼	⅜
S. O. Calif.	170	172
Tri Bullion	⅛	¼
Tuolumne	¾	⅞
United Copper	⅛	½
Wettlaufer	12	14
Yukon Gold	2	4

LONDON QUOTATIONS

(By cable, through the courtesy of Catlin & Powell Co., New York.)

	July 24. £	s.	d.
Alaska Mexican	1	17	6
Alaska Treadwell	8	0	0
Alaska United	3	12	6
Arizona	1	17	6
California Amalg	0	2	6
California Oilfields	4	0	0
Camp Bird	0	15	0
El Oro	0	15	0
Esperanza	1	0	0
Granville	0	10	0

	July 24. £	s.	d.
Kern River Oilfields	0	5	0
Mexico Mines	5	5	0
Messina	1	10	0
Oroville	0	5	0
Pacific Oilfields	0	2	6
Rio Tinto	73	7	6
Santa Gertrudis	0	17	6
Stratton's	0	2	6
Tanganyika	1	17	6
Tomboy	1	5	0

AUSTRALIAN

	July 24. £	s.	d.
British Broken Hill	1	17	6
Broken Hill Props	1	15	0
Golden Horse-Shoe	2	11	3
Great Boulder Props	0	12	6
Ivanhoe	2	17	6
Kalgurli	1	16	9

	July 24. £	s.	d.
Mount Boppy	0	15	0
Mount Elliott	4	15	0
Mount Lyell	1	2	6
Mount Morgan	3	7	6
Waihi	2	5	0
Waihi Grand Junc	1	0	0

JUNE COPPER PRODUCTION

	Pounds.
Greene Cananea (silver, 89,093 oz.; gold, 473 oz.)	2,908,000
Nevada Consolidated	6,344,836
Utah copper	11,637,947

Sulitjelma, Norway (by Elmore process), produced 960 tons of copper concentrate.

During the first half of the current year, the Anaconda Copper Co. produced 136,050,000 lb. of refined copper, sold at an average price of 15¼c. per pound, with an inclusive cost of 10c. per pound, or a slightly higher cost of production than that of last year. Net earnings for the period total $7,140,000, or at the rate of $3.50 per share per annum, as against dividend requirements of $3.

It is now stated by Sidney Norman that the report of a dividend of $105,000 on preferred and $45,000 on common stock had been declared by the Federal Mining & Smelting Co., of the Coeur d'Alene, Idaho, is incorrect.

GOLD AND SILVER

Pixley and Abell, of London, report the following on July 10: Since the last circular £784,000 in gold bars has reached London, of which £613,500 was from South Africa; £121,000 was retained for India, and in the absence of any Continental demand, nearly the whole of the balance is going into the Bank of England. Next week £726,000 is due from South Africa and about $66,000 from Bombay. Since the last circular the Bank has received £992,000 in bar gold, £20,000 in sovereigns from Mexico, £200,000 from Egypt, £7000 from Panama, and £6000 from the West Indies. Bar gold, fine, is quoted at 77s. 9d. per ounce standard.

The silver market is still very quiet, and, after small fluctuations during the past week, today's closing quotations are 26⅞d. for spot and 27⅛d. for forward, being the same as on July 3.

Business continues on a small scale, the principal buyer being China, while offerings, owing to the smaller supplies from Mexico, are moderate. The premium on forward silver has been maintained at ¼d., though yesterday only 3/16d. was quoted. Easier money conditions and the demand for China being mostly for spot silver having eased the position of holders. A further increase of ¾ crores* in the holdings of rupees is reported from India, the total holdings now being 26.25 crores, against 18.15 crores at the same date in 1912.

In Shanghai, also, stocks have increased and now stand at about £5,650,000. In Bombay, on the other hand, there has been a slight reduction of 200 bars, while in London stocks are still about £3,800,000.

Exports of silver from London to India, China, and the Straits for the year total £4,461,000, against £4,610,700 last year.

DURING the past year, 696,524 tons of ore was hoisted at the Robinson Deep on the Rand, yielding 111,124 oz. of fine gold. An average of 183 stamps daily crushed 623,800 tons in 332 days, and 8 tube-mills working 319 days, an average stamp duty of 10.26 tons per day.

COST PER TON

Mining	$2.38	Tube-milling	0.22
Development	0.48	Cyaniding sand	$0.22
Ore sorting and crushing	0.06	Cyaniding slime	0.14
Ore transport	0.04	General charges	0.32
Stamping	0.26	Plant renewals	0.15
		Total	$4.27

*Hindu term meaning ten millions, or one hundred lakhs of rupees. One rupee equals 32 cents.

Mineral Production of the Eastern Appalachian States

The area covered is for the greater part coincident with the broad belt of old metamorphic and associated igneous rocks extending southwestward from Canada to Alabama. The zinc-lead belt of southwestern Virginia and eastern Tennessee, however, whose rocks are mainly Cambrian and Ordovician limestone and dolomite, lies to the west of this great metamorphic belt. According to H. D. McCaskey, of the U. S. Geological Survey, ore and metal production in 1912 was as follows:

State.	Short tons.	Gold.	Silver.	Copper, lb.	Lead, lb.	Zinc, lb.
Alabama	5,693	$ 16,724	$ 103	.....	.....	.....
Georgia	1,359	14,360	112	.....	.....	.....
Maryland	14,458	14,830	410	160,831	.....	.....
Pennsylvania	210,742	.....	.....	473,060	.....	.....
New Jersey	459,585	.....	.....	.....	.....	139,510,008
New York	100	.....	.....	.....	.....	.....
North Carolina	16,073	166,014	2,985	75,915	92,000	283,320
South Carolina	12,358	16,915	.....	.....	.....	.....
Tennessee	635,576	8,265	55,284	18,483,173	.....	4,366,845
Virginia	5,790	218	604	112,835	469,026	497,235
Total	1,361,734	$222,496	$59,498	19,265,945	561,026	144,699,863

The total value of all metals was $13,470,276.

Quicksilver Production in 1912

There were altogether 20 mines and prospects producing quicksilver in the United States, against 25 in 1911 and 19 in 1910. In all three years, also, there were a few mines producing ore but no metal, and a few producing metal from ore mined in previous years. Seventeen of the producing mines reported in 1912 were in California and three in Nevada and Texas. As in 1911 and 1910, no output was reported from Arizona, Oregon, Utah, Washington, or other States.

According to returns to the United States Geological Survey from every producing district, the output of quicksilver was 25,064 flasks of 75 lb. each. At the average domestic price per flask at San Francisco for the year of $42.05, this production was valued at $1,053,941. Compared with figures for 1911 and 1910, the yield of 1912 showed an increase of 3808 flasks in quantity and of $75,952 in value over the production of 1911, and of 4463 flasks and $95,788 over the production of 1910. The production of California increased from 17,211 flasks, valued at $800,484, in 1910 to 18,860 flasks, valued at $867,749, in 1911, and to 20,524 flasks, valued at $863,034, in 1912. The output of Nevada and Texas combined decreased from 3390 flasks, valued at $157,669, in 1910, to 2396 flasks, valued at $110,240, in 1911, but increased to 4540 flasks, valued at $190,907, in 1912.

There was 139,347 short tons of ore treated in California, averaging 11 lb. of quicksilver per ton treated, or 0.55%, and in Texas and Nevada combined, 16,346 tons was treated, yielding 20.8 lb. per ton, or 1.04%. Of the ore treated, 99.3% was dealt with by shaft furnaces.

Cement Production in 1912

The total quantity of portland, natural, and puzzolan cement produced in the United States in 1912 was 83,351,191 bbl., valued at $67,461,513, as compared with 79,547,958 bbl., valued at $66,705,136, in 1911. This represents an increase in quantity of 3,803,233 bbl., or 4.78%, and in value of $756,377, or 1.13%. It should be noted, according to Ernest F. Burchard, of the U. S. Geological Survey, that any table in which the production of these three kinds of cement is combined to form a total of barrels is necessarily inconsistent, for the weights per barrel of each kind of cement are different. Portland cement is sold in barrels weighing 380 lb., natural cement in 265-lb. barrels, and puzzolan cement in 330-lb. barrels.

The distribution of the total production among the three main classes of cement is as follows:

	Barrels.	Value.
Portland	82,438,096	$67,016,928
Natural	*821,231	367,222
Puzzolan	*91,864	77,363
Total	83,351,191	$67,461,513

*Shipments.

PRODUCTION BY STATES

In the following table the portland cement production for 1912 is given by states, or by groups of states where there are less than three producers in a single state. By the term producer is meant a portland cement manufacturing company, whether the company operates one or more plants. In the table, the term producing plant is applied to a mill or group of mills at one place and operated by one company, but each establishment at a different place is counted as a plant.

State.	Producing plants.	Quantity, barrels.
Pennsylvania	23	36,441,338
Indiana	5	9,924,124
California	8	5,974,299
New York	7	4,492,806
Missouri	5	4,355,741
Illinois	5	4,299,357
New Jersey	3	4,246,803
Michigan	10	3,494,621
Iowa	3	3,228,192
Kansas	10	3,225,040
Ohio	5	1,433,344
Washington	3	1,362,416
Utah	3	868,312
Texas	4	2,977,179
Oklahoma	2	
Tennessee	2	2,348,886
West Virginia	1	
Kentucky	1	
Virginia	1	1,737,739
Maryland	2	
Montana	1	1,035,764
Colorado	2	
Alabama	2	992,135
Georgia	1	
Total	109	82,438,096

The apparent stock on hand at the end of 1912 was 7,811,329 bbl., compared with 10,385,789 bbl. at the end of 1911. The approximate consumption in the United States was 80,865,527, an increase of 11% over the previous year. Imports totaled 68,503 bbl., and exports 4,215,532 barrels.

CARBONIZED WOOD and remains of leaves have been found in the tin deposits of the Clarence Prospecting Association, eastern Tasmania. These fossils were microscopically examined by H. H. Scott, of the Hobart Museum, who stated that the wood structure and the leaf are of modern forests, and belong to the white peppermint tree. This is a *eucalyptus amygdalina*. There are two different kinds of peppermint trees in Tasmania, whose species is questioned.

Company Reports

THE ZINC CORPORATION, LTD.

This Company operates a large flotation plant for the recovery of lead and zinc content from old bought tailing, and the South Blocks mine and mill, at Broken Hill, New South Wales. It has also recently acquired the Sunny Corner mine, details of which were given in the *Mining and Scientific Press* of July 5. The reserves of tailing on hand at the end of 1912 amounted to 1,844,748 tons, assaying 14.7% zinc, 6 oz. silver, and 5% lead. Ore reserves in the South Blocks mine total 721,191 tons, assaying 14.4% lead, 2.3 oz. silver, and 9.1% zinc.

The principal work on the lead lode consisted of the intersection of the lode in the main west cross-cut at No. 7 level, at a vertical depth of 1050 ft., and the extension of the main north and south drifts from this cross-cut. The lode at this level, where intersected, proved to have a value of 14.1% lead, 2.4 oz. silver, and 13.6% zinc over a width of 18 ft. Since the end of the year a similar cross-cut has been driven from the main shaft at No. 8 level, at a vertical depth of 1180 ft., and has proved the lode at that point to have an average assay value of 14.8% lead, 2.3 oz. silver, and 10.7% zinc over a width of 50 ft., namely, from 70 to 120 ft. west of the shaft. The total width of ore disclosed by the cross-cut is 85 ft., the extension beyond the above mentioned width of 50 ft. assaying from 4.1% lead, 1.3 oz. silver, and 4.8% zinc to 12.5% lead, 2.9 oz. silver, and 8.6% zinc, over 5 and 15-ft. samples, respectively. Drilling at a point 666 ft. south of the main shaft cut 32 ft. of ore between 176 and 208 ft. in the hole, assaying from 2.3% lead, 0.4 oz. silver, and 2.4% zinc, to 16.9% lead, 3.4 oz. silver, and 13.3% zinc. Another hole cut 6 ft. of ore averaging 18.5% lead, 4.11 oz. silver, and 11.8% zinc. The financial results were as follows::

Sale of concentrate, etc.	£644,924
Cost of mining, treatment, office, depreciation, etc.	412,093
Profit	£232,831
Dividends	139,021
Carried forward	90,352

LAKE VIEW & STAR, LIMITED

This Company operates the Lake View Consols and Hannan's Star mines, a 75-stamp mill, and treatment plant at Kalgoorlie. The report covers the year ended February 28, 1913. Results may be summarized as follows:

Development work, feet	4,023
Station and bin cutting, cubic feet	8,612
Ore reserves:	
Lake View, tons	107,050
Hannan's Star, tons	305,720
Average value, per ton	$6.65
Ore mined:	
Lake View, tons	95,258
Hannan's Star, tons	117,348
Revenue from gold recovered	$1,210,000
Working expenses	1,010,000
Dividends	153,600

The general managers, Bewick, Moreing & Co., report that the main shaft of the Lake View was sunk a further 209 ft., to 2154 ft., while stations were cut on the 1900 and 2100-ft. levels, and a main west cross-cut was started on the latter level. The Lake View lode was followed below the 1800-ft. level by a winze, which opened 88 ft. of ore averaging $7.68 per ton. On the 1900-ft. level the north drift of the cross-cut was in poor ore except for 46 ft., which averaged $7.92 per ton over 5 ft. The winze below this level was down 107 ft. at the end of May 1913, in good ore. Prospecting was done on the 100-ft. level in the northeastern part of the leases, and proved a fair tonnage of ore. At the Hannan's Star leases, about a half-mile distant, work was directed toward opening ore in the upper levels on the Morrison east and west lodes available for stoping. Reserves show an increase of 27,436 tons. Ore worth $10.32 to $5.80 per ton, with widths of 6 to 5½ ft., was opened between the 500 and 700-ft. levels. Generally, results at the mines are satisfactory. H. E. Vail is superintendent, and James Bros., of London, are consulting engineers.

SILVER KING COALITION MINES COMPANY

This Company operates at Park City, Summit county, Utah, and the report covers the year ended April 30, 1913. The property contains 2200 acres of patented ground, and has been the subject of a great deal of litigation with the adjoining property of the Silver King Consolidated Mining Co. Legal expenses during the year totaled $20,799. The general manager, Thomas Kearns, reports that the mine is in splendid condition, and has plenty of ore opened. Owing to the great depth the ore has reached in the western developments, the management found it necessary to

MAP OF UTAH.

sink a shaft in the middle west workings of the property from the present level of the Alliance adit at a point of about 8500 ft. in from the mouth, the collar of this shaft being about 1600 ft. vertical under the surface, and at that point known to be 1000 to 1200 ft. above the contact of underlying quartzite, known to be the foot-wall or underlying limits of the great orebodies. It was found necessary to sink a large standard 3-compartment shaft, which is already down about 260 ft., and a large direct-driven 500-hp. hoisting engine as well as a large electrically driven compressor of the Sullivan type have been ordered. The new equipment will cost $40,000, but is necessary. Results of operating are as follows:

Ore mined:	
First class, tons	18,229
Lead content, per cent	31.20
Silver content, ounces	64.48
Gold content, ounces	0.057
Second class, tons	81,996
Concentrate from second-class ore, tons	12,485
Lead content, per cent	35.55
Silver content, ounces	55.76
Metal production:	
Lead, pounds	20,253,704
Silver, ounces	1,871,656
Gold, ounces	1,850
Revenue from ore, metals, lessees, etc.	$1,485,675
Forward from previous year	367,011
Mining, milling, marketing, etc.	1,052,686
Loans to bondsmen	300,000
Dividends	500,000
Balance in banks	314,066

Decisions Relating to Mining

Specially reported for the MINING AND SCIENTIFIC PRESS.

THE TAILING QUESTION AGAIN

The ever-recurrent controversy between the farmers and miners over the pollution of streams by mine tailing has just been settled in Arizona by a decision of the United States Supreme Court in the case of The Arizona Copper Co., Ltd. *v.* William Allen Gillespie.

The Arizona Copper Co. was engaged in mining and reducing copper ore near Clifton, Arizona, and a large part of the tailing and waste from the reduction works was carried by the water used in the reducing process into the streams adjacent, or was deposited nearby and was later carried into the streams and thence into the Gila river. The appellee, William Gillespie, owned 276 acres of land on the Gila river about 25 miles below the point where the water polluted by the tailing, as above, found its way into the river. He had reclaimed this land and was irrigating it with water drawn from the Gila river through the Montezuma irrigation canal. The irrigation of the lands of appellee and other farmers of the Gila river valley by this method dates from 1872. With the installation of the reduction and concentration works at Clifton in 1885 the slime and tailing began to discolor the water as above stated, and quantities of them were carried down and deposited upon Gillespie's land through the irrigation ditches, as the court found, to the great detriment and damage thereof.

Gillespie obtained an injunction in 1907 from the District Court, enjoining the Copper company from depositing any slime, slickens, or tailing in such manner that they might be carried into the waters of the Gila river. The territorial Supreme Court modified this order so as to permit the construction by the appellant of settling-basins in such situations as to prevent the deposit of the tailing on farming lands, and affirmed the judgment with this modification. The Arizona Copper Co., while accepting the terms of the modified judgment and constructing large settling-basins to hold the tailing, brought the case up to the United States Supreme Court for final adjudication. The decision just rendered (June 16, 1913) affirms the decree of the territorial court.

The principal questions of law involved were whether the use of water for mining purposes was a higher use than for irrigation, and whether, if the right to use water for mining purposes could not be exercised without polluting the streams with tailing, etc., the lower users should be denied relief from the necessary consequences of the exercise by the miner of a legal right. Both questions were decided in the negative, the court holding that the Arizona statute places both industries on a parity of importance and that the maxim *sic utere tuo ut alienum non laedas* governs property rights in Arizona as elsewhere. The reasoning is in line with that applied to the hydraulic mining cases in California some years ago, and one of those cases (Woodruff *v.* North Bloomfield Mining Co., 18 Fed., 753) was cited in support of this decision.

It is to be hoped that the settling-basins constructed on the Gila river will prove to be effective. The difficulties that beset the operation of copper smelters and reduction works wherever they impinge on agricultural communities seems to be legion. The bitter controversies that have been waged over the Shasta county smelters in California, the Anaconda smelter in Montana, and the reduction works at Clifton, Arizona, suggest the conclusion that the possibilities of these legal difficulties will have important influence upon the future development of copper mining throughout the country.

ABANDONMENT—WHAT NECESSARY TO CONSTITUTE

Where two mineral locators re-located claims previously held by themselves, and in their location notice declared that they re-located the claims as 'abandoned ground', this declaration was not sufficient to show an abandonment in view of surrounding circumstances showing that they had never in fact abandoned the ground. The term 'abandonment' includes both the intention to abandon and the act by which the abandonment is carried into effect. There must be a concurrence of intention to abandon and actual relinquishment of the property, so that it may be appropriated by the next comer.

Peachy *v.* Frisco Gold Mines Co. (Arizona), 204 Federal, 659.

James Lewis & Son's Copper Report

Copper has been devoid of animation during June, in sympathy with the generally prevailing depression and serious shrinkage in the value of stocks and shares. Standard copper prices fell from £67 2s. 6d. for cash on the 2nd to £65 2s. 6d. on the 11th, advanced to £66 2s. 6d. on the 13th, declined to £61 15s. on the 23rd, and recovered to £64 7s. 6d. on the 25th, when three months prompt sold up to £64 15s. A fall to £63 10s. for cash and £63 15s. for three months took place on the 27th, and a reaction to £64 2s. 6d. and £64 10s. on the 30th. Closing prices on July 1 were £63 12s. 6d. for cash and £63 15s. 0d. for three months prompt. Sales amounted to about 38,000 tons.

On June 16 American refiners reduced their quotation for electrolytic copper to 15c. per pound, but sales from second hands were made down to 14¼ and 14⅜c., with sellers at £67 5s. per ton c.i.f. for wire bars, without inducing much demand from consumers whose immediate requirements are evidently well supplied from recent large deliveries. With slackening trade generally, and much reduced consumption of copper for the manufacture of sulphate, combined with steadily increasing production, a considerable increase in the stocks appears quite probable during the next six months. United States' shipments for June were advised as 27,815 tons.

Imports into England and France were 3375 tons, and deliveries 202 tons, greater than during the same period last year. The total arrivals in England and France for the month have been 12,992 tons, and the deliveries 14,804 tons fine.

The arrivals in England from Chile during the month have been 1791 and the deliveries 2517 tons fine, and from other countries 7435 and 8000 tons fine, respectively. The arrivals at Liverpool and in Swansea from the United States have been 1940 tons bars, etc., and 620 tons ingots, etc., equal to about 2543 tons fine copper, in London 660 and in France 3330 tons. The Chile charters for the month were advised as 2600 tons, including 1525 tons for the United States, while exports from Chile to June 3 were 18,062 tons.

STOCKS OF COPPER (TONS FINE)

	July 1, 1910.	July 1, 1911.	July 1, 1912.	July 1, 1913.
Chilean in—				
Liverpool and Swansea...	14,252	5,061	5,414	2,611
France	737	497	926	482
American in—				
Liverpool and Swansea...	33,055	19,851	4,289	1,683
France	5,010	4,548	3,958	1,739
Sundries in—				
Liverpool and Swansea...	1,517	859	574	96
London and Newcastle...	19,124	7,685	4,292	2,647
Birmingham	105	578	329	146
France	598	798	601	638
English in—				
Liverpool and S. Wales...	20,084	21,545	13,735	12,050
Total in England and France	[illegible],482	61,422	34,118	22,092
Sundries in—				
Germany and Holland....	4,200	17,300	6,545	11,354
Total European stocks..	98,682	78,722	40,663	33,446
Afloat (as advised by mail and cable to date)—				
From Chile	2,200	1,500	1,475	1,350
From Australia	7,275	7,250	6,000	4,700
Total visible supply....	108,157	87,472	48,138	39,496

Concentrates

Most of these are in reply to questions received by mail. Our readers are invited to ask questions and give information dealing with the practice of mining, milling, and smelting.

A GASHOLDER of 12,000,000-cu. ft. capacity is being erected by the Australian Gaslight Co., of Sydney.

GOLD OUTPUT of the Rand in June was valued at $15,674,809, making a total of $97,579,505 for the half-year.

DIPPER TEETH for steam-shovels and dipper dredges must be kept in good condition always in order that economical operation may result.

SULPHURIC-ACID production in the United States during 1912 was valued at $18,338,019, compared with $17,369,872 in the previous year.

PEAT is used for fuel, stock food, paper stock, and stable litter. In 1912, according to the U. S. Geological Survey, the United States production was 47,380 tons worth $228,572.

AN INVESTIGATION into the water-power sites of Japan has occupied three years at a cost of 700,000 yen ($350,000), resulting in the locating of 892 sites capable of developing 2,020,000 horse-power.

PLACER CLAIMS cannot be located on land belonging to lumber interests, or to private individuals; but probably an arrangement could be made with the owners for temporary occupation.

ROTARY CEMENT KILNS operating in the United States in 1912 were 867, ranging in length from 40 to 240 ft. Of these, 695 were fired with coal, 126 with oil, and 46 with natural gas.

FULLER'S EARTH production in the United States in 1912 was 32,715 short tons, valued at $305,522, a decrease of 7982 tons from 1911. It is mined in 14 states, principally by Florida, Georgia, Arkansas, and Texas.

DEVELOPMENT WORK in the Lake View mine, Kalgoorlie, during last year cost as follows, the bulk of the work being done in a greenstone formation: Shaft sinking $108.72; driving, $17.56; cross-cutting, $21.20; raises, $23.40, and winzes, $26.30 per foot.

ELECTRIC POWER for the Coeur d'Alene mining district, Idaho, is generated by hydro-electric power-plants of the Washington Water Power Co. It is transmitted at 60,000 volts, and at present there are 11 sub-stations with a transformer capacity of 13,900 kilowatts.

BARYTES, or heavy spar ($BaSO_4$), contains 65.7% of barium oxide and 34.3% of sulphur trioxide. It is principally used as a pigment in mixed paints, and in manufacturing lithopone, a white pigment. Production of barytes in 1912 was 37,478 short tons, valued at $153,313. This came principally from Missouri.

MUNTZ-METAL SHEETS on piles at Wellington harbor, New Zealand, have been found in excellent condition after being under water for 3½ years, so much so, that the original brand could be deciphered. The harbor engineer reports that the muntz-metal supplied during later years is not up to this standard by any means.

POWDERED ALUMINUM is now made by the Aluminum Company of America. It is used in explosives, lithographing, printing, as a paint pigment, and in precipitating silver from cyanide solutions. The concern has in operation at New Kensington, Pa., one of the most complete aluminum bronze plants in the world.

THE new alloy, elianite, is produced in an electric furnace at the electro-chemical works of Rossi, at Legnano, Italy, and is to be used in the manufacture of nitric acid from the air; it is said to differ from similar alloys known in that its resisting power is not limited to certain acids, and it is a good conductor of heat. The composition is kept secret.

AMMONIA BOMBS are being tried in some of the national forests for the purpose of extinguishing forest fires. They are said to have worked well in the case of brush fires, where the fire-fighters find difficulty in getting near enough to the burning area to beat out the flames. Each bomb exploded will extinguish fire in a circle of about five yards in diameter.

STRONTIUM MINERALS of commercial importance are celestite (Sr_2SO_4) and strontianite (Sr_2CO_3), the latter being the more valuable, though rarer. It is found in San Bernardino county, California, and Maricopa county, Arizona. Strontium hydrate is mainly used in recovering sugar from beet molasses, while strontium nitrate is chiefly used in the manufacture of fireworks.

RELATIVE CALORIFIC VALUES of certain liquid fuels are as follows: Methyl (wood) alcohol, liquid, 5314 calories; ethyl (wine) alcohol, liquid, 7107; hexane (paraffin), liquid, 11,603; benzine, liquid, 10,001; commercial gasoline, 11,368; commercial kerosene, 11,050; crude California asphaltic petroleums, including those from Coalinga, McKittrick, Midway, Kern and Sunset, average 10,350 calories per gram.

MINERAL PRODUCTION of Tasmania during the first quarter of 1913 was as follows: gold, $175,000; silver-lead ore, 22,897 tons, worth $360,000; blister copper, 351 tons, worth $144,000; copper ore, $10,000; black tin, 787 tons, worth $556,000; coal, 11,188 tons; wolfram ore, 7.4 tons, worth $3800; bismuth, 0.75 ton, worth $1300; osmiridium, 257.45 oz., worth $10,000; and shale, 10 tons, worth $4800. There were 5584 men employed.

THE asphalt in an oil may be determined by Holde's method, which consists of distilling off the light oils which may exist in the crude oil and then shaking the residue with 40 times its volume of gasoline, boiling between 65 and 95°C., and as free as possible from unsaturated hydrocarbons. It then is allowed to stand for 24 hours and is filtered. By this means the solid asphalt contained in the oil is obtained upon the filter, together with the clay and other mineral impurities contained in the oil. The asphalt is dissolved by washing with benzol. The benzol is evaporated in a weighed porcelain dish and the weight of the asphalt obtained.

THE iron-nail method of assaying has been used for a number of years, but has not met with the approval of all assayers, according to E. J. Hall and C. W. Drury. The method possesses advantages which may be given as follows: (1) no preliminary treatment is required; (2) a lead button of proper size can be obtained; (3) it is economical. On the other hand, it has its disadvantages, which may be summed up as follows: (1) it is not applicable to ores containing large amounts of impurities other than sulphur, as practically all the base metals will contaminate the lead button; (2) the slag is unsatisfactory in the larger number of fusions; (3) the method was known to give low silver results under certain conditions and the gold results were questionable.

OWING to the fact that every mine has its peculiarities in formation and methods, according to H. T. Van Ells, in the Transactions of the A. I. M. E., the question of arriving at what charges should be included under the head of development is one that has occasioned considerable thought and comment, and in the cost sheet of the Anaconda Copper Mining Co. this account has been sub-divided to show the expenses of breaking ground, tramming, timbering, shaft-sinking, raising, and cutting stations and skip chutes. It has always been the policy of the Company to charge the entire cost of this work to operations monthly, whether the mines are producing or not, also the cost of the opening up of new mines; and only surface construction and additions are charged to capital, excepting original machinery installed for operating plants.

Book Reviews

ANALYSIS OF METALLURGICAL AND ENGINEERING MATERIALS. By Henry Wysor. P. 82. Ill. The Chemical Publishing Co., Easton, Pennsylvania, 1912. For sale by the *Mining and Scientific Press*. Price $2.

A study of this volume impresses the reader that it is thoroughly practical, and, while not attempting to deal with the higher branches of analytical work, it will raise the efficiency of students' work to a point where good results should be obtained. The methods of analysis have been carefully selected to include the examination of the more important metallurgical and engineering materials. In this respect may be mentioned studies of steel alloys, tungsten, ferro-manganese, special bearing metals, producer gas, calorimetry of gases, lubricating oil, and the microstructure of iron and steel, which are all important subjects of the engineering industry. Several of these are accompanied by full-page cuts. A student does not always follow the reactions in chemical analyses, and in this volume, those under discussion are clearly given, as are also instructions in general laboratory work. The volume is published in an unusual style which makes it possible to revise or add to the matter without disturbing the part not affected by the change. There is a table of gravimetric factors, and a bibliography of standard analytical works and papers, but no index. On the whole, the work is worth while.

ELECTRIC METERS. By Cyril M. Jansky. P. 370. Ill., index. McGraw-Hill Book Co., New York. For sale by the *Mining and Scientific Press*. Price $2.50.

Information regarding electric meters has in the past been obtained from the manufacturers of these instruments, and for this reason it has been incomplete and difficult to secure. Mr. Jansky's new book gives complete information on the theory of electric meters and discusses fully the construction and operation of those meters which may be said to represent American practice. The book starts at the beginning of the subject and, in an elementary way, sets forth the theory of magnetism, energy, power, etc. There are chapters on the theory of alternating currents and alternating current circuits. After describing in detail various volt, ampere, and watt meters, the book takes up at considerable length a discussion of the integrating watt meter. The adjustment and testing of this meter are gone into fully and the effect and extent of errors in this meter are discussed at some length. There are interesting chapters on power factor and frequency meters and synchronizing devices. Prepay meters are also discussed. This book is one that must be read through carefuly. It must be studied and cannot be read at odd times by the busy commercial man. It is not a handbook and could be used as a book of reference only by the student who had thoroughly mastered it. The author intended the book as a help in his course on this subject at the University and it was written for students primarily; but it seems to the reviewer that an appendix, containing a brief summary of the important formulae and wiring diagrams for the correct installation of meters in polyphase circuits, would be a valuable addition and of great use to the practical man who needs this information, but who has not the time or frame of mind to patiently study the whole book. Such an appendix would be invaluable to the meter man of a power company or to the engineer or machinery man who has to do with efficiency or guarantee tests in the field and must use meters of this kind.—C. R. S.

AN INTRODUCTION TO THE PHYSICS AND CHEMISTRY OF COLLOIDS. By Emil Hatschek. P. 92. P. Blakiston's Son & Co., Philadelphia, 1913. For sale by the *Mining and Scientific Press*. Price $1.

This small volume is a reprint of a series of ten lectures delivered at the Sir John Cass Technical Institute in London, and will at once commend itself to the many workers in the field of metallurgy and ore dressing who need to keep in touch with progress in the field of physics and chemistry, but who lack opportunity, aptitude, and inclination to plough through the mass of current literature in which the skirmish line of progress is steadily being carried forward. Not less important is the fact that the newer concepts are based upon a grasp of principles and details to which many earlier students are comparative strangers. The great importance of the study of colloids in the field of physiological chemistry has somewhat overshadowed the bearing which they have in the inorganic field of industrial chemistry, as well as in purely physical operations. Those in the mining profession who hope to lead, rather than follow, will be grateful to Mr. Hatschek for giving them in a volume of brief compass and low price all the fundamental data concerning colloids which investigation has so far established. If any criticism is justified, it is that the book is too brief, for the subject is so new that many will perhaps be unable to perceive unaided the significance of the phenomena so briefly pointed out. Thus the brief references to adsorption might not suffice to indicate to metallurgists and chemists, for example, that in the fine grinding of copper ore, preparatory to leaching, a sufficient quantity of colloid material may be formed to tenaceously retain by adsorption considerable quantities of soluble copper salts. The possibilities of 'salting out' of colloids in the chemical and physical industrial process is similarly of much importance and deserves fuller discussion. Such topics can, however, only be adequately treated by those who supplement an accurate knowledge of theoretical considerations by a comprehensive knowledge of operating conditions, and this book may therefore be regarded as the first step in attaining such a consummation. And even if there is no visible immediate effect beyond decreasing the misuse of 'adsorption', a word which many engineers use, but few correctly, its preparation will have been well worth while.

Recent Publications

DISCOVERY OF PYRRHOTITE IN WISCONSIN. With a discussion of its probable origin by magmatic differentiation. By Rufus Mather Bagg. Reprint from *Economic Geology*, June 1913. P. 4. Ill.

A GEOLOGIC RECONNAISSANCE OF PART OF THE RAMPART QUADRANGLE, ALASKA. By Henry M. Eakin. Bulletin 535. P. 38. Ill., maps.

CELESTITE DEPOSITS IN CALIFORNIA AND ARIZONA. By W. C. Phalen. Bulletin 540-T. P. 15. Ill.

THE KOYUKUK-CHANDALAR REGION, ALASKA. By A. G. Maddren. Bulletin 532. P. 119. Ill., maps, index.

WATER RESOURCES OF HAWAII, 1910-1911. By W. F. Martin and C. H. Pierce. Water-Supply Paper 318. P. 552. Ill., maps, index.

THE MELTING PHENOMENA OF THE PLAGIOCLASE FELDSPARS. By N. L. Bowen. Reprint from the *American Journal of Science*, Vol. 35, June 1913. P. 23. Ill.

United States Geological Survey, Washington, 1913. Advance chapters from 'Mineral Resources of the United States, 1912.'

PRODUCTION OF PEAT. By Charles A. Davis. P. 7.

THE CEMENT INDUSTRY. By Ernest F. Burchard. P. 24.

SULPHUR, PYRITE, AND SULPHURIC ACID. By W. C. Phalen. P. 24.

PRODUCTION OF FULLER'S EARTH. By Jefferson Middleton. P. 8.

QUICKSILVER PRODUCTION AND RESOURCES. By H. D. McCaskey. P. 20.

PRECIOUS AND SEMI-PRECIOUS METALS IN THE EASTERN STATES. By H. D. McCaskey. P. 22.

PRODUCTION OF BARYTES: WITH A NOTE ON STRONTIUM ORE AND SALTS. By James M. Hill. P. 8.

PRODUCTION OF ASPHALT, RELATED BITUMENS, AND BITUMINOUS ROCK. By David T. Day. P. 12.

COMMERCIAL QUALITIES OF THE SLATES OF THE UNITED STATES AND THEIR LOCALITIES. By T. Nelson Dale. P. 17.

National Tubing

THE illustration furnished by the National Tube Co., of Pittsburgh, Pennsylvania, is submitted as evidence of the high quality of the products manufactured by this Company. The illustration is a part of the tubing used in lining of an oil well near Gore, Ohio. The well when completed was shot in the usual manner, and later a second shot consisting of 150 quarts of nitroglycerin with a 20-

EFFECT OF EXPLOSION ON TUBING.

quart anchor shot was used. The lining was then pulled, and it was found that there was still one joint in the well. This joint lodged about 1500 ft. below the surface, but was finally taken out by means of a bell socket. The well was about 3000 ft. deep and the casing was not damaged in any way. The part illustrated was normally about 18 ft. in length, and, due to the intense shock of the explosion at this point, has been compressed to a length of about 8 ft. Careful examination will show no fracture in the material, notwithstanding the punishment to which it was subjected.

A Continuous Replacing Machine

The L. C. Trent underfeed replacing machine eliminates filtering for treating any slime, as the extraction of solution may be readily performed in the vat itself. The machine feeds previously agitated slime continuously into a vat containing thickening apparatus with means for mixing wash-water at the bottom, and having a controlled water inlet and slime orifices. This utilizes the principle of the Trent underfeed agitators, which not only mechanically thicken pulp, but are so designed for replacing that the disturbance caused by the thickened slime in which it operates does not retard settling above.

A circulating pump is supplied from a circular perforated pipe surrounding the interior of the vat near the bottom, the perforations being on the under side to prevent choking. This method insures perfect distribution, with the disturbance confined to a limited plane. The wash-water is introduced gradually through the pump suction and is properly mixed with the thickened slime. Slime flowing from the agitators is introduced into the vat through the distributor at the surface, and the solids settle from the original solution into barren wash-water, and thicken at the bottom, where they are washed and discharged. The original solution is replaced with water introduced through the pump, and mixed with the thickened slime through the agitator jets near the bottom of the vat; while the released pregnant solutions overflow into the launder surrounding the top of the vat and is read for clarification and precipitation.

The following is an example: In treating 100 tons of 1½ solution to 1 slime per 24 hours in a 24 by 16-ft. vat, there will be fed in 26 gal. of solution and 139 lb. of ore per minute, and there will overflow 26 gal. of solution mixed with a maximum of 6½ gal. of excess wash-water, totaling 32½ gal. of solution extracted. There is discharged as residue 26 gal. of water and 139 lb. of ore, equaling 6 gal., or a total of 33 gal. of ore and water combined per minute. Therefore, the solution has been diluted but about 25%, and the residue remains the same in volume as in the original slime, a high percentage of which can be recovered by simple methods, so that the final discharge will not exceed 35% of water, and the reclaimed water returned for further use. In providing for 25% of excess wash-water, there is a maximum rising liquid column of but 0.025 in. per minute to retard the settling slime, quite insignificant in such a dilute bath. A bed of thickened slime several feet deep is maintained on the bottom of the vat. This slime is kept diluted by the agitator mixing the slime at the bottom with wash-water admitted through the pump, supplying an excess beyond that required for discharging the slime to waste. The excess water rises in the vat around the falling slime, washes it, and, mingling with the pregnant solution, overflows to the gold-tank or clarifier.

The method of introducing slime to the vat causes the heaviest and most granular portion of the pulp to settle around the central bottom area contiguous to the residue discharges, while the lighter slime falls toward the periphery, whence the circulating liquid to the pump is withdrawn. This protects the pump from grit and insures the thin slime being mixed with the discharging solids. The solids in the slime settle through a slowly rising column of weak solution passing a zone of barren water into barren slime. The inflowing pregnant solutions are discharged from the surface of the charge as rapidly as received with the solids removed, and but slightly diluted or increased in volume, the amount of such dilution being subject to regulation. The falling slime, by displacement, causes an upward flow of liquid which washes the solids and resists any tendency to diffusion. There is continually brought from the depths of the vat to the clear overflow a volume of barren liquid equal to the volume of solids being discharged from below. As the lower liquid in the vat is wash-water, diffusion is stopped automatically, and channeling is rendered impossible because the wash-water is intimately mixed with the slime before entering the vat. The L. C. Trent Engineering Co. has under construction eight of these machines, including one for the West End mill, Tonopah, and two for the Gold Cross mill, Imperial county, California.

A New Hoisting Cage

George S. Rice, chief mining engineer of the United States Bureau of Mines, has dedicated to public use a patent just issued by the Government for a hoisting cage which is primarily for use in rescue work, but can be used for other purposes.

In describing his invention, Mr. Rice states that it has for its object the provision of a novel cage which shall have peculiar advantages in regard to portability and ease of assembling and disassembling. He adds that although not limited to such use, it is of especial utility in mine-rescue work as an emergency cage. It frequently happens in case of mine accidents that the regular hoisting equipment may be so damaged or disarranged that it cannot be used. In such cases the provision of an emergency cage which can be made ready in a few minutes will greatly facilitate the work of rescue parties. The cage comprises a collapsible frame consisting of two flat bars, each bent into a form which may be termed approximately elliptical, and the ends welded together, thus forming endless members which serve not only as uprights but also as top and bottom frame parts. The inclosing members for the cage comprise horizontally arranged hoops, each bolted to the upright frame members, thus serving both to brace the frame and to form skeleton sides adapted to prevent falling or displacement of load. It will be seen that the generally elliptical contour of the cage will greatly facilitate its travel past obstructions in the shaft, and that the curved upright portions of the frame will serve to a certain extent as guide shoes. In large cages it may be desirable to use more than two of these frame members.

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EDITORIAL

REPORTS from Boston state that the Utah Metal Mining Company "is now drifting to the west in the face of a good silver-lead vein." This is, of course, much better than drifting down Salt creek in the teeth of a raging gale.

PARTICIPANTS in the visit of the American Institute of Mining Engineers to Japan in 1911 will be glad to learn that the *Umegaka Maru*, the clean little steamer in which the party traveled through the Inland sea and which was later sunk in a storm, has been raised and is being refitted.

INVASION of the 'tight little isle' by American slang is deprecated by the *London Mail*, which lays the blame upon the ubiquitous moving-picture film. Apparently the editor of our British contemporary is not a perspicacious attendant upon 'the movies,' since for the benefit of his readers he defines a 'flume' as a waterfall, and 'clean-up' as the completion of a task.

THE Hyde process of mineral flotation as conducted at the Butte & Superior property has been recently adjudged an infringement on the Minerals Separation American Syndicate, by Judge Bourquin in the United States District Court of Montana. The answer to the old question as to 'when is a patent not a patent' seems to be, until it has been adjudicated as such in from one to a half dozen courts.

A PRACTICAL application of Russell's 'dry lake theory' of salt deposition is recorded in the present number in an interesting account of the recent exploration work which has been conducted in Railroad valley, Nevada. Mr. E. E. Free, who has been in charge of this investigation, has made a valuable discovery which, as described in this article, furnishes the first direct evidence of the existence of a large salt deposit as confirmatory of the 'dry lake theory.' The discovery of this bed of gaylussite presents unquestioned evidence of a saline lake deposit, and there is every reason to suppose that future exploration work will result in the discovery of the more soluble salts of sodium and potassium.

ANOTHER evidence of the security of foreign lives in Mexico is presented in the recent arrest of Charles Biesel and Bernard MacDonald in Chihuahua and their sentence to death on the charge of conspiracy to defraud the government. Just how an attempt to move the bullion of one of the properties of the Mines Company of America out of the

path of the 'revolutionists' was construed as a capital offense punishable by death and also carried with it the right of the 'government' to confiscate an automobile belonging to the offenders, is a new wrinkle in the federal code. However, these are trying times in Mexico and laws are made and unmade with such rapidity that for the ordinary layman to keep posted on Mexican revolutionary jurisprudence is almost superhuman. After protest by the State Department, Messrs. Biesel and MacDonald have been released.

WHILE the general subject of mechanical efficiency as applied to mining and milling machinery is one which receives but little attention by the average superintendent, that it is one of importance in the final reckoning of cost is also certain. The subject of investigating rock-drill performance is one which has been practically neglected, and it is therefore pleasing, indeed, to present to our readers an article in the current issue on the subject of rock-drill testing as conducted at the North Star Mines. While the subject of the mechanical efficiency of air drills is not discussed as such, the data which are being obtained through this investigation have tended to materially increase the efficiency of the drills as well as decrease the complaints from the mine.

CONSTRUCTION of a plant for the manufacture of steel forgings, at Longueil, on the opposite side of the St. Lawrence from Montreal and about ten miles distant, is said to be assured. The plant, which is to be built by Armstrong, Whitworth & Company, Limited, will cost about $1,000,000. The iron and steel industry of Canada is showing healthy growth. In addition to the considerable tonnage of iron ore mined to the north of Lake Superior, the Canada Iron Corporation is now mining in Nova Scotia, where the Nova Scotia Steel & Coal Company and the Dominion Iron & Steel Company are also engaged in iron smelting, chiefly imported ore. The earnings of the latter company are improving rapidly, and the Canada Steel Corporation has under construction a concentrating plant for its ore.

GOLD production and its effect on industrial conditions is a topic which gives certain economists a great deal of concern. Business and banking credits are based on gold reserve, and the tendency of the population of India to acquire gold and hoard or bury it has caused much discussion in the past few years. Now the news comes that India is decidedly slacking off as a purchaser of gold, and Brazil and Argentina are also taking less quantities of gold than in former periods. The gold output of the world will therefore be, in a large measure, directed to the banking centres of Berlin, Paris, Vienna, and London, where it will go far toward relieving the present stringency of money markets. It is an interesting instance of how economic factors work together that, when the world's gold production gives every evidence of beginning to decline, a better natural readjustment of conditions is beginning to make a better utilization of the supply possible.

The Lake Superior Strike

The strike of the miners and millmen in the Lake Superior copper district has subsided to the dull routine of picket duty and an occasional encounter between some isolated workman and a crowd of strikers. The demands made include the recognition of the Western Federation of Miners, by which organization the strike was declared; an increase in the wage scale, decrease in the length of the working day to eight hours, the abolition of the one-man drill, and a general improvement in the conditions surrounding the miner. In short, the Federation demands that the same conditions be enforced in the Superior district as obtain through the mining districts of the West.

The Calumet & Hecla company, as the chief producer of the district, is the natural leader in the present controversy, and upon its action will depend to a large extent the attitude of the smaller mining companies, and, as such, a few words as to the Company's position are timely. It will be recalled that this Company made a general increase in the wage scale amounting to ten per cent, in May of last year, when copper was selling at 16 cents and better. This scale, which has in no way been altered with the decline in the price of copper, was largely responsible for the increase in the cost of production for the year from 8.52 cents in 1911 to 9.86 cents in 1912. This cost of production, under present working conditions and with the most modern equipment, is in excess of the cost of most of the large mining companies of the West. The one-man drill, which has been asked to be discarded, was adopted after experience had proved it to be a more efficient drill for the work in hand than the old two-man machine. It would seem that this was the logical thing for the management to do under the circumstances. It has been the history of all classes of industry to discard the inefficient for the efficient, and the efficient for the more efficient. Just why mining should be an exception to this, is one of the questions which the present strike has to decide. The question as to hours and wage scale is, of course, the all-important issue. The strikers' contention is that the time and wage scale should be placed on the same basis as that of the Western miners; the labor being the same, it should command the same wage. The operators hold that the price of metal will not permit of such an increase. The wage scale and working hours of the Western Federation, if adopted in the Lake Superior copper district, would mean approximately a 50 per cent increase in wage and a 25 per cent decrease in the length of the working day. If an increase of 10 per cent in the wage scale alone caused a rise in production cost from 8.52 to 9.86 cents per pound, will it be possible to operate the mines with a fair profit to the shareholders if the demands of the strikers are met as to time and wage and a comparatively inefficient drill is adopted as well? The question at least admits of debate, and is one which we trust will be submitted to judicious arbitration rather than to gunpowder, and an amicable understanding may be reached.

Flotation Processes

Flotation, as is well known, while discovered in the United States, found its first large and important field in beneficiation of the zinc ores at Broken Hill, Australia. In 1904, when the significance of the new development first came to be generally appreciated, it was estimated that nearly 6,600,000 tons of ore was made available for production in this one district. Roughly, this was equivalent to the world's consumption of spelter for two years, as matters then stood. There was in addition the possibility of a wide application of the process in other districts, and, at the time, great fears for the market were entertained. It is now estimated that the production of zinc ore at Broken Hill has attained a maximum, though but little more than one-third of the total estimated reserve has been worked into metal. While prices are depressed at present, it needs but a brief study of production and markets to make clear that the Broken Hill surplus has been placed on the market without general injury. The consumptive power of the world, as regards metals, has grown so enormously in the last decade that it is rather a question as to how much consumption would have been restricted by 'run-away prices' if flotation had not come to the rescue.

Whether the same sequence is to follow in the copper field is an interesting question. Copper production has increased by leaps and bounds—from 280,000 metric tons in 1891 to 529,000 in 1901 and 970,000 in 1911, the latest year for which complete figures are available. Consumption has, however, grown *pari passu*, and, while the copper surplus has been at times a dreaded nightmare, the visible supply amounts normally to little more than one month's consumption. A copper famine has been repeatedly predicted even by careful and conscientious students. In the meantime, development of the so-called 'porphyry' mines of the United States has greatly increased the production, and enormously increased the total amount of metal available by lowering the necessary content of the ore. It is worth noting that this has been due less to invention than to better business organization. The great mills at Garfield, Utah, and at Ray, Arizona, which have treated 21,000 tons and 8000 tons, respectively, in a single day, contain little that is novel. A one per cent copper sulphide ore is now treated, where formerly five per cent possibly spelled the lowest limit, because of capital investment, rather than of improvement in technology. The process used in the mills is wet-concentration, an old process made to do its best, rather than any fundamentally new scheme of treatment. It is the scale of operations that has converted worthless rock into ore. It is estimated that in 1913 a total of 1,590,327,000 pounds of copper will be produced by 32 American companies, including under that term, as is proper, those in both South and North America. More significant, possibly, is the fact that the total known ore reserve of seven of the great 'porphyry' mines may now be placed at 700,000,000 tons of commercial ore. The Chile Copper Company, whose operations at Chuquicamata are under the competent direction of Mr. Frederick Hellman, begins operations with 160,000,000 tons of 2.40 per cent copper ore, and with 'probable ore' to the extent of another hundred million tons or more. At this mine, as at the Braden, and at Anaconda, leaching is to be undertaken, but at most of the big copper mines in America the limitation as to saving is that fixed by the imperfections of wet concentration.

Speaking in general terms, the concentrating mills that operate on low-grade copper ores, save 70 per cent of the metal. In a few plants, and in still others at times, the recovery may run up to 80 per cent, but in general 25 to 30 per cent of the copper in the ore is lost. This large field for possible saving has attracted the best talent in the metallurgical field, and leaching and flotation are being tried at a number of places. Perhaps the most significant announcement is that the Inspiration Copper Company, impressed by the results obtained by Mr. E. H. Nutter, is applying the Minerals Separation process to Inspiration ore, as we announced April 19. If this proves as successful in the pilot plant of 600 tons as it has in the 50-ton plant that has been in operation for several months, direct treatment by flotation will be adopted, with an incidental saving of $1,000,000 in construction cost. Such an example is likely to prove contagious, and numerous tests on other American ores are already being made. The United States supplies over half the world's copper, and America as a whole, easily dominates copper mining. If, as begins to appear, adoption of flotation will render possible a 5 to 20 per cent better saving in American mills, the copper market faces the same problem as did the zinc market in 1904. Entirely aside from the effect of the revival of interest in leaching processes, which, while important, is not likely to be disturbing, preliminary estimates indicate a possible increase of 100,000,000 pounds of copper per year from the United States mines as a result of adoption of flotation. Of this, something over one-half may come from producing mines at which the process has been actually tested and found available. The remainder is from other mines, either in the same district or in which the ore is known to be of the same general character. While flotation is, as yet, an empirical process, and it is impossible to say in advance whether or not a given ore can be treated successfully, the above estimates have been made with care and are believed to be conservative. Applying the ratio of possible saving to the known reserves of ore, analogy to the history of flotation in its application to zinc ore is found in that a trifle over two times the world's present annual output of copper is added to the reserve by the expected increase in recovery. It will not do to push analogy too far, but it is easy to believe that this copper will come to the market so slowly as to meet merely the continued per capita increase in consumption and the abandonment of existing mines. We are permitted, therefore, to rejoice in the triumph of the metallurgists without fear of danger to investors. If by this means the large tonnage of waste may be made to yield an additional per cent to the net extraction, a great good has been accomplished.

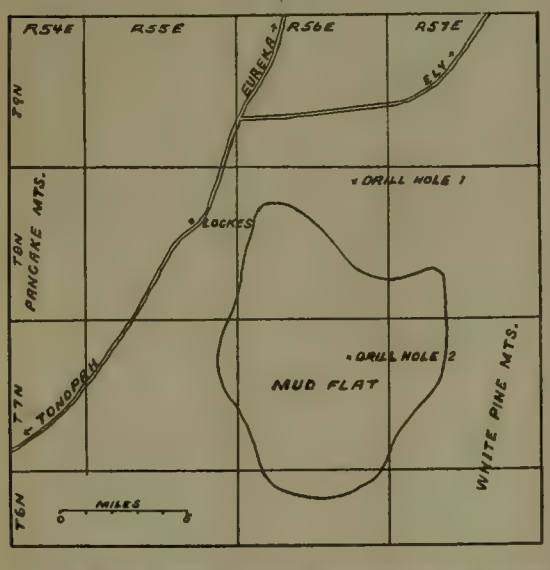
Progress in Potash Prospecting in Railroad Valley, Nevada

By E. E. Free

For nearly two years past, the Railroad Valley Co., of Tonopah, has been making an active search for a potash deposit in Railroad valley, Nye county, Nevada. The incentive of this search lies in what has come to be known as the 'dry lake theory,' the essentials of which were developed by Russell[1] with reference to the Quaternary lake Lahontan.

Dry Lake Theory

The theory may be outlined briefly as follows. Many of the landlocked basins which collectively make up the Great Basin show unmistakable signs of having been the homes of great lakes, among which



PART OF RAILROAD VALLEY, SHOWING SITUATION OF DRILL-HOLES.

Bonneville and Lahontan were the largest and have been most studied. Most of these lakes were as completely landlocked as are the present minor lakes of the Great Basin. Of the larger lakes, only Bonneville rose high enough to attain discharge to the ocean. The others, always undrained, must have accumulated in their waters large amounts of soluble salts derived from the normal solution of the rocks of the drainage area by rain and streams. The disappearance of these lakes can be ascribed only to a climatic change in the direction of greater aridity, with the consequent evaporation of the lakes, and, since there can have been no way of escape for the contained salt, that salt must be within the lake basins still. However, the most careful examination of the Great Basin discloses no bodies of salt sufficiently large to represent the saline residue of the vanished lakes. The surface salinity, while sometimes considerable, cannot account for more than a small fraction of the salts which the lakes must have contained. Confronted by this dilemma, Russell developed the theory of salt burial, or freshening by desiccation, which assumes that the missing salts were covered by washed-in alluvium after the complete desiccation of the lakes and are now buried beneath the basin floors either as actual salt bodies or as masses of saline alluvium. More recently, at the hands of H. S. Gale[2] and others, this theory has received the natural extension that such buried salt-bodies *may* contain segregations of potash and other valuable salines. Hitherto this theory has rested almost entirely upon indirect evidence only. With a few minor exceptions, no buried salt-body has been actually discovered. The work outlined in the present paper furnishes the first satisfactory direct evidence of the existence of such a body of significant magnitude.

Railroad Valley

In all essentials Railroad valley fulfills the necessary conditions of this 'dry lake theory.' It is a landlocked basin surrounded by high mountain ranges with no passes low enough to have been channels of discharge. The deepest depression of the valley is a comparatively non-saline mud flat or *playa*, the situation and relations of which are indicated by the accompanying sketch map. The drainage area now actually tributary to this flat is probably not over 4000 square miles; but previously, when a moister climate maintained a drainage of greater vigor, the tributary area was approximately 6340 square miles. Even now the cut-off portions of this former drainage are cut off only because of stream decay and the failure of all drainage. The drainage is barred by no important divides.

At the present time there is no permanent lake in the basin. Heavy rains occasionally produce floods in the central *playa*, and during a part of the year water from springs stands an inch or two deep over a small area on the western margin. It is possible, however, to trace around nearly the entire circumference of the basin remnants of two well marked shore terraces and of several intermediate ones which are less pronounced. The highest of these terraces is approximately 150 ft. above the present *playa* and furnishes conclusive evidence of the existence in recent geologic time of a lake of considerable depth and probably about 225 square miles in area. From present data, the history of this lake is not decipherable in detail, but the system of fainter terraces below the highest indicates that the fluctuations of the lake were not essentially dissimilar from those of Lake Lahontan and the other lakes which have been more closely studied. As with them, the disappearance of the lake is to be ascribed to climatic causes, and the salts which its waters contained must be buried beneath the basin floor.

The hope that this hypothetical salt-body may contain potash rests mainly on the character of the rocks composing the drainage area of the basin.

[1] 'The Geological History of Lake Lahontan,' U. S. Geol. Survey, Monograph 11 (1885).

[2] U. S. Geol. Survey, Bulletin 530-A (1911).

Rhyolites of high potash content are prevalent, and probably predominate. The eastern border of the basin is the high and steep White Pine range, rising sharply from the deepest depression of the basin and consisting largely of Silurian limestones and other Paleozoic sediments. Rhyolites or other igneous rocks are not prominent, though several limited areas have been identified, especially in the southern portion of the range. The western border of Railroad valley proper is the Pancake range, but this is not the boundary of the drainage area. Hot Creek valley, which lies westward from the Pancakes, is tributary to Railroad valley, the drainage crossing the Pancakes through Twin Springs pass. The western border of Hot Creek valley, and of the Railroad valley drainage, is the prominent Hot Creek range, centrally of sediments similar to those of the White Pine range, but containing large areas of rhyolites and other volcanics at both northern and southern ends. The intermediate Pancake range is almost entirely of volcanics, even the occasional water-laid beds being largely of volcanic tuff. Both rhyolite and basalt are abundant, the latter being represented by some recent flows and cones, but the rhyolites are far more extensive than the basalts. Reliable quantitative estimates will not be possible until more accurate geologic maps are available, but it is safe to assert that the high-potash rhyolites cover a sufficient proportion of the basin to insure the abundant presence of potash in the drainage and in the waters of the ancient lake.

Results of First Drill-Hole

The first important step in the potash prospecting was the sinking of a drill-hole, about three miles north of the mud flat, at the point marked 'drill hole 1' on the map. The hole was sunk with a churn-drill to a depth of 1204 ft., and required for drilling a little over five months, from March to August, 1912. The materials encountered were alternating sand and clays, with the clays largely in excess. Below 100 ft. nearly all sand carried fresh artesian water. Between 1140 and 1144 ft., there was encountered a cemented sand, the cement of which was determined as gaylussite by J. Claude Jones, of the Mackay School of Mines, Reno, Nevada. Between 1175 and 1190 ft. was a similar cemented sand, but with the cement of calcite instead of gaylussite. With these two exceptions, no chemical lake deposits were encountered in the hole. Between 1190 and 1204 ft., the materials were alternating sand and reddish clays. Further progress was impossible because the casing could not be forced through the cemented material between 1175 and 1190 feet.

This record was interpreted as indicating that the drill site was too far north and had missed the edge of the basin in which the salt had accumulated and been buried. Accordingly, a second drill-hole farther south was decided on, and, after some shallow exploratory drilling with a hand drill, a site was selected near the centre of the mud flat as shown on the map. Drilling operations in such a place are extremely difficult. The moving of the equipment over the spongy surface of the mud flat was slow and difficult, and was rendered more so by floods. Fuel wood had to be brought from over 30 miles away. It was necessary to construct a ditch eight miles long in order to bring water for drilling purposes from the artesian flow of hole No. 1. These difficulties consumed much time, but were successfully surmounted, and the drill was started at 8:20 a.m. on July 7, 1913. At midnight, July 12, the drill had reached a depth of 843 ft., and drilling was discontinued, the record being deemed sufficient for present purposes. The machine employed was the combined rotary jetting equipment of the American Well Works, drilling a hole 5½ inches in diameter. No casing was employed, it being found unnecessary. Careful watch was kept of the material penetrated, not only by continuous sampling and examination of solid materials brought up, but by chemical analysis of descending and ascending drill water at 10-ft. intervals. The record of the hole is as follows:

Surface	to	2½ ft.	Brown clay containing skeleton crystals of calcite.
2½	" 22	"	Gray clay.
22	" 44	"	Soft black mud.
44	" 52	"	Gray clay.
52	" 55	"	Black mud.
55	" 56	"	Gray clay.
56	" 69	"	Black mud.
69	" 85	"	Dark gray clay.
85	" 113	"	Black mud.
113	" 114	"	Gray clay.
114	" 121	"	Black mud.
121	" 128	"	Gray clay.
128	" 136	"	Black mud.
136	" 149	"	Gray clay.
149	" 151	"	Hard black clay.
151	" 169	"	Alternate thin layers of black and gray clay.
169	" 173	"	Alternate layers of black and brown soft clays.
173	" 191	"	Stiff gray clay.
191	" 195	"	Soft black and gray clays.
195	" 232	"	Hard gray and black clays, slightly saline.
232	" 241	"	Hard black mud.
241	" 251	"	Gray clay.
251	" 258	"	Gray clay cemented with a small proportion of a calcareous cement, probably calcite.
258	" 272	"	Gray clay.
272	" 279	"	Cemented gray clay.
279	" 280	"	Soft black clay.
280	" 288	"	Cemented black clay.
288	" 290	"	Soft gray and black clays.
290	" 297	"	Cemented black clay.
297	" 301	"	Soft gray and black clays.
301	" 304	"	Cemented black clay.
304	" 306	"	Gray clay.
306	" 316	"	Soft white clay.
316	" 360	"	Hard gray clay, probably cemented.
360	" 394	"	Gray and black clay, probably alternate layers.
394	" 422	"	Hard black clay.
422	" 426	"	Hard gray clay.
426	" 429	"	Cemented black clay.
429	" 463	"	Hard black clay, probably with occasional gray streaks.
463	" 475	"	Light gray and brown clays with cemented streaks.
475	" 487	"	Cemented black clay.
487	" 492	"	Black clay.
492	" 506	"	Cemented black clay.
506	" 517	"	Hard gray clay.
517		"	Two-inch stratum of hard rhyolitic volcanic ash.

517	" 529	" Hard gray clay.
529		" Thin stratum of rhyolitic volcanic ash.
529	" 550	" Gray and black clays, probably alternating layers.
550	" 556	" Cemented black clays.
556	" 567	" Soft white and brown clays.
567	" 582	" Stiff white and brown clays.
582	" 639	" Soft white and brown clays.
639	" 653	" Light gray clay with occasional cemented streaks.
653	" 659	" Hard light brown clay, partly cemented.
659	" 679	" Tough gray clay.
679	" 682	" Soft gray clay.
682	" 684	" Hard brown clay, somewhat saline.
684	" 718	" Tough gray clay.
718	" 765	" Gray clay with crystals of gaylussite, and carrying many hard layers cemented with gaylussite.
765	" 781	" The same, with the proportion of gaylussite crystals increasing downward.
781	" 790	" Crystalline gaylussite.
790	" 794	" Rapid alternations of crystalline gaylussite and gray clay with loose gaylussite crystals.
794	" 799	" Crystalline gaylussite.
799	" 841	" Crystalline gaylussite with occasional layers of gray clay carrying gaylussite crystals.
841 –	" 843+	" Crystalline gaylussite.

This record falls easily into four main divisions: 1, alternate gray and black clays, 2½ to 251 ft.; 2, the same with cemented layers, 251 to 556 ft.; 3, brown, white, and light clays, 556 to 718 ft.; 4, crystalline gaylussite, with some admixture of gray clay, 718 to 843 feet.

Significance of Gaylussite Beds

It seems beyond question that the gaylussite bed between 718 and 843 ft. represents the deposit of a saline lake. In no other way could there be deposited so large a body of this mineral in such comparatively pure condition.[3] Gaylussite is relatively insoluble in water or saline solutions, and is therefore the first or one of the first minerals to be deposited by an evaporating lake. With the exception of calcite and gypsum, any other minerals which may have crystallized from the lake ought to overlie the gaylussite, and it follows that the gaylussite bed furnishes a datum representing an early stage of the lake's desiccation. The clay layers and admixture in the gaylussite doubtless correspond to floods, wet seasons, etc., which brought unusual amounts of alluvium into the lake and possibly interrupted for short periods the deposition of the gaylussite. However, the essential purity of the bed implies strongly that such interruptions were minor and transient and that the evaporation of the lake proceeded fairly steadily and probably fairly rapidly.

From the gaylussite bed alone it is not possible to say that the lake evaporated completely to dryness, but a strong implication to this effect is carried by the non-salinity of the superposed clays. It is inconceivable that the lake could have contained in its waters the constituents of gaylussite, and them only. There must have been present also some or all of the usual more soluble salts, the chloride, sulphate, and carbonate of sodium and the salts of potassium. If the lake continued steadily to evaporate, the deposition of gaylussite would cease only with or after the commencement of deposition of some more soluble salt. In any case, the deposition of all or a large part of the gaylussite would leave the lake a mother liquor, not necessarily highly concentrated, but containing large total amounts of the various more soluble salines. If the lake then were freshened, thus causing a cessation of chemical deposition, these more soluble salts would remain in solution and would be found either on the present surface or impregnating the clay beds overlying the gaylussite. Neither is the case. The surface salinity of the basin is inconsiderable, and only two thin strata of the superposed clays carry noticeable amounts of salt, 195 to 232 ft., and 682 to 684 ft. A dried sample of the former, from 196 ft., contained 3.73% of water soluble materials, mostly sodium chloride and carbonate. A sample of the lower stratum, from 683 ft., contained 6.99% of water soluble material, mostly sodium chloride and sulphate.

Position of the Soluble Salts

In my opinion the facts are better explained by the hypothesis that the lake went completely or nearly to dryness. The more soluble salts would then be deposited above the gaylussite and probably over a more restricted area in the deepest depression. The failure to find them in the present drill-hole must be assumed due to the hole having been beyond the edge of this area. The gaylussite may have a much wider extent than the soluble salt bed overlying it. It is expected that later exploration work will either prove or disprove this.

On these assumptions, I am strongly inclined to regard the light colored clays between 556 and 718 ft. as the product of *playa* conditions following the complete desiccation of the lake. It is not impossible that the slightly saline stratum of 682 ft. may be an outlier of the main soluble salt body. The superposed black and gray clays, calcite-cemented strata, etc., are probably the record of a series of shallow and transient lakes subsequent to the greater lake which deposited the gaylussite, none of which minor lakes lasted long enough to produce any important chemical deposit. It is apparently only recently that this succession of transient lakes has given way to *playa* conditions and to intenser desiccation. Only the superficial 2½ ft. of the record is the product of the present conditions. It is quite possible, however, that short desiccation periods, similar to that now existing, have broken occasionally the succession of transient lakes and are recorded in the light colored clays encountered at 169, 306, and 463 ft. The slightly salty bed at 195 ft. may well represent a minor saline bed corresponding to one of the periods of desiccation.

Practically, the problem has now become one of finding the bed of soluble salts believed to overlie the gaylussite and which it is hoped may contain potash or other valuable salines. It is believed that the gaylussite horizon will furnish a datum plane which will make this possible and further holes are to be drilled immediately in order to obtain further data on the subject.

[3]Gaylussite is Na_2CO_3, $CaCO_3$, and $5H_2O$; or sodium carbonate 35.81%, calcium carbonate 33.78%, and water 30.41%. My field identification of the gaylussite has been confirmed by J. Claude Jones.

Rock-Drill Testing at the North Star

By Robert H. Bedford and William Hague

*The following article, describing efforts made to throw light on some of the dark spots connected with rock-drills and drilling, may prove interesting to those with whom the drilling problem is relatively important. At the North Star mine, Grass Valley, California, where these tests have been carried on, the ore is a narrow vein of quartz between walls of tough diabase in the upper, and no less tough granodiorite in the lower levels. The amount expended last year at this mine upon drilling, namely, for labor, power, repairs, lubricants, hose, and tool sharpening, was 20% of all outlays made. It is, therefore, of the utmost importance that the drills shall be kept in the best repair. The work of collecting details of drill-repair data started about two years ago. Early in the investigation it was found that drills which sounded all right when run against a block in the repair shop, frequently did but poor work underground. A great part of the loss in the mine was directly due to inferior condition of machines. There was needed some testing device which would give reliable information concerning the condition of a drill. W. D. Paynter, the 'drill doctor,' accordingly set himself to the task of devising such a machine.

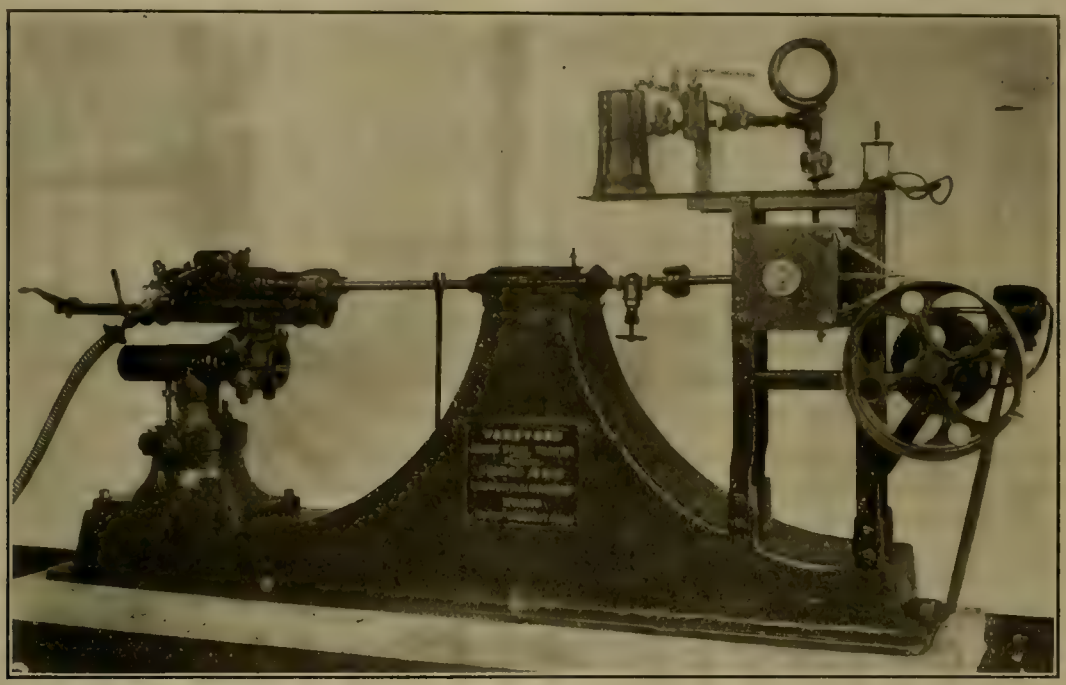


Fig. 2. TESTING MACHINE, WITH DRILL IN PLACE FOR TESTING.

The First Tester

The tester as originally constructed consisted of a plunger, cylinder, and diaphragm, the system being filled with oil. This is shown in Fig. 1.

The blow of the drill, through the plunger and oil, expends its energy in distending the diaphragm. The number and magnitude of these movements of the diaphragm, when suitably recorded, give a graph of the work done by a drill. The magnitude of each diaphragm movement is measured by a lever, so arranged as to record the displacement in an amplified form upon a strip of paper fastened to the periphery of a revolving drum. The graph so obtained, in addition to showing the number of blows per minute and the strength of each blow, shows any abnormal action of the drill. Results obtained with this crude apparatus were encouraging enough to warrant the building of a more elaborate and precise machine, the essential features of which have been patented by Mr. Paynter. This machine is able to test both air-feed stopers and reciprocating drills.

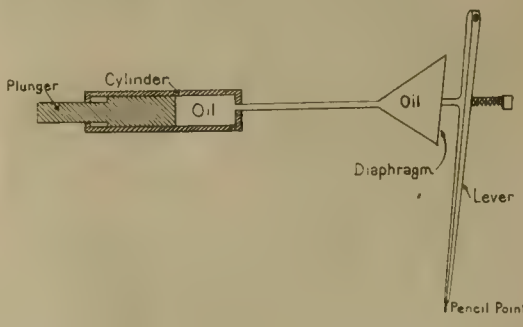


Fig. 1. DIAGRAMMATIC SKETCH, SHOWING ESSENTIALS OF TESTER.

Fig. 2 is a half-tone of the perfected machine, with a feed-screw machine in place to be tested.

Fig. 3 is the card of an air-feed stoper, No. 205.

*Acknowledgment is also given to the engineering staff of the North Star Mines.

This card was obtained in the following manner. The drum was revolved with no pressure on the system, the resultant trace is marked 'O air pressure.' Air was then admitted to the feed barrel and the drum revolved to give the trace marked 'feed barrel pressure.' With the drum revolving, the drill was started, giving the trace marked *A B C*, etc. The length of the line *A B* represents the magnitude of the kinetic energy of the blow delivered by the hammer. The reaction of the diaphragm in assuming its normal position is shown by the line *B C*. That the strength of the blow might be given in foot pounds, the tester was calibrated by means of a pendulum.

Fig. 4 is a card obtained from another machine of the same type but showing a small intermediate 'reactionary' blow, which has not as yet been explained. The drilling speed in hard rock should be compared to that given with Fig. 5.

Fig. 5 is a card of a machine in poor repair. It is of interest because it plainly shows a great departure from the graphs obtained from good machines of which Fig. 3 and 4 are examples. The great variation in the actual drilling speed obtained by the machines shown in Fig. 4 and 5 in hard rock confirms what the tester indicates by the relative strength of blow.

Below are given in tabulated form the results of tests on various machines. Unless otherwise stated, the machines tested are air-feed stopers of various construction.

TABLE I.—MACHINE No. 85,042

Gauge.	Blows per min	Ft-lb. per blow.
98	2280	29
90	2244	27
85	2208	25
74	2100	21
66	2016	20

It should be noted that the strength of blow seems to be more affected than the number of blows by the gauge pressure. Thus, in this instance, a 32% drop in pressure caused a 31% drop in the strength of blow, but only a 12% drop in the blows per minute. This has been the case with every type of machine so far tested.

Table II shows the effect of various gauge pressures upon drilling speed in hard rock.

TABLE II

Machine.	Gauge pressure.	Blows per min.	Ft-lb. per blow.	Ft. drilled per minute	Remarks.
No. 501	95	1210	39	0.36	Sharp steel.
	80	1170	34	0.34	
	70	1115	27	0.19	
No. 501	90	1200	38	0.26	Same steel as
	80	1170	34	0.23	used in first
	70	1115	27	0.14	test.
No. 201	95	1190	39	0.20	
	80	1150	34	0.20	
	70	1100	27	0.15	

In this table the blows per minute and the foot-pounds per blow at the various pressures are taken from curves plotted from the results of a number of tests made on machines of this type of construction.

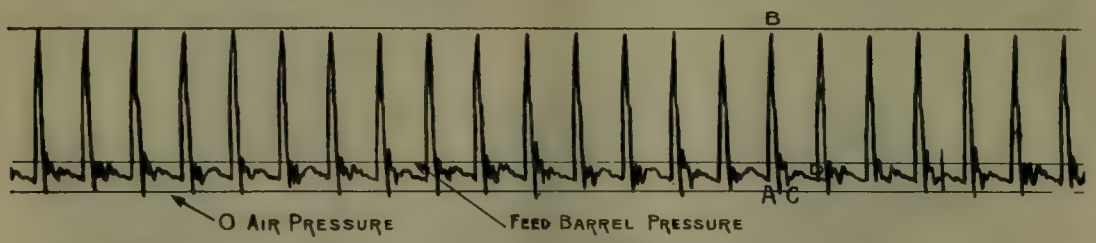


FIG. 3. No. 205. AIR PRESSURE, 100 LB. BLOWS PER MINUTE, 1284. FOOT-POUNDS PER BLOW, 50.

From these results it appears that the drilling speed in this particular rock, and for this particular type of machine, depends largely upon the strength of the blow, within certain limits. The data are insufficient as yet to say more on the subject. In general this table confirms the results shown in Fig. 4 and 5.

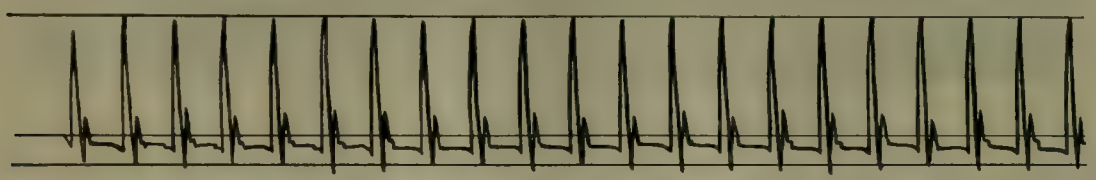


FIG. 4. No. 217. AIR PRESSURE, 96 LB. BLOWS PER MINUTE, 1260. FOOT-POUNDS PER BLOW, 40. DRILLING SPEED IN HARD ROCK, 105 FT. PER MINUTE AT 84 LB. PRESSURE.

Losses Due to Defects

The following tests show what loss may be caused in drilling speed by various defects in machines. Drill No. 516 was tested to find the effect of different conditions of feed packing leather.

Packing.	Gauge.	Blows per min.	Ft-lb. per blow.
New	95	1356	44
Old	95	1332	39
Damaged	95	1296	34

Drills No. 507 and No. 09152, the latter a feed-screw machine, which had been reported from underground as being in 'good shape,' but unable to do satisfactory work, were tested before and after equipping with new cylinders. Both these machines

were reported as 'doing well' when again used in the mine. It should be noted that the blows per minute vary but little.

Machine.	Cylinder.	Gauge.	Blows per min.	Ft-lb. per blow.
No. 507	old	98	1212	21
.....	new	95	1176	36
No. 09152	old	95	1248	16
.....	new	97	1224	36

As only one test was made to find the effect of various lubricants upon a new machine, the following figures are interesting, but not conclusive. A worn cylinder might give less pronounced differences.

Lubricant.	Gauge.	Blows per min.	Ft-lb. per blow.
Heavy	95	1116	25
Medium	95	1212	34
Light	95	1224	38

The statement is frequently made that excessive air consumption indicates that a drill is in bad condition. From a large number of tests, machines of type No. 200 and No. 500 have been found to have an average air consumption of 75 to 80 cu. ft. free air per minute at 90 lb. gauge pressure. A test of a machine of this type using 90 cu. ft. of free air at the same pressure, gave 1296 blows per minute and 43 ft-lb. per blow. From this it would seem that increased air consumption does not necessarily indicate that a machine will do poor work.

As a further example of the usefulness of the tester, this instance is cited. Four new valves were obtained from the manufacturers and were placed in machines. The tester showed that one failed to meet the standard set. Upon investigating, a piece of steel cutting was found concealed in one of the ports. This had throttled the air sufficiently to reduce the strength of blow about 35 per cent.

Although many tests have already been made, the data are by no means complete. We believe, however, it has been shown that by means of this device it is possible to set a standard which all machines must attain before leaving the shop, thereby facilitating the problem of drill maintenance. No figure in dollars can at present be given for the saving effected; but it may be stated that complaints from the mine about the condition of machines have been materially reduced.

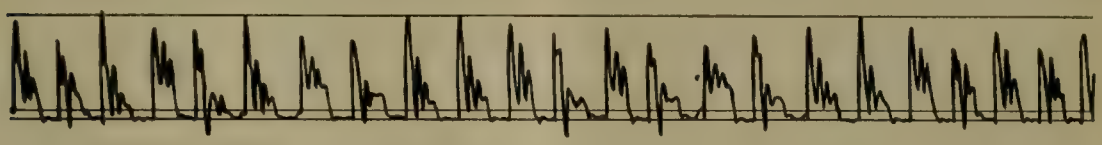


FIG. 5. NO. 227. AIR PRESSURE, 84 LB. BLOWS PER MINUTE, 1272. AVERAGE FOOT-POUNDS PER BLOW, 15. DRILLING SPEED IN HARD ROCK, 0.05 FT. PER MINUTE AT 84 LB. PRESSURE.

Oil Production in Peru

*Along the north coast the following oil companies have been in operation for some time: The Lobitos Oilfields, Ltd., the Zorritos establishment of Faustino G. Piaggio & Co., Ltd., the London & Pacific Petroleum Co., Ltd., the Lagunitos Oil Co., and more recently the Bayovar Oil Development Co., Ltd. The Zorritos property is now producing in excess of 15,000 metric tons of crude oil annually, and the Lobitos field yields about 65,000 tons. The Talara, Negritos, and La Brea regions, worked by the London & Pacific and the Lagunitas companies, are producing between 120,000 and 130,000 tons. The chief markets at present for this oil are in Peru, Chile, and California, but with the opening of the Panama canal route, oil-tank steamers will undoubtedly pass through from the West Coast fields to the great consuming centres on the Atlantic seaboard.

The above companies are doing good work, as also is a recently formed company for the development of an important area adjacent to the Port of Bocapan, situated between Zorritos and Lobitos. This undertaking, known as the Bocapan Oilfields, Ltd., registered in Callao, consists of a property of some 900 *pertenencias* in a well studied area, more or less divided between Tertiary and post-Tertiary strata. Plant of modern type has been purchased for working this property, and competent management has been engaged.

*Abstract from *Peru Today*.

Costs at the Lake View & Star Mines

During its fiscal year, these properties produced 212,606 tons of ore, which was treated at the following cost:

	Cost per Ton		
Mining:		Milling:	
Development	$0.50	Rock-crusher	$0.05
Breaking ore	0.97	Ore transport	0.07
Filling stopes	0.09	Stamping	0.35
Tramming and hoisting	0.58	Concentrating	0.14
		Roasting concentrate.	0.11
		Filer-pressing	0.26
Total mining	$2.14	Precipitation, clean-up	0.06
Cyaniding concentrate.	$0.06	Disposal of residue..	0.10
Fine grinding concentrate	0.04	Total milling	$2.28
Fine grinding sand	0.35		
Preliminary grinding..	0.17	General expenses	0.22
Agitation	0.52	Bullion charges	0.04
		Total working costs..	$4.68

The Lake View and Star mines are about a half-mile apart, and ore is taken to the mill on the former property by a narrow-gage steam locomotive and 3-ton cars. It is then dumped into a storage-bin or pass, and hoisted up the Lake View shaft. With ore from the latter, the whole product is broken by a large jaw-crusher and transported to the mill-bins by belt conveyor. There are 75 stamps at work, crushing ore through a coarse screen, the pulp being further reduced in Freeman pans, one for each battery of five stamps. After agitation, it is filter-pressed, precipitation of gold being by zinc shaving. The concentrate is roasted in Edwards furnaces, ground and amalgamated in pans, agitated, and filter-pressed.

The Witwatersrand Gold Industry in 1912

By W. L. Hosson

In the light of data now available for the past year it is clear that, taken as a whole, the mines of the Rand have made notable advancement. This is true in respect to both operation and intrinsic soundness, as well as the financial position generally.

A total of 25,486,361 tons was milled by about 60 producing companies, as against 23,888,258 tons during the previous year. The yield in gold amounted to £37,182,795, equivalent to 29s per ton, which was 1s 1d. per ton better than for 1911. The gold won was, therefore, 10.8% greater, although the scale of operations increased by only 6.7%. Explanation lies partly in the fact that for the previous year the unit recovery was abnormally reduced, owing to several companies mining an unnecessary proportion of unprofitable ore. Comparison is further complicated by the knowledge that in both years several companies, for good reasons, worked somewhat above the average grade of their ore reserves.

Average Working Cost

The average working cost advanced from 18s to 18s 6d. This apparent advance should not be taken too literally, since, to some extent, it was due to the fact that the figure for 1911 was unduly low because of the mistaken policy of mining unprofitable ore, referred to in the preceding paragraph. Apart from this consideration there were certain factors which undoubtedly affected costs unfavorably. Chief among these may be mentioned the increase in cost of native recruiting and higher wages. The high cost of securing labor has now been checked by the formation of the Native Labor Corporation, which will deal with the matter cooperatively and correct in some measure the past disadvantages of competition. Costs were also adversely influenced by increased inefficiency of white labor, brought about by the eight-hour law, more exacting government regulations, and the expenditure called for in consequence of legislation for the compensation of miners suffering from phthisis. The last charge will be largely eliminated by concerted application of preventive measures, more particularly the maintenance of a moist atmosphere throughout the mines by liberal spraying. In considering working costs, it has also to be borne in mind that in 1912, as in the preceding year, there was a disposition in many instances to charge directly to working accounts extraordinary items which, if money could have been raised as freely as in the past, would have been dealt with as capital expenditure.

The working profit totaled £12,678,099, as compared with £11,415,861 for 1911, a gain of slightly over 11%. The per ton figures for the two years were 10s and 9s 7d respectively.

In the matter of dividends the showing is outwardly not so satisfactory. There was an increase of £189,908 in the aggregate distribution, making the total for the year £7,952,994, but the per ton declarations averaged only 6s. 3d. as against 6s. 6d. for the previous year. The explanation lies chiefly in that the money markets were unfavorable to the provision of additional working capital. For this reason it was necessary, as in the year before, to appropriate large amounts to cover extraordinary expenditure in connection with additions and alterations, both underground and at the surface. These changes had to be undertaken at this time, more particularly in connection with the recently merged properties, and under more propitious monetary circumstances would have been charged to capital account. This point will perhaps be clearer if the following per ton figures are considered:

	Working profit.	Distributed	Undistributed.
1910	10s. 6d.	8s. 1d.	2s 5d.
1911	9s. 7d.	6s. 6d.	3s. 1d.
1912	10s. 0d.	6s. 3d.	3s. 9d.

The tendency shown by this comparison would be cause for uneasiness were it not that the special improvements to which it is due are either completed or nearing completion. It has, however, to be borne in mind that, as a result of the hopeful feeling which prevailed in 1910, certain mines overreached themselves and made a better showing than was warranted by their intrinsic position. Figures for that year consequently cannot be taken as an absolute basis of comparison, although in the aggregate they were not far out and may be again realized. One is forced to the conclusion, therefore, that the relatively poor showing of the last two years in the matter of dividends is not due to intrinsic deterioration, but to an enforced change in financial policy.

Working Profit v. Dividend

Whether and to what extent it may be possible and advisable to bring about a closer relationship between working profit and dividend than that shown above, is a question open to difference of opinion, but not so simple as has been suggested. If we take working cost as covering all head office, maintenance, and operating expenses, including the development called for by the equipment provided, then the remaining super charges against working profit fall chiefly under the heading of interest and redemption of loans, profits tax, and capital expenditure. It would, of course, be possible to add to the published monthly and quarterly costs a fixed charge per ton under each of these three headings, or any others that might be called for. These fixed charges would be based on experience and probability and would be fairly reliable as to loans and profits tax, although in the latter case, owing to its determination being a matter of complex calculation by government officials at the close of the year, only an approximate figure could be used. The matter of capital expenditure however, would present far more difficulty. As commonly interpreted it embraces all the various and varying items of ex-

*Published by arrangement with the Transvaal College of Mines Quarterly.

traordinary expenditure necessary to conform to engineering progress, meet the demands of expansion, and deal with both incidental and accidental exigencies of major importance. These items, obviously, cannot be charged directly to working costs without perversion of the comparative value of the latter and the consequent confusion of the shareholders. It is not surprising that directors and engineers hesitate to forecast expenditure when it includes such a variety of items. If a true approximation were attempted, those responsible would probably find themselves either trammeled by underestimates or criticized for misleading overestimates.

Financial Policy

In practice, the latter would probably be taken as the lesser of two evils and generous provision would be made against contingencies, a course hardly favorable to economy. It may be urged that any resulting surplus could be carried forward or credited to general revenue and expenditure. But this is equivalent to abandonment of the advantage aimed at; for the surplus might equal the margin of uncertainty under the present policy. Even if it were possible to forecast the expenditure with approximate accuracy, and this forecast were embodied in the monthly and quarterly reports, the showing would still be open to misconstruction owing to uncertainty as to the financial policy that might be called for at the close of the year, more particularly as to the matter of balance forward. Furthermore, the financial policy of a company is open to modification in accordance with market conditions, or other circumstances, and there are a number of companies which at a favorable moment may, by new share issues or otherwise, materially alter their position and thus make available for distribution amounts that have now to be apportioned to capital expenditure. Enough has been said to show that the question is not so simple as has been implied by some critics. The prevailing custom admittedly results in interim reports which do not directly reflect the dividend position. Such perfection, however, is not aimed at; it might be realized by some of the companies some of the time, but not by all of the companies all of the time, a consideration of special bearing where uniformity is as important an item as on the Rand.

Reports

All that is claimed for the monthly and quarterly reports as now published is that they provide confirmation or modification of certain comparative data, the dividend significance of which has been previously foreshadowed by precedent and prophecy with as much certainty as would probably result from a more ambitious attempt. Taken in this light, much can be said in their favor. It should, perhaps, be added that some critics have advocated going to the other extreme and publishing no interim reports whatever, their argument being that, apart from the fact that at best such publications may prove misleading in some degree, there is the practical consideration that they may lead to a somewhat costly struggle for regularity in matters essentially irregular.

Recent Position of Companies

With regard to the industry as a whole, it is doubtful if, taken from the standpoint of actual demonstration, it has ever shown greater soundness, that is, a more satisfactory correlation between salient factors. The financial position of the companies generally is unusually strong. Plants are in good condition and, where required, have been enlarged to meet the demands of expansion. Necessary underground haulageways and mechanical facilities have been provided to meet the requirements of increasing tonnage and greater tramming distance. Development is well advanced and there is apparently no material change in tenor. The native labor situation is probably more satisfactory than ever before, and is in the way of further improvement, partly through the better organization recently effected, and partly through the wider use of machine drills. In the latter connection, it is interesting to note that the number in use has increased by about 57% within the past two years, a total of 5634 drills now being employed. Unfortunately, the white labor position is not so satisfactory, this country, like most others, having now to contend against both shortage and inefficiency. This difficulty will probably disappear when it is recognized, as it inevitably must be sooner or later, that the existing prejudice against the employment of natives of superior capacity on certain so-called 'skilled labor' is unreasonable and inadvisable under the circumstances. The prospect in this connection, however, is too vague to be reckoned at present. Generally speaking, the mines are neither unduly pressed as to tonnage and grade, nor over-strained as to dividends. In fact, there is a reserve of strength in the working position that promises to find expression in a materially improved showing for the current year.

Gold in the World's Banks

The following table, dealing with this important subject, has recently been compiled by the London *Statist*, as shown in the following table:

Banks	1913	1912
Austria Hungary	£ 50,412,000	£ 52,067,000
Belgium	8,883,000	7,611,000
Denmark	4,483,000	4,344,000
England	38,493,000	41,510,000
France	132,641,000	130,440,000
Germany	53,977,000	44,395,000
Italy	50,463,000	46,084,000
Netherlands	13,451,000	12,033,000
Norway	2,349,000	2,035,000
Russia	161,101,000	150,498,000
Spain	18,216,000	17,034,000
Sweden	5,704,000	5,225,000
Switzerland	6,836,000	6,420,000
United States Treasury	256,954,000	247,330,000
United States national banks	30,248,000	32,675,000
*Argentina	52,660,000	41,854,000
*Brazil	24,909,000	23,076,000
†India	25,664,000	21,620,000
Total	£937,444,000	£886,251,000

*Conversion offices.
†Currency and gold standard reserves.

To this should be added about £20,000,000 held by banks in Australasia.

SHEEP CREEK CAMP AND AERIAL TRAMWAY TO TUNNEL. MAIN ADIT TO PERSEVERANCE MINE.

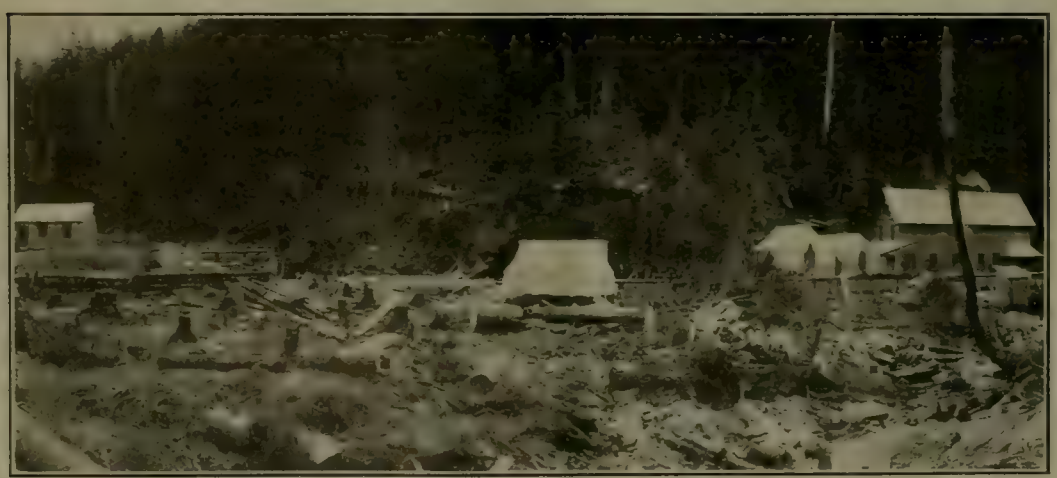
Preparatory Work of the Alaska Gold Mines Company

By Grant H. Tod

The work being conducted by the Alaska Gold Mines Co., the holding company for the Alaska Gastineau Mining Co., is of great interest to the mining public, and a brief outline of the general situation should be opportune. The ground now being developed comprises a mineral district from 70 to 400 ft. wide, with an approximate length of three miles. The ore in this zone averages from $1.50 to $2 per ton, with an estimated recovery of from $1.25 to $1.50 per ton. The margin of profit is estimated to be from 50 to 75c. per ton milled. This grade of ore will necessitate working a large tonnage, and for that reason a little over two years ago the Alaska Gastineau Mining Co., being satisfied with the results of development work, commenced operations on a large scale. The first work to be done was the driving of adits to cut the orebodies at depth and afford transportation facilities for the ore from the mine to the Gastineau channel. The millsite and railroad connections with these adits can be seen close to Juneau, and have been so arranged as to facilitate the handling of ore.

Mine Development

Plans being carried out at this time are as follows: The Perseverance claim, in the Silver Bow basin, being developed by means of raises, shafts, and drifts, has resulted in the opening of some large stopes. The building of permanent houses to replace the construction camp is now well under way. Machinery and railroad facilities are being rapidly installed which will handle a daily output of 10,000 tons. The plan of development is to be so arranged, owing to recent discoveries of new orebodies in the mines, that this output can be increased to 20,000 tons per day. At the Perseverance mines, H. J. Jackson, the superintendent, is pushing development work. The main vertical raise, 940 ft. in height, has been enlarged to a 3-compartment shaft and is now being sunk to meet the main



SALMON CREEK CAMP AT DAMSITE. ALASKA GASTINEAU MINING COMPANY.

RESERVOIR-SITE ON SALMON CREEK.

adit from the Sheep creek side, on the Gastineau channel.

One feature of interest is the fact that practically all the metal content of the ore in the Gastineau properties is contained in the large quartz lenses that make up about 50% or over of the entire ore zone. This permits of an easy mechanical sorting process at the mills, by using roughing tables as sorters. The rest of the ore zone, being slate and of little value, is easily sloughed off, after the first grinding, and does not need to enter into any future treatment of the ore. This places an entirely new face on the possibility of treating $1.75 grade of ore.

Ore Transport, Power, and Mill Construction

At Sheep creek, south of Juneau, on the Gastineau channel, a large tract of land was obtained on which will be built the mill, machine-shops, boarding and bunk-houses, warehouse, and other buildings. The first unit of the plant is to have a capacity of 6000 tons per day.

An electric railroad is being built to connect the millsite with the Perseverance mine, three miles distant. Two miles of this distance will be through an 8 by 10-ft. tunnel, which is now being driven in hard slate at a splendid rate of advance. During the month of June, 570 ft. was driven, and on some days during this month a rate of 1 ft. per hour was maintained. The ground was stiff, requiring 24 holes to be drilled to the round. A good indication of the splendid system with which this work is being conducted is the fact that, although the tunnel has now advanced over a mile, the miners are back in the face of the tunnel rigging up the top bar 14 minutes after blasting. The tunnel is being driven on the strike of the lode and will connect with the shaft of the Perseverance mine, and will cut the ore zone at a depth of 2300 feet.

At Salmon creek, about four miles north of Juneau, a dam of the variable radius arch type is under construction, having a height of 165 ft., and approximately 700 ft. long on the crest. This storage system will furnish continuous electric power of about 6000 hp. for use at both mines and mills. It is expected that the actual pouring of concrete will commence late in July. When complete the dam will contain about 60,000 cu. yd. of concrete, requiring about 15,000 tons of cement. The handling of this tonnage of cement is conducted most ingeniously. The cement is loaded on covered cars and carried in them on barges to Salmon creek

BUNK-HOUSES, DOCK, AND TEMPORARY SHOPS. MILLSITE BEING CLEARED. SHEEP CREEK.

dock. Here they are hoisted by cable tram to the railroad at an elevation of 300 ft. Then comes an uphill pull for 4 miles to another cable tram, where the cars are pulled to the damsite proper, and the cement handled for the first time after being unloaded from aboard ship in the Gastineau channel. The dockage system at Salmon creek is most ingenious, enabling a barge to land at any stage of the tide. An apron car or lift, designed by J. R. Whipper of the Gastineau company, is in use. This is quite a feat owing to the tremendous differences in tide-level at this point.

Regarding the operation of the plant, it is the present intention of the management to have the first unit of the mill in operation by January 1, 1914, and it is pleasing to note that development work is well in advance of the plans contemplated a year ago.

A complete experimental mill of 100 tons per day capacity is in operation under B. E. V. Daveler. This mill is practically a test mill for the large plant now under construction.

During the present construction period the Alaska Gastineau company is employing about 1000 men, the payroll for January being over $90,000. With the first unit in operation, the Company expects to employ about 1500 men. The general outlook would indicate that the Alaska Gastineau will be a large producer.

Cyanide From Residue of Sugar-Mills

By C. A. Browne

*Germany has made the greatest advancement in this regard. Of a total production of 400,000 tons of beet molasses in this country, about 55% is desaccharified for sugar production, about 30% is used as cattle food, about 10% is fermented into alcohol, and the remaining 5% is utilized in miscellaneous ways. Among the last may be mentioned the use of molasses for manufacturing dye stuffs, shoe blacking, yeast, molds and briquettes, and numerous other commodities.

The residues from the desaccharification factories, best known under its German name of molasses *schlempe*, has been a subject of special study from the standpoint of utilization. From 1000 kg. of beet molasses are obtained about 350 kg. of concentrated *schlempe*, containing about 30% of mineral matter, mostly potash salts, some 20% or more of nitrogenous substances, and a remainder of acids, gums, caramelization products, and other organic residues.

Molasses *schlempe* contains 12 to 15% of potassium and 4% or more of nitrogen, and its conversion into derivatives of these elements constitutes at present the chief method of utilization. The *schlempe* is first heated in retorts, by which means it is decomposed into a mixture of volatile products consisting of carbon dioxide, carbon monoxide, hydrogen, nitrogen, methane, ammonia, methyl amine, methyl alcohol, water, and other substances. The volatile decomposition products escape from the retorts at a temperature of about 400°C. and are led through a system of tubes heated to a temperature of about 1000°C. The effect of this heating is to convert the volatile nitrogenous compounds into ammonium cyanide, the gas after cyanization containing about 7% NH_3 and 7% HCN. After leaving the hot tubes, the gases, which are always kept under reduced pressure, are cooled, freed from tar, and then washed over sulphuric acid to break up the ammonium cyanide, the ammonium sulphate, which is formed, being recovered. The hydrocyanic acid is then absorbed in water, and the residue of combustible gases is led back to the furnaces for heating the retorts. The hydrocyanic acid is then distilled, and absorbed in sodium hydroxide; the solution of the latter, after evaporating and crystallizing, yields solid sodium cyanide.

By the above method, about three-fourths of the nitrogen in molasses *schlempe* is recovered as ammonium sulphate and sodium cyanide, the remaining one-fourth escaping as gaseous nitrogen. A small amount of pyridine is also obtained by this process, in connection with the ammonia. The residue of mineral matter in the retorts, after distilling the *schlempe*, is worked up into potash, of which some 15,000 tons is made annually in Germany from this source.

Two factories in Germany produce annually, by the process of distillation described, about 5000 tons of ammonium sulphate and 5000 tons of sodium cyanide, with a commercial value of about $1,750,000. The sodium cyanide thus manufactured is nearly all exported to the Transvaal, where it is used for extracting gold by the well known cyanide process.

Chemists in Germany are making further efforts toward improving the utilization of molasses *schlempe*. By the present methods of distillation, about one-fourth of the nitrogen is lost, and this is wasteful from the standpoint of highest economy. It has been felt by some chemists that efforts should be made toward removing some of the valuable organic constituents of the *schlempe* before making the distillation.

*Abstract from Columbia School of Mines *Quarterly*.

Japanese Oil Production

The Nippon and Hoden Petroleum companies imported rotary boring machines from the United States last year and have been engaged in the boring of oil wells. Since then the yield of petroleum in Japan has greatly increased. Until last spring the average output of petroleum was about 4000 bbl. per day, or about 1,430,000 bbl. per year. This output has recently increased to about 5700 bbl. per day or about 1,900,000 bbl. per year. Those engaged in the petroleum industry are now planning to expand their business by employing the rotary boring machine, and it is expected that the yield of petroleum will be considerably increased within a few years, so that most of the imports from abroad may be checked. At present about 2,660,000 bbl. of petroleum is yearly imported from Russia, the United States, and other foreign countries.

Aluminum bus-bars in place of the copper equivalent, for switchboards, have shown a higher efficiency, and a minimum saving of 25% in price is effected, according to the British Aluminum Company.

Geology of the Kalgoorlie Goldfield - III

By Malcolm Maclaren and J. Allan Thomson

The rocks within the Kalgoorlie auriferous belt are shown in the following table, in which is also indicated the influence of each on auriferous deposition. Only the solid geology is considered, and recent surface deposits are neglected. The rocks are shown in order of increasing age from top to bottom of the table.

Younger Greenstones	1. Albite porphyry		Barren
	2. Porphyrite		Barren
	3. Ultra-basic rocks: serpentine, hornblende rock, talc schist, magnesite rock.		Barren
	4. The Kalgoorlie quartz-dolerite dike	(a) Quartz-dolerite greenstone (Boulder type)	Highly auriferous
		(b) Quartz-dolerite greenstone (North End type)	Faintly auriferous
		(c) Quartz-dolerite amphibolite	Barren
	5. Sedimentary series: shale, micaceous schist sandstone		Barren
Older Greenstones	6. Fine grained amphibolite and calc-schist		Normally barren but occasionally auriferous when near contact with quartz-dolerite greenstone of the Boulder type.

It is impossible to determine at any rate with the data at hand, the relative ages of the various members of the Younger Greenstones. To this generalization there is one marked exception, for felspar (albite) porphyry dikes are found ramifying through most of the others. They are, therefore, clearly the youngest members of the group. For

Younger Greenstones

The forces that, acting at the surface, folded the rocks as above indicated, also exercised the pressure at great depths, on the magmas, molten, or potentially so, that are assumed to exist beneath the solid crust, with the result that molten igneous rock was forced toward the surface along the foliation planes of the Older Greenstones, giving rise to the various rocks that are here grouped together under the title of Younger Greenstones. They have a great range in character and include ultra-basic rocks as peridotite as well as felspar-porphyry rock high up in the scale of acidity. According to modern views, these various rocks may well be regarded as differentiates discharged from a single magma during the course of its cooling. The assumption is open to objection and is here advanced merely as being a helpful conception in grasping the internal relations of these Younger Greenstones. The various members of this series in increasing percentage of silica (acidity) were: peridotite, pyroxenite, hornblende-dolerite, dolerite, gabbro, quartz-dolerite, with their associated rocks, porphyrite, and felspar (albite) porphyry. It is to be remembered that the original nature of the individual members of the above series is not always clear; peridotite has given place to serpentine, talc-schist, and a coarse carbonate rock; and both pyroxenite and hornblende-dolerite have yielded amphibolites, the rock derived from the latter being 'lustre-mottled.' Gabbro and dolerite have changed to epidiorite, while the quartz-dolerite has suffered various changes. The more acid porphyrite and felspar porphyry alone remain unchanged.

Of the Younger Greenstones, those occurring in the immediate neighborhood of Kalgoorlie have naturally received the closest attention, though somewhat similar rocks are found throughout the region. A large area of ultra-basic rocks (serpentine, etc.) lies to the east of Bulong and stretches away to the north and to the south of that town. It has yielded traces of copper deposits, but its gold occurrences have so far proved insignificant.

the other, it is assumed that gabbro, dolerite, and quartz-dolerite are fairly representative of the original magma and that they were first extrusions from the magma. With further cooling and pressure peridotite and pyroxenite were expressed from the main mass and these were followed by a more acid product of cooling (porphyrite). The internal relations of these rocks appear, however, to have no economic significance and no bearing on the origin and filling of the auriferous lodes and need not be further discussed. But gold has a peculiar, and as yet unexplained, affinity for one member of this series, the quartz-dolerite. Therein lies the importance of the whole series. It is abundantly clear from the physical characters of the members of the Younger Greenstones series that they solidified slowly and under considerable pressure. They were then far from the then existing surface; in the course of geological ages many hundreds of feet of solid rock have been removed from above them by the agents of denudation.

Differentiation Series

At this stage in the history there was a broad area of crushed, upturned, and denuded igneous schists and sedimentary sandstones, grits, and conglomerates intruded, along their foliation planes, generally N.N.W.-S.S.E. by broad dikes and masses (batholiths) of ultra-basic, basic, intermediate, and slightly acid rocks (Younger Greenstones), all the latter being presumably members of a 'differentiation series' from a common magma. The surface was possibly partly covered with lavas and ashes ejected from volcanic vents situated on the track of those dikes that reached to that height.

There now came the last of the great internal modifications to be undergone by the rock complex above outlined, that caused by the mighty intrusions of granite that form so large a portion of the present surface of Western Australia. These were apparently not accompanied by violent compression of the greenstones; they rose, so far as can be seen, beneath great anticlines of the greenstones, probably lifting the anticlinal crest a little higher.

It is not probable that there was much 'stoping' of the overlying rock; neither the margins nor the surfaces of any granitic areas that have been examined show in inclusions of greenstone or evidences of the local cooling of the granitic magma that would accompany such 'stoping'. The long narrow greenstone bands throughout Western Australia, therefore, in all probability represent the bottoms of the great folds into which the Older Greenstones were thrown prior to the slow upward welling of the broad granitic magmas.

There were naturally enough intrusions from the main granite mass along lines of weakness in the greenstones. These are aplite, pegmatite, and granite-porphyry with a few miles of the margins of the granite, but farther away in the greenstone tongues from the granite are few and small, and are represented by thin quartz-porphyry dikes.

The Older Greenstones

In the description of these rocks, it is most convenient to commence with the oldest. These are the fine-grained amphibolites and calc-schist of the Older Greenstones. Their geological relations have been sketched in the preceding article. They are assumed to represent ancient lavas and tuffs that were probably andesitic to basaltic in character. This rock forms a single broad belt, nearly two miles wide, striking N.N.W. and S.S.E. The Kalgoorlie dike to the south is intrusive in the middle of the belt, while its two northward tongues lie, one near the western margin and the other near the eastern margin of the Older Greenstone belt.

In hand specimens the fine-grained amphibolite shows no structure. Its color varies from bluish green through greenish gray to gray. In the lighter-colored specimens, an irregular, close network of minute quartz veins is very characteristic. The rock is only faintly schistose, and this character is in any case only developed on weathering. It does contain bands of fissile sericite (white mica) schist, but these are not inherent to the mass of the rock and are developed only along later and local shearing planes. Two main types of rock occur in the amphibolite series: The first consists essentially of an aggregate of feathery needles of amphibolite with zoisite, epidote, quartz, and chlorite; the second of lathe-shaped felspar in a hornblende felt. These characters are microscopic and cannot be made out with the naked eye. The distinctly amphibolitic portion of the belt lies in the northeastern portion of the area. The characters of the western portion are hardly known, since there are no workings in it, and it is for the most part, especially in the township of Kalgoorlie, completely covered by detrital products.

Near the large mines in the southeastern part the amphibolite loses its green color and becomes slaty gray to white, a change due to the removal of chlorite by vein-waters radiating outward from fissures into the mass of the rock. This dike has been provisionally termed 'calc-schist', though the schistosity is not strongly marked. The first term of the name indicates the predominance in the rock of calcite and allied carbonates. All hornblende, and even all chlorite derived from hornblende, has been leached away by slow-moving waters, and these rocks are now merely aggregates of carbonates (dolomite, siderite, calcite, and intermediate forms), quartz, and sericite, through which magnetite and pyrite are impregnated. When these rocks become schistose there is a correspondingly greater development of sericite mica. Occasionally the carbonate is segregated into large rhombohedra of calcite, and in this case a considerable amount of chlorite is left unaltered. This calcite-chlorite rock is typical of a large area in the north of the Kalgoorlie Amalgamated leases of the Oroya Links, Limited.

The fine-grained amphibolites are barren. In no case in Western Australia has a gold mine of any importance been developed in them. The calc-schist rock is also normally barren, but in two cases at Kalgoorlie they have been known to contain important orebodies. These are the famous Oroya Brownhill 'pipe' and the Eclipse lode, belonging to the Oroya Links, Ltd. In the first case, the Oroya Brownhill 'pipe' lies along the contact of the Kalgoorlie quartz-dolerite dike, and in the second the ore of the Eclipse lode has probably traveled in solution from the quartz-dolerite northward along the track of the Lake View lode fissure, the strongest in Kalgoorlie, and has been deposited in the Eclipse ground by the local influence of a small albite-porphyry dike which there crosses the Lake View lode channel. Other small deposits are known in this rock, but as they are confined to the oxidized zone, they are regarded as merely local secondary surface deposits, not genetically connected with calc-schist, and indeed deposited there despite rather than by virtue of the enclosing rock.

Sedimentary Series

Within the area described, sedimentary rocks have but a small development. They occur on the eastern side of the fine-grained amphibolite belt, and form the western margin of a broad belt of silicious shales, schists, and fine grained schisted quartzite that underlies the valley lying east of Kalgoorlie. They are easily eroded and sink to form the valleys of the regions. Definite information regarding them is, therefore, difficult to obtain. As a matter of fact, they are exposed at one spot only, the old Phoenix brick pits, northeast of Hannan's brewery. Here they are fine grained recemented quartzites whose bedding (or perhaps foliation) planes strike north 30° west, and whose dip is steep to the southwest. They are grouped together with the Older Greenstones, and have, like them, suffered the same folding and crushing described in the previous chapter. Within the area mapped they are not known to carry any auriferous veins, and from experience elsewhere they may be regarded as inherently barren.

Newer Intrusive Rock

Both the Older Greenstones and the sedimentary series were subjected to pressure from east-north, east-west, and south-west, and from being horizontal they were first compressed into low broad swelling waves. With increase of pressure the crests of the waves were brought closer and closer until they finally touched (isiclinal folds), so that in the end

the originally horizontal strata were highly inclined, and all dipped the same way, to the westward. Their strike, in obedience to the pressure, was of necessity N.N.W. and S.S.E.

The same earth pressure was exercised at a depth of, say, 10 to 15 miles, which when the diameter of the earth is considered, may be regarded as at the earth's surface. At this depth, however, it operated on a fluid, or potentially fluid, igneous magma whose only channels of escape from compression were toward the surface. And so the less viscous portions of the magma were pressed upward through fissures in the overlying solid earth crust. Passing into that portion of the surface composed of the Older Greenstones and sedimentary rocks described above, they found their easiest passages along the foliation planes of the older rocks. These have a strike N.N.W. and S.S.E., and dip westward. The numerous dikes of igneous rock forcing their way along the foliation planes and solidifying there have, therefore, of necessity the same general strike and dip. The recognition of the strike and dip of these dikes is of prime economic importance, since they contain all or nearly all the auriferous deposits of Western Australia and since the life of a mine depends on its possession of as large a solid block of the auriferous dike rock as possible. This point is made clear on studying the transverse sections of the Kalgoorlie goldfields and comparing the respective quantities of the auriferous dike rock possessed by, say, the Associated Gold Mines and the Ivanhoe Gold Corporation, Limited.

The Kalgoorlie Dike

Locally one dike and its northward extension is especially important. This is here termed the 'Kalgoorlie dike.' It is composed of 3 members: (1) quartz-dolerite greenstone (Boulder type); (2) quartz-dolerite greenstone (North End type); (3) quartz-dolerite amphibolite. It is, however, to be clearly understood that there is no great petrological differences between these three rock types, and that they represent not original differences, but rather local variations due to difference in pressure or more probably to rate of cooling of the original magma, which was essentially a quartz-dolerite. The original magma, when forced into the position now occupied by the Kalgoorlie dike, was homogeneous. Since, however, this present survey is primarily economic, and as the slight variations noted above appear to exercise a potent influence on auriferous deposition, it has been considered necessary to adopt the foregoing classification.

The Kalgoorlie dike has in the south of the area an average breadth of a mile. With this breadth it rises from beneath the deposits of the slope toward Hannan's lake and strikes N.N.W. for a distance of nearly two miles, or to the North Kalgurli and Brownhill leases. Disregarding for the moment minor irregularities, it sends northward two long narrow tongues through the Older Greenstone. For convenience of description, the eastern tongue is termed the Brownhill branch, and the western the Hannan's branch. The Brownhill branch leaves the main dike near the old Trafalgar shaft and passes beneath the Brownhill township to Parkeston township and so beyond the limits of the survey. In the far north it has narrowed to a few hundred feet. Its average thickness is less than a quarter of a mile. The western or Hannan's branch of the Kalgoorlie dike leaves the main body at the North Kalgurli and passes west of the Eclipse shaft through Maritana and Cassidy hills, thence through the Hannan's Reward leases (whence the name of the branch) through the Golden zone and New Reefers leases and beyond. Its outlines are irregular in horizontal section, but its average width may be stated as a little more than a quarter of a mile. It is narrow near its point of departure from the main body, but swells to its maximum width of half a mile in the neighborhood of the Golden Zone lease north of the Mt. Charlotte reservoir.

Quartz-dolerite Greenstone (Boulder type)

This is, both economically and petrologically, the most important rock type in Kalgoorlie, for it not only contains nearly all the important known orebodies, but it also represents most nearly in composition the general mass of the magma that welled up to form the Kalgoorile dike. This rock when originally solidified is believed to have been one that might be termed indifferently quartz-dolerite, quartz-gabbro, or quartz-diabase. This apparent confusion is not entirely due to any inherent difficulty in determining the nature of the rock. The choice between the two first terms is merely a matter of structure, and the first has been selected as approaching more nearly to a correct name for the mass of the rock. A choice between quartz-dolerite and quartz-diabase is possible because of the confusion in petrological nomenclature owing to the rapid growth of the science; many pairs of terms are now engaged in a battle for existence, and it will be yet a generation before these struggles are ended. 'Quartz-dolerite' is selected in this place merely because it is believed that it will finally emerge as victor; it is conceded that most petrologists of an older school would prefer the term 'quartz-diabase.'

But the auriferous rock of the Kalgoorlie mines has not readily been recognized as a quartz-dolerite. During long years of subjection to pressure and to the action of slow-moving percolating waters, some of its original minerals have been decomposed and their place has been taken by others with a considerable rearrangement in the structure of the rock. It has not been found possible finally to determine the original character of the rock from a single specimen, and it is only after the consideration of several hundreds of rock slides that the character of the original rock has been reconstructed. The original rock contained a peculiar intergrowth of quartz and felspar, columnar crystals of a basic felspar, augite, probably hornblende, and a relatively small quantity of unimportant minerals. There now remains only the intergrowth of quartz and felspar; all the others have suffered a change. The basic felspar has been converted to albite, both augite and hornblende have been changed to chlorite, to which the dark green color of the freshest specimens ob-

tainable is due. It has therefore been necessary to indicate that the freshest rock now to be found is yet a much altered one; and this has been fulfilled by the selection of the term 'quartz-dolerite greenstone'; that is, a somewhat indefinite rock derived from quartz-dolerite and one that would fall into the old, useful, field group of greenstones.

The mapping of the distribution of this rock has proved to be the chief problem of the survey. From the north of the main mass, spring the two branches previously mentioned, but there is also another short tongue projecting northward to Block 45 of the Oroya Links, Ltd., lease. As shown by the underground contours this tongue rises rapidly to the surface from the south. In both the Hannan's and Brownhill branches of the Kalgoorlie dike the quartz-dolerite greenstone of the Boulder type soon gives place to either the North End type or to an amphibolite, both of which are unproductive. In all three tongues it would appear that the maximum breadth of quartz-dolerite greenstone is exposed at the surface, and that the tongues narrow in depth.

Description of the Quartz-Dolerite

The quartz-dolerite greenstone is normally a dark-green rock of medium texture, but it has also a wide variation both in color and in grain. The color is due to a green mineral, chlorite, which is decomposed by vein-waters. With the disappearance of chlorite the rock becomes lighter in color, until it finally reaches a dead white, which is the color of the then predominant carbonates, felspar, mica, and quartz. In this case the iron of the chlorite forms pyrite with sulphur from the vein-waters, but in other cases the iron may be partly oxidized. The rock then assumes a pink color, which rapidly changes to red on exposed surfaces. In grain also the quartz-dolerite greenstone may vary from a coarse gabbroid rock to a fine grained dense mass. The aspect of the rock is generally porphyritic owing to the preservation, in the general process of alteration, of the outlines of the large columnar felspars so characteristic of the ordinary diabasic structure. It is this porphyritic appearance, together with the destruction of the other original minerals, that has led Judd and others to describe the rock as a quartz-andesite. The most characteristic mineral in hand specimens, however, is leucoxene, a whitish to light yellow mineral arising from the decomposition of ilmenite. It is best seen on wetted surfaces and may always be recognized by its skeletal structure, which resembles a close network of superposed, unequal-sized triangles having often a common side. The lustre is occasionally slightly metallic and the mineral may then be mistaken for pyrite. A hard lens will, however, nearly always disclose the characteristic triangular skeleton. Quartz-blebs are numerous through the rock. These are black in color owing probably to the background of dark chlorite, and may then be mistaken, without a hand lens, for broken crystals of magnetite. The micro-pegmatitic structure (intergrowth of quartz and felspar), the most characteristic feature of the rock, cannot be observed in hand specimens.

Changes in Color of the Rock

The most striking variation visible to the miner is the change in the rock from green to red or white noted above. The former rock is the 'diorite' of the miners, the latter 'granite' or 'porphyry.' The evidence from the mine workings confirms that of the microscope in the assumption that the latter is merely a bleached form of the quartz-dolerite greenstone, impregnated with lime, magnesia, and iron carbonates. The white or pink variety varies in width from an inch or even less on the wall of a fissure, to bands many feet wide. The extension of a white or pink band both in length and in depth is always erratic. The bands may be continuous for hundreds of feet in length or depth, or may cease suddenly at a 'head.' They are best developed at and near the intersection or junction of two strong lode-channels. While no general rule may be made out, they may be said to be better developed on the foot-wall side (in this case the east) of the fissures to which they owe their origin. To understand this distribution, it must be remembered that while foliation or crushing is more or less parallel to the walls of the Kalgoorlie dike (60 to 65° W.S.W.), the dip of the strong shear-zones in which the lodes are formed is on the whole nearly vertical. Vein solutions rising in the fissures will therefore find an easier passage up the open combs on the east than down the same combs on the west.

Color v. Mineral Deposits

Fortunately this alteration has no great bearing on the economic problem. It is true that a lode on passing from the normal quartz-dolerite greenstone into the white variety may spread the gold so widely that the lode channel ceases to yield pay-ore (for example, the Australia east lode from 600 ft. L. to 1000 ft. L.), but on the other hand, an enrichment of the lode may take place in the white rock. When it is stated that the rich Tetley's, Kalgurli, and Hainault shoots all lie in this rock, it is clear that it exercises no detrimental effect on the formation of orebodies. As a matter of fact, the presence of much white or pink rock may be taken as evidence of the existence of strong lode-channels, since it has been formed from solutions passing along the same fissures in which afterward, or perhaps even at the same time, the telluride and sulphide ore was deposited.

The Bureau of Mines proposes to make tests to establish a list of electric switches permissible for use in mines where inflammable gas may be present. The conditions under which these tests will be made and the regulations governing the submission of switches for test will be published in a forthcoming bulletin.

Concrete work for the Panama canal locks is practically completed. On June 21 the total quantity laid was 4,471,463 cubic yards.

Rubies valued at $17.000 were produced by washing 86,000 loads of ground at the Burma ruby mines, in June.

Operation of the West End Mill, Tonopah

By Jay A. Carpenter

*While costs might be lower if the mill were situated at the mine, where certain expenses could be shared in common, they are at present at a figure that compares favorably with mills of an equal or greater tonnage. The extraction of silver and gold for the year, while nearly the average obtained, falls short of the best results in the district. During the first quarter of the year it was 88%, due to treating over $17 ore, containing coarsely crystallized ruby silver, without concentrating. Unexpected mine developments giving this grade of ore after belt sorting for smelter shipments, caused prompt action to be taken in adding the concentration addition, the excavation for which was started May 20, and the unit completed and put in operation July 1, 1912. With the increased tonnage and improvements made during the past year, the current term should show a further decrease in costs and an increase in extraction.

Treatment Operations

Results may be stated as follows:

Ore treated, tons	44,756
Gold content, ounces	9,357
Silver content, ounces	93,337
Gross value of ore	$764,854
Gross value per ton	$17.09
Gross value recovered	$690,932
Gross value per ton recovered	$15.44
Gross value in tailing	$73,922
Gross value per ton, tailing	$1.65
Recovery before shipment, per cent	90.3
Recovery after deducting transportation and treatment charges, per cent	88

The total recovery of metals was:

Gold, ounces	8,817
Silver, ounces	830,893
Gold extraction, per cent	94.24
Silver extraction, per cent	89.02
Total metallic extraction, per cent	89.91

There was obtained from the metallic contents of the ore:

	Gold, %.	Silver, %.
By cyanidation	87.38	73.49
By concentration	6.85	15.53
Lost in tailing	5.77	10.98

Each stamp worked 94.7% of the total time, with a stamp-duty of 6.12 tons per day. One per cent of the lost time was due to the lack of power, leaving 4.3% for repairs and holidays. This is a satisfactory record, considering that all of the batteries are driven from a single motor drive, and the tube-mills likewise. During the last quarter of the year, each stamp worked 97.4% of the time, with a stamp-duty of 7.26 tons per day; the total extraction for the same period being 91.16%. The direct milling costs for the year were $3.288 and the indirect 34.1c. per dry ton. During the year the tonnage treated per day was increased from 102 tons for the first quarter to 145 tons for the last quarter. To accomplish this increase, and to treat the higher grade of ore, it was necessary to add a concentrating addition and to make many minor changes and additions to the equipment of the mill.

*Abstract from annual report of the West End Consolidated Mining Company.

Plant Improvements

The largest item of this expense, $9965, was that of the concentrating addition, built in May and June, containing 12 No. 3 Deister slimers, with the necessary cones, sumps, pumps, tanks, and the floor space for handling the concentrate. The flow of pulp and concentrate from the tables to their respective sump tanks being in concrete launders below the floor-level, gives a neat and labor-saving installation.

The cost of handling supplies and products to and from the cars on the new spur line is, in cents per ton: Concentrate and zinc, 15; cyanide, 27; lead acetate, 30; pebbles, 50; shoes, 55; and lime, 60.

In April, by additional piping, at a cost of only $60, the Trent agitators were connected for continuous agitation, described in the *Mining and Scientific Press* of May 3, 1913, by a simple and reliable method, resulting in a longer agitation for the pulp, a saving of power and heat, and less labor for operation. Another beneficial result of this change was that it gave a small continuous feed to the Dorr thickener, and by giving the arms of the thickener a steeper slope, it is possible to decant half of the pregnant solution direct to the silver-tank, and deliver a thick pulp of 1.36 or greater specific gravity to the stock tank. From this thick pulp a 1½-in. cake can be made in less than 40 minutes that is uniform and porous to the washing solutions.

Slag Grinder

A slag grinder and jig were installed to remove the metallic shot from the slag preparatory to sacking it for shipment, and a Case low-pressure fan and oil burner was adapted to the Faber du Faur refining furnace, resulting in but one-third of the oil consumption, faster melting, and less heat and noise in the refinery. These changes aided materially in lowering refining costs. Larger clutches and a stronger chain drive were placed on the tube-mill drive, at a cost of $1150, allowing the pebble load in the mills to be increased to the maximum capacity of the 100-hp. motor, resulting in a greater output from the mills and an increase of ore treated from 102 tons to 120 tons per day. The speed of the stamps was increased from 98 to 104 drops per minute, with 7-in. drop, by a change of pulleys. This resulted in greater tonnage, with no greater repairs. In 18 months only one stem has been turned. Experiments on one tube-mill proved that if the pebble load could be increased still further beyond the point used in general practice, the resulting greater tonnage would many times repay the greater power and pebble consumption. Consequently, a 150-hp. motor was installed to replace the 100-hp. machine, resulting in a marked daily increase of tonnage,

averaging 146 tons per day for the last quarter. Two Campbell & Kelly 4-in. centrifugal pumps were purchased and installed at a cost of $425 to replace Butters pumps, used on Trent agitators, since the two pumps of this make already in service have proved remarkably well suited to the work, with a minimum expenditure for repair work. The Butters pumps were transferred to solution work. With the greater tonnage treated, it became necessary to increase the zinc-box capacity to precipitate the metals in solution, and especially to lower the value of the wash solution used in the filtering operation, in order to reduce the loss in soluble metal from the mill. To carry this saving of solution content to a further point than usual in common practice, where an incomplete replacement of the wash solution in the filter-cake can be made by wash-water, due to dilution of mill solutions, two steel zinc-boxes were installed which were 3 ft. wide, 12 ft. long, and 140-cu. ft. zinc capacity each. One of these is used to give thorough precipitation of the silver solution for wash-solution purposes, and the other to precipitate the long water wash given in the cake, this wash-water staying in a circuit by itself. By this method the filter-cake is washed with wash-solution until the effluent solution from the vacuum-pump is as low in value as the wash solution, then the cake is again washed with wash-water until the effluent solution is nearly as low as the precipitated wash-water. The loss in soluble content before the change was 20c. or greater per ton of ore, which, while excessive, was no greater than the average in the district. This loss was not determined by the inaccurate method of washed and unwashed filter-cake, but by assaying the filtered solution from the sample taken from the discharge launder. This loss is 7c. per ton of ore, or a reduction of 13c., which amounts to a saving of over $500 per month.

Zinc Lathe

A No. 3 Hampton zinc lathe was installed in the concentrating department, at a total cost of $233, and the concentrator men cut the zinc necessary. This has resulted in a saving of 2.8c. per pound of zinc shavings, or $154 per month, besides giving a fresher product and of the right thickness for the boxes. Of this saving, $135 is credited to the concentrating department for cutting the zinc.

In concentrating pulp after tube-milling it is difficult to obtain a good percentage of the value in the ore in the concentrate, without also including the heaviest particles of quartz, thus making a low-grade concentrate. At the West End, with the heavier tonnage obtained by other changes enumerated above, the tables were overloaded, and to obtain 15% of the value of the ore by concentration the concentrate contained 60% silica. After careful tests, a Wilfley table of half the standard area was installed to reconcentrate the concentrate from the Deisters; also a 1-in. centrifugal pump to raise the concentrate from the 12 tables. These were flattened to deliver the maximum concentrate along with considerable silica. The Wilfley, handling but two tons per day, makes a much cleaner separation, resulting in making but one-half the previous amount of concentrate of but 35% silica, which contains 15% of the value of the ore in 0.5% concentrate. The cost of the installation was $227, and the saving made in freight and treatment charges amounts to $170 per month. After this change was made it was not necessary to enlarge the concentrating plant.

Change in Character of Ore

In November the ore in the mill began to change from one entirely quartz and sulphides to one containing a large percentage of oxidized material. The clay content of this ore made settling very difficult, filtering slower, the previous method of discharge impossible, and the method of pumping away the residue expensive for additional water. An installation of 6-in. pipe connecting the filter pump with separate valves to the filter hoppers made it possible by the use of the pump to discharge from the hoppers the entire filter residue in a well mixed pulp. In February, at the slime pumping station, where the slime is lifted 30 ft. over a ridge to join the Montana-Tonopah tailing, a 6 by 20-ft. tank at the end of the flume and pipe was cut out. The pump was also lowered in the excavation to pump from the bottom of the tank instead of from the 24-in. pipe. By this method the slime pulp is not held back in the pipe, but with the swirl in the tank it is kept in constant motion until discharged, resulting in a marked decrease of water necessary for discharge, which is now about 0.9 ton of water per ton of ore.

With this content of oxidized ore, the settling capacity of four 16-in. Dorr thickeners was not great enough, resulting in a slimy overflow, the solids of which accumulated in solution-tanks and pipes. To correct this, a fifth Dorr thickener was installed in one of two tanks previously used for return battery-solution, and a fifth diaphragm pump was added to take the thickened pulp from the new thickener.

Detailed costs were as follows:

	March 1913.	Fiscal year.
Superintendent and foreman	$0.056	$0.062
Crushing and conveying	0.080	0.103
Stamp batteries	0.224	0.248
Tube-mills	0.398	0.492
Concentrating	0.113	0.130
Agitating	0.823	1.033
Filtering and discharging	0.171	0.218
Precipitating	0.155	0.260
Elevating and settling	0.057	0.103
Motors and lights	0.040	0.036
Refining	0.072	0.097
Drayage	0.008	0.010
Assaying	0.028	0.042
Steam heating	0.136	0.130
Water	0.164	0.214
General expense	0.065	0.110
Total direct	$2.590	$3.288
Salaries	$0.070	$0.074
Office expense	0.016	0.010
Legal and traveling	....	0.002
Insurance	0.030	0.036
Taxes	0.034	0.040
Liability insurance	0.018	0.021
Depreciation	0.265	0.158
Total indirect	$0.433	$0.341
Total operating	$3.023	$3.629

Discussion

Readers of the MINING AND SCIENTIFIC PRESS are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment. Insertion of any contribution is determined by its probable interest to the readers of this journal.

Hoisting at a Chinese Mine

The Editor:

Sir—The illustrated article under the above head, in last week's issue, reminds me of a feat performed by Chinese coolies in Singapore in 1902. The battleship *Terrible* was lying at the Tanjong Pagar docks, and orders were given to coal her as fast as possible. At 10 a.m. the work started, and by 3 p.m., the same day, 1500 tons of coal had been dumped into the ship's bunkers. This was done by coolies carrying baskets, holding about 200 lb. each, two to each basket, from the storage sheds to the ship. The number employed was never properly known, as the coolies could join in or leave the work as they wished, the job being done by contract. This shows what can be done by crude methods of handling coal. In Borneo, in 1903, I saw a good deal of work done at a placer property by baskets handled by Javanese coolies who were paid about 15c. per day.

M. W. VON BERNEWITZ.

San Francisco, July 30.

The Dorr Agitator

The Editor:

Sir—I note with interest Mr. Symmes' interesting description of his agitator, in your issue of July 19. His description of a perfect agitator is certainly that of a practised operater, and one to which we can all subscribe. I regret, however, that I had not informed Mr. Symmes as to the details of the Dorr agitator, to which he refers, and realize that the cut which appeared in our advertisement was not clear enough to give the information which he evidently lacked.

The Dorr agitator has two arms attached by strong hinges to the central air lift, and are arranged so that if for any cause the power is cut off and the machine stopped, the arms can readily be raised to a vertical position. On starting again, they can be gradually lowered until the settled pulp has been brought into suspension and they have regained their original position.

It is entirely true that if the mill crew should allow the arms to remain lowered after the power has gone off for any length of time, with quick-settling sandy material, it might be difficult to start again without breaking something, although in one case we have known of starting after a 24-hour shutdown. My belief is that with the raising and lowering made a matter of entire convenience for the operator, a mill-man who would neglect it would do as much or more damage to all other parts of the mill, and could not be expected to last. This would be comparable to a battery man who might wander away with the feed shut off the battery and the stamps dropping.

During a recent visit to Cobalt, one of the companies there which has just installed a Dorr agitator for agitating concentrate told me that the machine had been installed in a tank partly filled with tightly packed concentrate left from the use of another agitator. A hole was dug for the central pipe to go in, and the concentrate brought into suspension without any trouble, by gradually lowering the arms.

In comparing our machine with Mr. Symmes', I would think the main difference would be that the latter uses a large number of air lifts, with probably a greater consumption of air, while we use only one, but that both machines should do equally good work. I have faith also in the efficiency of the circulation established in our machine, as adapted to accomplish the best results with the minimum power.

JOHN V. N. DORR.

Denver, Colorado, July 24.

Forestry Service

The Editor:

Sir—In the June 28 edition I note the communication of Mr. J. C. Kennedy of Manhattan, Nevada, one time Deputy Mineral Surveyor for the District of Nevada, but whose commission was revoked by the Commissioner of the General Land Office, July 27, 1909.

The case mentioned by Mr. Kennedy needs only a little fuller explanation of the facts and circumstances to make perfectly clear the consistency of the policy of the Forest Service touching matters of this kind and the action taken in this particular case. For this reason it is deemed proper to give your readers the facts in the case.

The application for patent was made by Mr. Kennedy himself for two claims together, the Pine Nut No. 2 and the Morning Glory lodes, embraced in mineral survey 4073 and mineral application 07533, Carson City series. In accordance with the instructions and procedure applicable to such matters, the notice of application for patent was sent to the supervisor of the forest concerned, who called on the ranger for report, which was promptly made. The report showed that on the Pine Nut No. 2 there was a valid discovery of mineral and that improvements and development work to the extent of $15,000 was manifest, and suggested that the claim be recommended for patent. As to the Morning Glory, the report showed that the development work was in surface ground and country rock. The dimensions of the workings were given and an estimate of their value of $225, or less than half the amount required by law. It was pointed out that the applicant, Mr. Kennedy himself, sought to apportion to this claim, as contributing to its development, a portion of a tunnel on the Pine Nut claim, which tunnel did not even run toward the Morning Glory claim. Mention was made of the only drift from this tunnel, which pointed in the general direction of the Morning Glory claim, but it was stated that even this drift, if continued, would come out of the hillside across the gulch from the claim proper. No technical knowledge was needed to recognize that such work was not properly credited to the Morning Glory claim. Discussing the matter of mineral showing, the ranger stated in the report that the discovery shaft was in country rock with no sign of

mineralized rock to be found in the vicinity. None of the trenches showed any signs of mineralized rock beyond a slight iron stain, and such material has not been known to carry metal in that district, in which the ranger had spent more than five years, and assisted the official mineral examiner in the examination of many mining claims. The claim was examined twice. Once in company with Mr. Kennedy himself, and later with two other practical local people, who were named as corroborating the statements of the ranger. From this it will be seen that insufficient mineral showing, while mentioned, was secondary to the other requirement of $500 development work. It also shows that the ranger's findings were supported by other witnesses; that good faith was not only lacking, but that bad faith was manifest. Seeking mineral patent to land of this kind and in this way, and advertising it to the public, to investors, or even to stockholders, is not prospecting, but 'wild-catting,' a practice to which the Government cannot give its sanction, and a distinction which the Government, through its field service, is trying to make clear to the public, and through ignorance of which investors have been bilked and working people robbed of a life-time's savings.

The ranger's report, forwarded to the district office with the supervisor's endorsement and approval, was considered by the mineral expert, who, along with the administrative officers, concluded that the expensive expert examination to determine sufficiency of mineral showing was unnecessary, since the other charge showed bad faith, was grounds for refusal of patent, and was provable by other testimony. Mr. Kennedy's article would give the impression that claims upon which $10,000 had been expended in development had been held up on the unsupported opinion of an inexperienced ranger as to the insufficiency of mineral showing, when the facts are that good faith could not be presumed, as Mr. Kennedy seemed to think it should be. The matter of insufficiency of discovery was not the unsupported opinion of the ranger. The ranger was not inexperienced in such matters, the claim upon which the $10,000 development work had been done was reported upon favorably, and not a thing stood in the way of its speedy passage to patent except that for which Mr. Kennedy is alone responsible, namely, his attempt to make it carry to patent a claim not meeting the law's requirement as to development expenditure, to say nothing of its questionable character from the standpoint of mineral showing.

In the closing paragraphs of his article Mr. Kennedy makes it plain that he chafes under the present policy of the Government, the basis of which he declares to be in "obscure and inexplicit clauses" in the law. But since under guise of mining patents large cattle companies have acquired watering places that control vast areas of range, timber speculators seized large areas of the most valuable timber lands, power companies sought, and to quite an extent secured, monopoly of power development, when townsite boomers have fleeced residents and settlers at our foremost mining camps for lots upon which to live and do business, and exploiting concerns, by the same means, secured control of water frontage and forced tribute from individuals who of necessity had to meet their demands, is it not time that laws ceased to be obscure and inexplicit? Charged with heavy responsibility in the execution of certain laws, the Forest Service is seeking diligently to discharge its duty to the public, and in doing so has sought earnestly to ascertain the intent of every part of every law with which its work is concerned. Uncertainty, obscurity, and darkness serve only to promote ignorance and wrong, while light and the open road make for justice and progress.

E. A. SHERMAN.

Ogden, Utah, July 24.

Inclined Baffles

The Editor:

Sir—Referring briefly to Mr. Spicer's letter, in the issue of June 21, concerning the use of the inclined baffle to increase the settling capacity in slime-settling tank, contrary to his sweeping statement that there is no advantage in the system, I have found the inclined baffle of marked benefit in the settling-tank, but like many other good things that are condemned off-hand, it is necessary to understand the principles involved.

The inclined and vertical glass cylinders show clearly that there is a decided advantage in the rapidity of settlement in the inclined cylinder. Mr. Spicer, while acknowledging that the cylinders indicate the possibilities, has apparently not tried to solve the principle involved, and cites hearsay evidence and ignorant application to condemn it.

The reason for this is apparent when his connection with a certain patented device in which the application would be expensive is taken into account. A statement like his, is certainly not credible to the intelligence of engineers who have solved problems in which it was not possible to get even an optical illustration of the solution.

JOHN E. ROTHWELL.

Butte, Montana, June 30.

Use of Steel Points for Core-Drilling

M. L. Martel, in an article that is appearing in the *Bulletin de l'Industrie Minerale*, furnishes an interesting account of the use of steel-pointed drills. The recent application of granules of steel instead of diamonds has shown that in many instances they offer advantages over old methods of boring. The principal advantage of steel granules is in the matter of cost, facility in obtaining bores of large diameter, and boring very hard rocks—such as corundum. It is hard broken rock that this method of drilling displays its superiority over the diamond-drill. The difficulty with steel-pointed drills appears when the bore-holes are far removed from verticality. Under favorable conditions the granules have penetrated 52 ft. in 24 hours, but generally, in ordinary ground and moderate depth, the daily advance is from 16 to 20 ft. This mode of boring seems destined to be extensively employed.

France has spent $35,000,000 in planting trees on the watersheds of important streams.

Special Correspondence

NEW YORK

THE COPPER MARKET.—FEDERAL MINING & SMELTING CO. RESULTS OF CONCENTRATING WITH THE McQUISTEN TUBE.—EFFECTS OF AFFAIRS IN MEXICO.—COBALT, PORCUPINE, AND TONOPAH MINES.

The walk-out of the Lake Superior copper miners, following hard on the heels of the resumption of copper buying, was quickly turned to account by the metal sellers, and sales were made at 15c. per pound on July 25 in New York, while the cables reported that Amalgamated was asking £69 5s. (15½c.) in London. Phelps, Dodge & Co., the American Smelting & Refining Co., and Aron Hirsch & Sohn being out of the London market for September delivery. In New York the last sale of Lake copper was made at 14¾c. on July 24, and Calumet & Hecla, Quincy, Mohawk, Wolverine, Copper Range, and all the other Lake companies announced that they are out of the market until the strike is settled. Exports of copper for the week ended July 24 were 3981, and the total exports since July 1 have been 19,375, or over 4000 tons less than the same period of last year. It is computed that total deliveries this month will amount to 121,000,000 lb., corresponding to a further decrease of 15,000,000 lb. in the surplus. At this rate of progress the copper market will soon be running on a deficit, statistically at least. Reports from Tanganyika bring a gleam of hope. According to the statement of the managing directors, it is proposed to build four more smelters at the Kansanski mine, which within a few months will bring the production of copper up to 6,000,000 lb. per month. However, we have heard reports from Tanganyika before, and smelters which can be built and operating in the heart of Africa in a few months sound no more plausible than many earlier statements. As a matter of fact, if the Lake mines stay shut down for a time and Mexico continues in chaos, it looks decidedly as though the copper market is in for a squeeze that may send that metal back to where it was last year.

Spelter seems to have turned the corner and has advanced to 5.3c. per pound, and producers are hoping that it will continue to advance. The Federal Mining & Smelting Co. has bloomed out as quite a producer of zinc, thanks to the McQuisten tube concentrator, and gives every evidence that it will continue to expand. The ores in the Federal properties became so refractory with the advent of zinc in depth that its operating profits almost disappeared, but were resuscitated by the tube concentrator, which yielded zinc concentrate at a good operating profit. This has been so satisfactory that the Federal company has been acquiring a number of deep mines and reopening them, and the Helena-Frisco, which was purchased last November, has just been unwatered. Through the Helena workings it is hoped to reach the orebodies in the Flynn and Star mines, two other recent purchases. Federal is now earning its dividends and shows excellent signs of 'coming back' in good shape.

Among the incidental effects of Mexican conditions are many happenings like that in New York last week, when Jose M. Ortiz was denied an injunction to restrain Volney D. Williamson from selling 15,855 shares of stock in the International Metals Co. which had been deposited as security for a loan of $60,000. Ortiz contended that under present conditions the shares would bring next to nothing and wished to have the sale postponed, but the presiding judge took the position that under present conditions it would be necessary to postpone the sale indefinitely and denied the injunction. The incident is typical of the less obvious losses which investors in Mexico are suffering as a result of present conditions there.

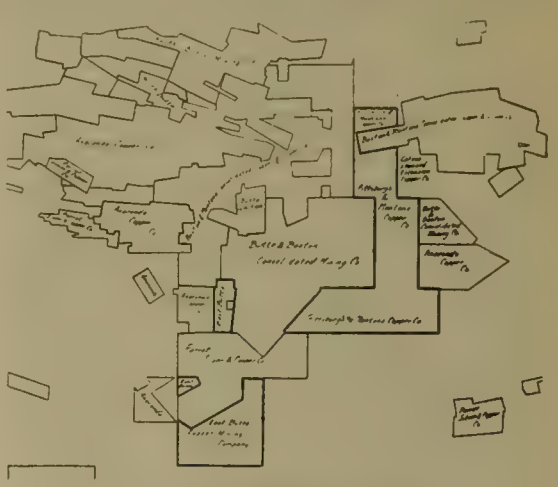
Silver mines are making a good showing. The La Rose, in its financial statement on July 1, shows cash and ore on hand ready for shipment amounting to $1,831,298. The Nipissing does almost as well with a total of $1,463,401 in cash and ore and bullion on hand or in transit.

The Tonopah Mining Co. recently paid a dividend of 40c. per share, but accompanied it with a note that the next dividend will probably be at a lower rate. The Company has paid a total of $10,850,000 in dividends to date. Tonopah Merger is reported to be making a good showing. Cobalt is reviving in interest. Nearly all the shareholders in Crown Reserve have subscribed for the shares of the Porcupine Crown Co. and the entire block of 442,203 shares was taken at 80c. per share. The regular dividend on Crown Reserve will be paid August 5. This Company owns 1,400,000 shares of Porcupine Crown, and it is hoped to have the latter yielding dividends before the end of the year. The Nipissing has both its mills in operation and has practically discontinued ore shipments.

BUTTE, MONTANA

BUTTE & ELY COPPER CO. AND THE MERGER AT ELY, NEVADA.—BUTTE & SUPERIOR MILL IN FULL OPERATION.—VEIN FOUND BELOW FAULT IN ALEX. SCOTT CLAIM.—RICH ORE IN THE RUBY MINE.

Some local stockholders of the Butte & Ely Copper Co. are far from satisfied with the proposed merger of that property into the Consolidated Coppermines Co. at Ely, Nevada. They say that, of all the various companies which are considered in the merger, the Butte & Ely is the only one with any considerable amount of cash on hand. These dissatisfied stockholders claim that the other companies have their eyes on the $250,000 on hand and are trying to get it without a fair return to Butte & Ely interests. A receiver for this Company has been asked for, and a



PLAN OF PROPERTIES AT BUTTE.

court order to restrain the majority interests from committing the property to the merger on these terms. Duluth interests control Butte & Ely at present.

The concentrator of the Butte & Superior Copper Co. has at last been remodeled in both sections and is now running at full capacity of 1200 tons per day. More than 8000 tons of 50% zinc concentrate will be produced in July, according to estimates, and this is expected to be increased to 10,000 tons in August. The confusion of experimenting seems to be nearly at an end, and the plant is beginning to take on a business-like look, which is encouraging. No first-hand information is available as to what success is being had with flotation, but the fact that that part of the plant is actively at work is suggestive that the results are satisfactory. An extraction of 90% has been claimed, but that seems almost too good to be true.

Some years ago the Boston & Montana Copper Mining Co. did some diamond-drilling and otherwise prospected the Alex. Scott claim on the 1200-ft. level. The results were so disappointing that the opportunity to purchase the ground was let slip; but now the same interests are compelled to pay a big toll to the owners of the Alex. Scott for the following unforeseen reason. Below the 1200-ft.

level, a vein was subsequently found beneath a fault, apexing in the Alex. Scott ground and dipping into the Boston & Montana ground lower down. This vein contains profitable ore and has been worked extensively by the Alex. Scott company. The vein in its steep southerly dip intersects the Colusa shaft of the Boston & Montana ground about the 2000-ft. level, so that in order to protect this shaft properly from the mining operations on the Alex. Scott, it is now necessary for the owners of the Boston & Montana ground to purchase a good-sized block of the vein at a liberal price. It is said that another stipulation of the deal requires that the purchaser agrees to refrain forever from bringing up any apex litigation over rights to this Alex. Scott vein. From all of which the moral might be drawn that in Butte a mining claim sometimes has veins thrust upon it, even when surface indications suggest the contrary.

Butte so far eclipsed in importance the other mining operations of the state that a first-class find can be made in a nearby camp without causing even a ripple of excitement in Butte's mining circles. As an illustration, some lessees in the Ruby mine, a gold-silver producer, 17 miles north of Butte, opened a fine body of high-grade shipping ore recently, which would have caused a furor in most Nevada towns. This find was given current notice in the newspapers, but affected the amount of activity at Butte in no way. No one not directly interested came up to see the ore, and the newspapers are paying no more attention to the matter, although the ore-shoot is expected to yield from $100,000 to $200,000 in the short time necessary to extract it. The mine is in dacite similar to that at Goldfield.

BOSTON

LOCAL INTEREST IN THE UTAH METALS MINING CO.—GREENE CANANEA STOCK PROPOSALS.—NORTH BUTTE INTERESTS BEING EXPANDED.—ORGANIZATION OF DOUGLAS COPPER CO.

Boston people are much interested in the recent statement issued by the management of the Utah Metals Mining Co., that the tunnel being driven through the mountain from Tooele to Bingham, Utah, had been completed. Utah Metals, which is a combination of the Bingham Central Mining Co., the Bingham Standard Copper Co., and the Bingham Metal Mining Co., has been pushing the completion of this tunnel for over three years. Previous to that time the three individual companies concerned in the amalgamation had been putting in more or less effort toward the completion of this same tunnel. It measures 11,494 ft. in length, is single tracked at present, with 35-lb. rails, and electrically lighted for its entire length. Fifteen different mineralized veins have been opened, and a large amount of water made available for commercial use. The Boston men interested in the undertaking are James E. Rothwell, William M. Wadden, M. Allison Taylor, W. E. L. Dillaway, Cabot J. Morse, and Harry L. Ayer, while from Salt Lake City are E. P. Jennings and William E. Hubbard. The above gentlemen and Arthur B. Martin, of Chelsea, Massachusetts, comprise the directorate.

Local investors are anticipating a new trading sensation in the coming certificates for full shares and certificates for fractional shares of Greene Cananea stock. The Company has recently changed the par value of shares from $20 to $100, exchanging one share of the new stock for five of the old. To those who have not even parts of five shares, the Company is giving fractional shares. It is the latter phase of the situation that Boston looks for untoward developments. As now planned, the holder of a fraction cannot vote his stock, nor can he receive dividends upon these fractions. Boston people think that someone has erred in this latter decision, as it fails to see how any company can refuse the ratio payments of dividends to the holders of fractional certificates. A fractional certificate represents a pro rata share of Greene Cananea's assets, as does a full share. Greene Cananea is now outputting about 100 tons of bullion per day, including the production from the Miami property, since the latter part of May.

Announcement is made here of the holding, under an option agreement, of the Victoria property in the Bingham district, Utah, by the Bingham Copper Co. The Victoria claims adjoin the Eagle & Blue Bell property, also controlled by the Bingham Mines Co., which itself is a reorganization of the old Bingham Consolidated Mining & Smelting Company.

With regard to the policy of expansion by the Tuolumne and Bingham companies, Boston also is following closely the news of the constant acquiring of territory by the Cole-Ryan interests in the Butte district, primarily for the interest of the North Butte Co., some $1,000,000 already having been expended for over 1000 acres of territory. It is felt here that such an undertaking is too much for the rejuvenated North Butte and that a new company will be formed to operate the new claims. The North Butte will be given a large stock interest in the new company, practically a working control, and will later probably absorb it, if the developments turn out as expected. The argument advanced at Boston is that North Butte can afford an investment of, say, $1,000,000 in such a plan, but is not able to altogether finance the purchase, development, and management of 1000 acres of prospect territory.

The formation of the Douglas Copper Co., owning 440 acres of land in the Lake Superior district, has not been particularly well received here. It is to be a St. Mary's Mineral Land management property, with the usual $2,500,000 capital, 100,000 shares, par value $25. Of the capitalization, 50,000 shares will be given in payment for lands, of which 160 acres came from the St. Mary's Mineral Land Co., 160 acres from the Sheldon-Douglas interests, and 120 acres from the Boston & Lake Superior Mineral Land Co. The territory of the new company underlies the No. 1 and No. 2 shafts of the Ahmeek property, two rich districts. The company's offices will be in the Sears building, Boston.

JOPLIN, MISSOURI

RECLAIMING SLUDGE ORES FROM GRANBY LAND AT ORONOGO.—NEW CONCENTRATING PLANTS CONSTRUCTED.—ZINC AND LEAD NOTES.

A sludge mill, equipped with four tables, is being erected by Charles Simpson and Charles Morris on a lease on the Pinnacle Mining Co.'s tract on the Granby Mining & Smelting Co.'s land at Oronogo. For about three years the sediment from the Pinacle mine, which is comparatively a new producer, has been collecting in the bottom of several old sludge ponds, and this sediment carries enough zinc sulphide content to make its remilling profitable. When the old sludge is all cleaned up, it will be taken direct to the mill. The treatment of slime is growing to be more common throughout the district.

At the Oronogo Circle mine, adjoining the Pinnacle lease, the slime treatment is considered of much importance, and at this property is found one of the largest and most complete sludge mills in the district. As a rule, the sludge carries from 3 to 5% zinc sulphide and a small percentage of galena, where there has been any appreciable amount of this ore in the original dirt from the mine. The product from the sludge tables does not command the high figure paid for the jig concentrate, yet in some instances the treatment of the slime affords the additional profit that may permit of a mine being operated successfully.

At various points throughout the district new concentrating plants are being erected. In some instances the building of these mills does not represent additional milling capacity to the district, as old mills that have suspended operation are used in the construction; however, several entirely new plants are going up. At Miami, Oklahoma, the Lost Trail Mining Co. has completed a plant of 300-ton daily capacity on a lease of the Frosty Morning Mining Co.. In the same district the Gray Top Mining Co. has completed a new plant of 300-ton capacity and is now making 'turn-ins.' At Duenweg, Missouri, the Wilsons Mines Co. is increasing the capacity of its mill from 300 to 600 tons, and the remodeled plant will be ready to run by the latter part of August. The old mill averaged 120,000 lb. of zinc sulphide concentrate weekly for the past year or more. New jigs, crushers, and rolls are to

be installed, and the shell of the mill almost doubled in dimensions. The operators expect to hoist as high as 1600 'cans' per day. A 40-ft. face of ore in disseminated ground is being worked at a depth of 172 ft. The extensive underground work, resulting in the opening of long drifts, has enabled the Company to hoist a much heavier tonnage than formerly; hence the decision to increase the milling capacity. Pumps throwing 300 gal. of water per minute hold the water to the working level with ease. Several sub-lessees are at work on the Wilson ground, one of these, the old Newsboy, having just completed the construction of a 150-ton mill, the plant having been moved from an adjoining lease. This makes the fourth mill to be erected on the old Newsboy workings, the gradual increase in ore prices since the first activities on this ground having made it possible for the various operating companies to handle thinner and thinner ore, and yet make a profit. On another sub-lease of the Wilson tract, Brown & Co. have a prospect on which they intend soon to begin the construction of a small concentrating plant. On the Center Creek Mining Co.'s land at Webb City, the J. M. Short Co. is constructing a mill to be known as the Comanche. The plant, which is made up chiefly of machinery taken from the old Yellow Dog mill, on the Underwriters Land Co.'s property, is to have a capacity of 200 tons per shift. The mill is on the site of the Good Shepherd, which was burned to the ground a number of months ago. Operations

CONCENTRATE AT A JOPLIN MILL.

are conducted in soft ground at a depth of 160 ft. Improvements at one of the mills of the American Zinc, Lead & Smelting Co., at Prosperity, have been completed, and the mill, the only one of four now operated at Prosperity by this Company, is running steadily, the weekly output being about 225,000 lb. of zinc sulphide concentrate and 30,000 to 50,000 lb. of lead. At the Redbush mine, on a lease of the Stewart land, at Neck City, where recent drilling has shown good ore, a plant is soon to be erected. At Spring City, the 150-ton mill of the Lulu V Mining Co. is completed and will be ready to run within a week or two. The Company used the mill of the Spring City Lead & Zinc Co., where operations have been suspended. The Lulu V mine is in virgin territory.

At Stotts City, in the eastern part of the district, six drills are at work. One of these is being operated by the Grasselli Chemical Co., one of the largest zinc-buying companies in the district. Only recently the Company began prospecting in this district, its work in the past having been confined solely to the purchase of zinc ores. The Company has prospected on the Riseling estate in the western part of Joplin recently, following which it moved its drill to property which it owned in fee in the Stotts City district. Virtually all the drilling in that district will be done on virgin ground. On an old lease, a sludge company is completing the construction of a small plant which will handle the lost slime from previous milling operations.

At the beginning of August 1913 zinc ore prices range from $41 to $44, assay basis of 60%, metallic zinc, while lots carrying a higher percentage of metallic zinc bring a premium and in a few instances bring as high as $47 per ton. The lower grades range down to as low as $30, settlement. At this time last year the record prices of the district were prevailing, the basis for blende being $62 to $64, with choice ores bringing $67. Spelter which is now firm at $5.25 was then strong at $7.25. East St. Louis quotations are used. The production is about 4500 tons per week, compared with 6000 tons a year ago. Calamine sells for $22 to $23, assay basis of 40% metallic zinc, with top grades commanding as high as $26. A year ago the basis range was $30 to $33, with top grades selling up to $38. Lead ore is unchanged at $52.50 per ton, with metal quoted at $4.25. A year ago metal brought $4.60 and ore sold for $60.

PORCUPINE, ONTARIO

STAMP-MILLS IN OPERATION AND BEING ENLARGED AT PORCUPINE.—MINE DEVELOPMENTS.—WORK AT COBALT.—INTERNATIONAL GEOLOGICAL CONGRESS ASSEMBLES.

The Porcupine gold district proper, exclusive of the Swastika and Kirkland Lake districts, has now 11 stamp-mills completed and in course of construction, having an aggregate capacity of 1665 tons of ore per day. The stamps now in operation number approximately 175. Plans now under way for the increase of equipment are as follows: The Dome will add 60 stamps, bringing the total number up to 100; the Hollinger will increase its mill from 40 to 80; the Jupiter, from 12 to 25; the Dome Lake, from 10 to 40; Porcupine Crown, formerly the McEnaney, from 10 to 40; Three Nations, from 10 to 25; the Rea, from 5 to 20; and the Hughes, from 3 to 20 stamps.

The entire force at the Hollinger has been put on an 8-hour day basis without change in the wage scale, anticipating the operation of the recent amendment to the Mining Act fixing the working day for miners at eight hours, which comes into force January 1.

At the Dome Lake a new orebody has been discovered by a cross-cut from the main shaft at the 180-ft. level, and shows free gold. The shaft of the Hughes has been sunk to the 300-ft. level, where a promising quartz vein, upward of 10 ft. wide and showing free gold, has been found. Deep development has shown that the veins are continuous and maintain their metal content. The directors have decided to adopt the cyanide treatment in connection with the new mill. While the forest fires raged in the district early in the month, the powder mill of the Pearl Lake exploded, causing considerable damage to the plant, but without injury to anyone. The mining claims owned by the Crown Chartered, in Porcupine, were put up for sale at auction on July 9, but were withdrawn, the bidding being under the reserve price. Important new discoveries are reported in the Kirkland Lake district. At the Burnside property, adjoining the Foster, which is being developed by a Haileybury syndicate, a surface vein showing free gold has been stripped for 50 ft. and a 19-in. orebody exposed, the gold content of which is stated to run $700 per ton. The Teck-Hughes has a shaft down 120 ft. on No. 1 vein, and is cutting a station at the 100-ft. level. Sinking has been started on No. 2 vein which shows free gold at the surface. The Wettlaufer has sunk on the Ovi vein to a depth of 50 ft., where there is 4 ft. of rich ore. The Bigelow property, in northeast Teck township, has a 12-ft. vein showing good gold content. The first clean-up of the 5-stamp mill at the Foster, after a month's run, during which about 10 tons of ore per day was treated, yielded 350 oz. of gold. The shaft is down to 170 ft., the ore holding well at that depth.

A winze was put down 20 ft. below the 650-ft. level of the Temiskaming mine. The Sebeca Superior has gone on a regular dividend basis of 10% every two months. The Company has cash in hand to the amount of $127,249, and ore in transit to the approximate value of $65,000. The Silver Cliff shipped a car of 18 tons of ore last month which realized $15,000, and will probably send out another carload. Five veins have been cut in the workings from the

Lake shaft. The Cochrane is driving on the 200-ft. level on a vein 6 to 10 in. wide, showing native silver. The vein was barren at the 100-ft. level. The Sterling mine, near Arsenic lake, in the Elk Lake district, which has been the subject of considerable litigation, was sold by order of the court, on July 8, to M. B. Sullivan, of Boston.

A number of noted geologists from abroad have arrived at Montreal in connection with the International Geological Congress, the principal session of which will be held at Toronto, August 7 to 14. A number of excursions to regions of geological interest will be held before that date, the first of which left Montreal for various points in Quebec and the Maritime Provinces on July 13.

JOHANNESBURG, TRANSVAAL

DEVELOPMENT OF THE MODDERFONTEIN GOVERNMENT AREAS.—TROUBLES AT THE CINDERELLA DEEP MINE.—RAND MINES, LTD., MEETING.

Among the plethora of company meetings held during the last week in May, and practically representing the strength of the entire length of the Rand extending from Springs to Randfontein, those dealing with the progress of that part known as the Far East Rand have attracted most attention. There is, for instance, the property known as the Modderfontein Government Areas, where during the week a 'reef' find of the highest importance has been made in the southeast shaft, following those in the northern shafts where the Main Reef was intersected a short time ago. The property is an extensive one, consisting of 2633 claims, or say 4000 English acres, surrounded on every side, save the southeast, by well proved properties, among them the Brakpan, Modder Deep, Modderfontein, Modder B, and Geduld. Being so surrounded, four shafts were started without recourse to preliminary boring operations, an unusual thing on the Rand, but the results have proved that this policy was the correct one. Speaking generally, it was considered that the northern section of the property was most valuable where the 'reef' was nearest to the outcrop, with the result that the sinking of the northern shafts was watched with considerable interest. Four shafts were started, two on the northern and best known area, and two on the southern area regarded as of more doubtful value. In the two northern shafts the reef was cut at depths of 2273 and 2395 ft., respectively, from the surface, and although the gold content at the point of intersection by the shafts was profitable, it did not come up to expectation, and, being in what was considered the most promising part of the property, the outlook was not encouraging. However, on being driven on, the ore improved, and at the beginning of June had quite come up to former anticipations. On May 21, however, the southeastern shaft, situated in what was regarded as the most doubtful section of the property, cut a fine body of 'reef' at a depth of 3580 ft. from the surface, averaging $16 over a width of 55 in., thus improving on the actual results obtained on driving in the northern section of the property. It will be seen that three-fourths of this extensive property has practically come up to anticipation, and little fear is expressed that the southwest shaft, with the Brakpan mines as a neighbor, will also follow suit and intersect a profitable 'reef.' It is not only the Modder Government Areas which have benefited from these satisfactory developments, but the prospect of other Government Areas lying to the south, for which tenders have been invited. With such excellent results on the southern section of the Modder Areas, coupled with those obtained at Springs, the mining prospects of the Schapenrust-Brakpan Government Area, for which tenders have been invited, are considerably enhanced and the uncertainty regarding its value materially reduced. These four East Rand improvements have been the outstanding feature of the work, for it is on the Far East Rand that the future increased gold production of the Rand goldfields so largely depends.

It has been decided to temporarily stop milling operations at the Cinderella Deep mine at Boksburg, and although this step has been somewhat expected for some time, the decision has cast a cloud over the town and district, following as it does the closing down of the East Rand Extension, Boksburg gold mine, Apex, and Benoni, while the disastrous strike at the New Kleinfontein has added somewhat to the prevailing depression. The Cinderella Deep belongs to the well known Albu group, whose managing director, Sir George Albu, has very properly earned a reputation for thoroughly testing several difficult mining properties, and it was hoped that despite the serious losses sustained during the last few months, it would not necessitate closing down the mill. In May, the 70 stamps and three tube-mills crushed 16,120 tons, but the value of the yield, although $5.68 per ton, resulted in a loss of $19,300. According to reports, there does not seem to be any prospect of the working cost of $6.94 being brought down to a reasonable figure. The trouble is essentially in mining, the Cinderella Deep being one of the deepest mines on the Rand, but stoping operations have for some time been principally confined to the 'rise' portion of the mine. Unfortunately, the Cinderella Deep is at present a single-shaft property, and, like the City Deep, experiences the greatest difficulty in efficiently ventilating the workings. I have previously pointed out that the temperature in some parts of the mine exceeds 90°F., a temperature not conducive to successful work and one which apparently cannot be reduced until the new shaft is connected with the present workings, which no doubt will take another year to accomplish. The closing down of the Cinderella Deep mill, on account of the mining difficulties, does not enhance the reputation of the engineering and mining talent of the Rand, because, if the ventilation difficulty was properly tackled, success would be assured. There is little difficulty in ventilating a deep mine on the Rand in a proper manner, if only the task is gone about in a workmanlike method; but if attempts be made to ventilate a mine in a faulty manner, no task becomes so difficult. Then the Cinderella Deep has earned a bad reputation for air-blasts, caused to a large extent by faulty methods of mining in ground conducive to the occurrence of these peculiar phenomena. What with one drawback and another, mining under present conditions and methods at this property is not by any means an easy task. It is clear that a monthly tonnage of 16,000 tons is far too small wherewith to earn a dividend for the shareholders, and doubtless when worked on an adequate scale the mine will give a good account of itself.

MAP OF RAND DISTRICT.

During the week ended June 23, the annual meeting of the Rand Mines, Ltd., a concern either controlling or holding interests in nearly every mine of marked value on the Rand, was held. These interests extend over three-quarters the whole length of the Rand and practically embrace all of the deep-level mines and properties worth having. The history of mining operations carried on here may be regarded as the history of the Rand.

General Mining News

ALASKA

CORDOVA

Mining at Knik and in the Willow Creek district is being rushed this season, in spite of the handicaps that the operators are under. The Alaska Free Gold, Alaska Gold Quartz, and Gold Bullion mines are all milling steadily. Generally, the district is opening in a promising manner.

FAIRBANKS

Twenty tons of ore from the Reliance Mining Co.'s claim yielded $134 per ton crushed. The Company has acquired the Wild Rose claim, between the Soo and La Rose claims on Dome creek.

JUNEAU

The June operations of the mines on Douglas island resulted as follows:

	Alaska Mexican.	Alaska Treadwell.	Alaska United.
Development, feet	80	400	775
Ore crushed, tons	18,207	74,900	36,197
Gold by amalgamation	$28,064	$110,014	$47,189
Concentrate, tons	124	1,426	865
Gold by cyanidation	$51,772	$100,498	$42,232
Total realization	51,254	208,407	89,517
Operating costs	23,113	83,391	50,875
Construction	2,791	15,640	4,114
Profit	25,350	109,375	34,528

KETCHIKAN

According to the Ketchikan *Miner*, the Great Boulder Proprietary Co., of Kalgoorlie, Western Australia, has taken over the options of the Alaska Venture Syndicate, which include the Bugge and nearby properties.

NOME

The Nome-Montana dredge started working in the Solomon district on June 14. The American Gold Dredging

HERMING'S HYDRAULIC MINE, NEAR KNIK, ALASKA.

Co. has launched its dredge, which should be at work soon at the mouth of Peluk creek.

SUSHANNA

Gold worth $3600, the first shipment from the new district north of Kennecott, has been received at Dawson, Yukon Territory, and is now on view. The gold was recovered from a claim on Little Eldorado creek in two days by two men shoveling. T. Doyle obtained $27 per pan on his claim. A. Taylor and T. Doyle, who are at Dawson, stated that all the claims in the district are staked, and prospectors should not go to the new field without several months' supplies.

VALDEZ

The Midas copper mine, near this place, is being reopened after a short shut-down due to disagreement between the owners and the Alaska Syndicate, which has an option on the property. Over 1800 ft. of development has been done, and reserves are given as 200,000 tons of 7% copper ore, with also some ore containing gold and silver.

ARIZONA

GILA COUNTY

(Special Correspondence.)—Because of the large amount of water and comparatively small amount of power available, work at the Magma has been held back to a great extent during the past few months; but such work as has been performed has been extremely satisfactory, and there is today an excellent showing of ore in both the 650 and 800-ft. levels east. When the transmission line from Roosevelt *via* Miami has been completed, the Magma will have ample power, development work will proceed more rapidly, and within the next few months construction of a concentrator will begin. It is said that the Company will begin purchasing mill equipment within 60 days. Considerable plant has already been ordered to be delivered at the mine, to be installed in time to begin operation when the transmission line is complete. Three 250-kva. transformers for the sub-station, to reduce the voltage from 45,000 to 2200 volts; three 75-kva. transformers, to reduce the voltage from 2200 to 440 for the mine pumps; three vertical Aldrich pumps, to be driven by 75-hp. motors; a 225-hp. motor to drive the compressors, and other machinery have been ordered. The Magma is shipping the usual amount of high-grade copper ore to Florence by team, thence by rail to the El Paso smelter. The underground force remains at about 40 men and will not be materially increased until the advent of the electric power. About 500 ft. of diamond-drilling remains to be done by contract. Ore has been found in all of the holes drilled.

At the Calumet & Arizona, south of Superior, the shaft is more than 500 ft. deep, and considerable iron and copper carbonate was reported as cut near that depth. A pump station is being cut at the 500-ft. level. The shaft is making about 6000 gal. of water per day. The main working adit is about 1000 ft. long, and stringers of carbonate and sulphide ore have been passed through. The Calumet & Arizona company's superintendent of motor power, Mr. McKee, visited the mine recently and took measurements for a 15-drill compressor, which may be installed at the plant in the near future. Thomas Ryan, diamond-drill contractor, who has been drilling the Magma property for several months, may contract with the C. & A. to drill 1500 ft. on the property.

Miami, July 26.

The report of the Arizona Commercial Copper Co. for the year ended June 30, 1913, states that the surplus amounts to $284,523. The Copper Hill shaft has been enlarged and retimbered 390 ft. from a depth of 418 ft. below the collar to the bottom of the old shaft, 808 ft. below; and it has been sunk 317 ft. farther to a depth of 1125 ft., and 450 ft. of drift has been repaired on the No. 3 level. Driving covered 158 ft. on the No. 4 level, and connection has been made with the Gray mine of the Old Dominion company. On No. 7 level, two narrow sulphide veins are being opened by a drift and raise, respectively; and No. 8 level is in limestone. There has been no leasing since the beginning of 1913, and no ore has been shipped since then.

Reports given out as being official are that what is known as the Christmas mine, 10 miles north of Winkleman, has been bonded for $1,000,000 to Eastern capitalists. B. P. Cheney, who is well known in financial circles, with headquarters in Boston, is the principal in the undertaking. It is stated that work will begin on this mine in about fifteen days.

CALIFORNIA

The June production of oil from all counties totaled 8,109,941 bbl. gross, compared with 8,098,138 bbl. in May. The consumption on the fields is included in this quantity, but owing to the general adoption of electric power this item is decreasing steadily. Operations during June were as follows: rigs completed, 48; drilling, 373 wells; producing wells, 5997; completed, 64 wells; and abandoned, 17 wells.

AMADOR COUNTY

A good quality of ore has been opened in the Oneida mine, adjoining the South Eureka, and 10 stamps of the

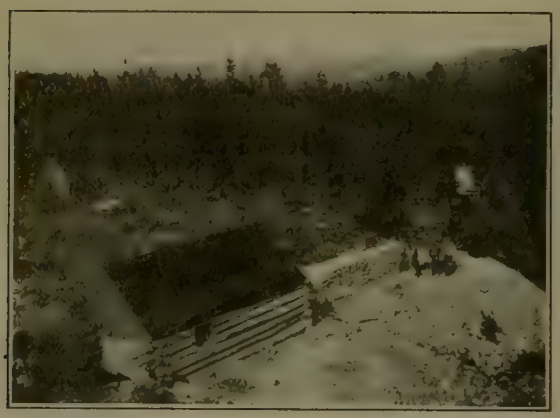
old mill are working. The Central Eureka has resumed shaft-sinking.

ELDORADO COUNTY

The new mill at the Homestead mine began crushing ore this week. J. B. Farnsworth is in charge of the work. The mine is being worked by Sacramento parties.

MODOC COUNTY

An ore-shoot, over 100 ft. long, has been opened in the Lucky Dutchman lease of the Sunshine property, and 100 tons of $60 ore has been mined. This will be shipped to Salt Lake City. A winze is being sunk in ore below the main adit-level of the Sunshine by a lessee, J. Miller. The lease on block No. 8 of the Sunshine, north of the adit, has opened good ore. The Modoc Mines Co. has a shaft down 200 ft. and is equipped with a steam hoist, the only one at High Grade. Water has been troublesome, but driving on the 50, 100, and 200-ft. levels on the vein is being started. W. Wrigley, Jr., and others, of Chicago, are interested in this property. The Gold Nugget and Gold



SUNSHINE PROPERTY, HIGH GRADE.

Shore claims are being prospected. A postoffice and telephone has been installed at High Grade, and the district is said to be quite promising.

NEVADA COUNTY

A company known as the You Bet Mining Co. has been organized, by Los Angeles people, with a capital of $200,000, to develop the claims of the late Jerry Goodwin at You Bet.

PLACER COUNTY

Construction work has commenced on the Yukon Gold Co.'s dredge near Auburn. The machine formerly worked at Oroville. The claims of Charles Gaws, on the North Fork of the American river, one mile below Auburn, have been bonded to a syndicate that will test their value for dredging. Borings will be taken immediately. Iowa Hill, an old mining town, is again booming. At the Bumps Cañon claim a placer machine of 500-cu. yd. capacity is at work.

PLUMAS COUNTY

According to the *Greenville News*, mining in the Seneca district is increasing in activity. Sol Camp and Grant Snyder, representing Salt Lake interests, have been examining practically all of the properties cutting the old channel under the lava cap. A deal is now pending for the purchase by their people of the Cameron old channel property. Rich Gulch quartz has also interested them, and they have taken samples and made a thorough examination of the Hazzard property. They went through the Sunnyside mine, one of the old channel properties down the river from Seneca, and have become interested in the properties lying between the Glacier and the Sunnyside. The Glacier is being worked by San Francisco people, while good gravel is being mined at the Sunnyside.

After six years of unceasing effort, the long-sought gold-bearing channel in the Golden Ancient mine, near Quincy, has been intersected.

SACRAMENTO COUNTY

The Ashburton Mining Co. is negotiating for the purchase of the land and dredges of the bankrupt Union Dredging Co. The Ashburton company has little land left to work, and unless the deal for the Union property goes through, will complete operations within the next few weeks.

SHASTA COUNTY

(Special Correspondence.)—An inspection of the Cottrell electrical precipitating plant is under way. It is planned to experiment with this device in the tests to recover the sulphur from Balaklala ores at low costs. Residents of Redding have subscribed approximately $5000 for the construction of a Fields process plant for treatment of copper ores without generation of noxious fumes. The building of the plant is planned for an early date. Numerous locations have been recently filed on the limestone deposits in the vicinity of Heroult. The limestone is of excellent quality, and strong interests are reported concerned in the acquisition of the deposits. The Noble Electric Steel Co. converts the material into an article of commerce by reducing the ores with the furnace gases from its electric iron furnaces. Including the June dividend of $9000, the Hazel mine, at French Gulch, has disbursed $54,000 in profits during 1913. This makes a total of $954,000 to date.

Redding, July 21.

TUOLUMNE COUNTY

(Special Correspondence.)—The shaft at the Josephine mine, situated near the Shawmut, and bonded a few months ago to Mr. Lewis, of Stockton, and W. T. Jones, is 100 ft. deep, and from the bottom a cross-cut is being driven through the vein to the hanging wall. A drift will then be driven toward the north 100 ft., raising thence to surface, and subsequently sinking. The shaft now used will then be abandoned for the new one, which will contain three compartments, be larger, and better situated. Surface prospects show a shoot 800 ft. long and 150 ft. wide, assays returning from 50c. to over $7 per ton. In the cross-cut being driven through the vein at a depth of 100 ft., assays show a better average. The mine is an old one, but has never been developed to any great depth, the present operators already having gone deeper than the former workings. It was once equipped with a Huntington mill, and a considerable tonnage of ore was mined, with good results.

W. T. Jones and J. McFarland have secured a lease on the No. 2 shaft of the Harvard and are working near the surface in ore that is paying well. The operators are confident of even better success in the near future. The hoist that has been installed on the leased ground is run by compressed air from the Harvard mine, as are also the machine drills.

Sonora, July 18.

YUBA COUNTY

The Hammonton company has bonded the Yuba river from Parks Bar bridge to the Narrows, and a boring machine will start work directly. This section is said to be rich in gold, as it is where the outlets from the Pactolus, Cement, Pittsburg, Blue Gravel, and Blue Point mines empty.

The Tarr Mining Co. has suspended operations at the old Blue Point property near Smartsville, after having spent many thousands of dollars on one of the most extensive mining plants in this part of the state. Apparently the investors, most of whom are said to be Sacramento people, have lost all they have put into the mine.

COLORADO

CLEAR CREEK COUNTY

The *Georgetown Courier*, in writing of the value of ore produced in the district in early days, quotes the following from the *Colorado Miner* of July 11, 1872. Figures were given by H. Stoelting, 'territorial' assayer for the county. This ore was shipped to Eastern states and Europe. The average assay value of 257 lots of ore was 298.6 oz. of silver per ton, valued at $386.32. The several lots from which the samples were taken varied in weight from

a few hundred pounds to a number of tons, and aggregated about 500 tons. Included in these were 53 lots which gave an average yield of 42.2% of lead.

Dolores County

It is stated that the Rico Wellington mill has been temporarily closed. The mine will be kept in operation without interruption, the zinc ores to be stored until the mill is in readiness to resume. Shipments of lead and copper ores will be made without any interruption.

Eagle County

It is stated that a vein has been found on the Wyoming and Beatrice claims which appears to be an extension of the Lady Belle. These two claims adjoin the Lady Belle claim to the northeast, and J. H. Hoffman, who is working these properties for Leadville men, states that the adit which is being driven on the Beatrice has cut a vein of low-grade ore like that found in the Lady Belle. The silver content is low, but it is understood that the vein is well defined and that its trend is toward the present workings of the Lady Belle.

Ouray County

During June, the Tomboy mill worked 28 days, crushing 11,500 tons of ore, yielding $81,000 from cyanidation, and 1800 tons of concentrate was shipped. The profit was $35,100.

During the quarter ended April 30, the Wanakah Mining Co. showed the following results:

Development, feet	583
Mill worked, days	87
Ore crushed, tons	4,174
Net value of crude ore, concentrate, and bullion	$35,868
Operating costs	22,691
Profit	$ 13,177
Expenditure on improvements, etc.	6,918

Teller County (Cripple Creek)

The El Oro Mining & Milling Co. has issued a pamphlet dealing with its property and proposals for ore treatment. The Company owns 60 acres and has an option on 50 acres in the district. According to the report of R. L. Riggs, the best claims are on the north slope of Battle Mountain, and numerous veins and dikes cross them, as proved by surface work. About ten years ago the 500-ft. shaft was sunk and the adits were driven fifteen years ago. About $1,000,000 worth of ore has been shipped from the property. There is now 500,000 tons of ore opened to 200 ft. which should be mined and milled at a profit of $1 per ton. Tests on the ore show that, by simply crushing to 8 mesh and cyaniding, 85% recovery should be made. A 200-ton plant is recommended, to be erected on the hillside. A report by Linderfelt & Stewart practically confirms these figures. Recent development has opened 100,000 tons of ore. Tests on this ore showed the assay value to be $12, and the tailing to be 20c. per ton after a 72-hr. leach on a 12-mesh product in a 3-lb. cyanide solution. The ore slimes readily, and will require classification, treating the slime independently of the sand. This will increase the extraction with little if any additional cost of treatment. A pocket of water, or a small watercourse, was opened on the 1600-ft. level of the Golden Cycle shaft last week, and in order to keep the electric pumps above water it was necessary to start up the steam pumps. Sinking of the Elkton shaft has been started from No. 12 level, and it is hoped to go 100 ft. before meeting with water.

The following description of the proposed El Oro mill is given by the *Cripple Creek Times*: It is favorably situated on the side of Battle and Squaw mountains in Eclipse gulch. Ores from the mines of the Company will be trammed to a storage-bin above the rock-crusher, and from this passes through a trommel, where a certain percentage of waste is rejected. The oversize from the trommel will be sent to the coarse-crushing rolls, and the fine rolls get that which passes the trommel. All ore is to be carried by a belt-conveyor to the main plant, where it is sampled and then run into storage-bins behind the Chilean mills. From one of these storage-bins that portion of the oxidized ores amenable to direct cyanide treatment will be conveyed to a series of sand tanks, where the usual leaching process for extracting the gold will be used. From the storage-bins containing the sulphide ores, the material is fed uniformly by plunger feeders into the Chilean mills, along with weak cyanide solution. After being crushed, the ore flows to a distributing barrel, and then to concentrating tables. The product from these will be shipped to smelters. The pulp next is lifted by a belt and bucket elevator to classifiers, which make two products, sand and slime. Part of the former is reground in tube-mills, the balance being leached in vats. The reground pulp is elevated to a height sufficient to return it to the classifiers which separate from it and return to the tube-mills any sand that may have escaped being crushed fine enough in going through the mills the first time, while the slime classification flows to cone classifiers. The underflow of these goes back to slimings tables, the overflow to the dewatering tanks. The overflow solution separated from the pulp during the pulp-thickening process is pumped back to the mill service tanks for re-use in the Chilean mills and general mill service. The underflow of the heavier pulp particles separating from the charge passes to a series of Pachuca tanks. The pulp from these is finally filtered by a revolving machine, and gold is precipitated by either zinc dust or shaving.

IDAHO

Custer County

Active development and installation of machinery is to begin at the Wall Street mine, which contains both quartz and gravel. Salt Lake people are largely interested. Clarence E. Eddy also succeeded in getting Eastern people to supply money for the property.

Lemhi County

The compressor and engine-rooms of the American Development, Mining & Reduction Co., at Gibbonsville, were destroyed by fire that is believed to have been of an incendiary origin, on July 13. A slow-speed Chilean mill of 20 tons capacity will shortly be installed at the Dora quartz mine, owned by F. E. Gonder, on Sheep creek, adjoining the A. D. M. & R. Co.'s property at Gibbonsville. Assays taken from an adit recently driven through a 7-ft. vein show from $13 to $50 per ton. A ditch 2000 ft. long is being built which will furnish water-power to drive the mill.

Shoshone County

The outlook in the Coeur d'Alene region is encouraging, more men are employed in the mines and mills than ever, the production promises to be a record for the year, and mining operators and investors are being attracted to the district. Extensive development of the Laclede mine, lying between the Hercules and the Tamarack & Custer and adjoined on the north by the Interstate-Callahan, is being planned by the Company. The No. 2 adit is in 2200 ft., 1600 ft. of which is in a cross-cut to the lead, and the remainder a drift on the vein. The results in the bore were not satisfactory, and recently a shaft was started at a point in the adit 1800 ft. in from the portal. Crystallized lead, similar to that in the Hercules, is exposed in the shaft, and ore should soon be cut.

The hearing of the suit of the Bunker Hill & Sullivan Mining Co. *v.* the Caledonia Mining Co., an action in which the plaintiff company attacks the title of the Caledonia orebodies, on the ground of extralateral rights, will come up for hearing in the federal court at Coeur d'Alene on October 22. The annual meeting of the Snowstorm Mining Co. was held at Larson on July 29. The manager, Leo Greenough, stated that the geological conditions of the district have been carefully studied, and the indications are that the orebody cut off by a fault lies from 400 to 600 ft. below No. 4 adit-level and to the east. It is sinking from this level and believes there is a good prospect of finding the vein again. During the year the mill operated with good results. Good progress is being made with preparatory work for the National mill at Mullan. Net earnings of the Stewart Mining Co., near Kellogg, in

June were $104,000. The shareholders in the Rex Mining Co., at Nine-Mile creek, are asked to subscribe $30,000 for further mine development.

ILLINOIS

Jo Daviess County

(Special Correspondence.)—The Mineral Point Zinc Co., which has purchased the old Marsden or Black Jack mine, south of Galena, has completed preliminary work and begun to pump out the mine. The Black Jack was worked on lease for many years by the Illinois Zinc Co. and has been a large producer. It is thought that changed conditions warrant reopening the property. The mining department of the Mineral Point company is about to move headquarters to Galena, so as to be in closer touch with the field. While prices for unroasted ore have been low for some weeks and a number of the smaller mines are idle, those equipped with roasting plants are doing well and some of the higher grades of ore are selling as well as ever. Buying is not active, as most of the smelting plants have a stock of high-priced ore to work off. The new plant of the American Lead & Zinc Co. at Hillsboro is settling down to regular work gradually. It began on low-priced Western ores, but is now using the higher grades from Wisconsin and some Joplin ore. Eventually it is expected that the new Tennessee mines will supply 300 tons per month to this plant.

Galena, July 19.

MICHIGAN

Houghton County

The mining companies at Houghton and district will pay their employees semi-monthly after August 15. At the Quincy mine, a system of checking the miners as they go and return from underground has been adopted. Also, at several shaft-houses, comfortable new waiting-rooms have been provided. There were no startling developments in the strike during the week.

NEVADA

Churchill County

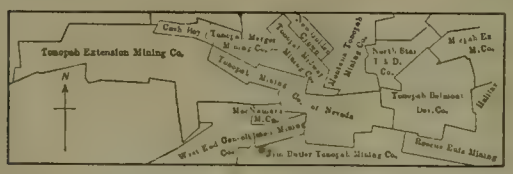
During June, the Nevada Hills Mining Co. treated 4600 tons of ore, yielding $59,012, with a net profit of $28,181. The average recovery was $12.83 and expenses $6.70 per ton. Assets, including cash, supplies, concentrate, and bullion, and the metal in solution, total $108,608, while bills payable are $20,000. All indebtedness was expected to be liquidated during July.

Esmeralda County

Rich gravel has been opened at Palmetto, near the border of California, by Grigsby and son, for 25 to 35 ft. width, and from 5 to 6 ft. of this the yield is from 50c. to $1 per ton. An option has been taken by Goldfield people. Water is scarce.

Nye County

On July 14 a settlement was effected of the pending litigation between John F. Davidson and the Round Mountain Mining Co. by which the latter paid to the former



PLAN OF IMPORTANT MINES AT TONOPAH.

and the parties interested with him, the sum of $15,000 and 15,000 shares of treasury stock; and secured from him a release and satisfaction of the judgment of $165,157.70; and a release of all claims of whatever nature now or at any time held against this Company. The directors have declared a dividend of 4c. per share, payable on August 25.

During the week ended July 26, the mines at Tonopah produced 10,800 tons of ore, worth $255,110. The Belmont company shipped 179,324 oz. bullion on July 20, this being the clean-up for the first fortnight of the month. The quarterly report of the Tonopah Mining Co. shows that the mill recovery was $643,967, and net earnings $328,979. A dividend of $400,000 was paid on April 21, and cash on hand on May 31 was $382,528.

White Pine County

The quarterly report of the Nevada Consolidated Copper Co. for the term ended June 30 was as follows:

Ore milled, tons	771,351
Value of copper	$2,389,787
Mining cost	550,689
Transport of ore	203,366
Milling and smelting	1,360,747
Net yield	$ 274,985

The tax on this output amounts to $5939.

Returns from 21 tons of ore from the Hamilton company's mine were 107.24 oz. silver, 20.55% lead, and 6.46% copper, netting $1479. The owners of this property are mostly McGill men.

UTAH

Juab County

It is stated that the option on 41 claims on Prospect mountain to Samuel Newhouse and Salt Lake City people will be completed within a few days. The old Dunderberg mines are included, and the shaft at the Atlas is to be retimbered to 500 feet.

High-grade lead ore has been cut on the 700-ft. level of the Eagle & Blue Bell, while the winze 90 ft. below the 1350-ft. level is in ore. At the Gemini, 100 men are working on leases. Some ore from this mine is averaging 320 oz. silver and 17% lead. Good carbonate ore has been opened on the 1000-ft. level of the Tintic Standard.

Summit County

A new slime collector has been patented by R. V. Smith, of Park City, and a full-size machine is being installed at the Daly-Judge mill.

WASHINGTON

Ferry County

J. L. Harper, of the Harper Consolidated Mines, at Republic, has taken a bond on the Faithful-Surprise mine near Danville, and reports that the work is progressing rapidly and that the showing is encouraging.

Stevens County

The Aurora and United copper mining companies, whose properties adjoin at Chewelah, are considering plans for extending the main adit of the latter into the former's ground to cut its veins at 1000 to 1500 ft. vertical depth. The United adit will have to be driven 3600 ft., and the Aurora adit is now in 1000 ft., having cut two veins of good ore. The latter adit is being driven 5 ft. per shift. Five cars of rich gold-silver ore have been shipped from the Union Mining & Smelting Co.'s mine, near Dunn. A 300-ft. shaft has been sunk and 400 ft. of cross-cuts driven.

MEXICO

Jalisco

The directors of El Favor Mining Co. have paid a dividend of $35,000 on July 30, being 1c. per share on each share of outstanding stock. The political troubles in Mexico have not seriously interfered with the operations of the Company. While there have been some bandit raids in the state of Jalisco, the mines have been unmolested, and, while no lawless bands have visited the properties, it was deemed best to fortify the camp, and a high protecting wall with suitable defending towers has been built, surrounding the Company's principal buildings, and with the loyalty of the hundreds of men employed in El Favor and Mololoa mines adjoining, it is believed that operations are thoroughly protected now. Although the expense of erecting this fort will amount to several thousand dollars (full amount not yet known), it was deemed not only prudent but just to the loyal employees to give them every possible protection. Both the revolutionary and the gov-

ernment parties have done everything possible to protect the interests of the Americans, vying with each other in giving encouragement to foreign capital. If any interference occurs, it would be through the bandits. Vigorous development work is being continued and in the Candelaria mines, being the farthest west workings of the properties, an unknown orebody has been cut which is proving quite extensive, carrying high bullion content.

MAP OF MINING DISTRICTS OF JALISCO.

SONORA

(Special Correspondence.)—An English company has been granted a concession by the federal government for the construction of a railroad between Ensenada, Lower California, and Mexicali, on the border. The road is also to be continued east, crossing the Colorado river and traversing the northern part of Sonora to Magdalena, where it will connect with the Southern Pacific of Mexico lines. The road will be approximately 450 miles long, and will pass through some rich mining country, although for a considerable distance will be nothing but a desert waste, with no signs of habitation.

Sonora mines, especially those in the south and central portions, are seriously crippled by the inability to secure supplies. In the Tonichi neighborhood, almost all the mines have been closed down during the past month, including La Barranca, San Xavier, San Antonio Copper Co., and others that are of lesser importance. La Dura property of the Mines Company of America is still operating, but with a small force of about 60 men, and will probably be compelled to shut down by the end of July. Mina Mexico continues also, with about 100 men at work. The 85-ton smelter has been started and is using charcoal burned on the property as a substitute for coke. The result of the use of charcoal in the furnace is not yet known here.

San Ygnacio mine, situated in the Moctezuma district, has also been closed down, directly due to the present unsettled conditions. Funds have been exhausted and an effort is being made at present to secure sufficient funds to install a 100-ton mill and continue development work.

Cananea, July 19.

The Tigre Mining Co. reports the June output as follows:

Ore crushed, tons	5,619
Tailing cyanided, tons	7,246
Bullion from shipping ore, concentrate, and cyaniding	$133,049
Total costs	80,611
Profit	$ 52,438

Since January 1, 1913, bonds amounting to $117,750 have been purchased and cancelled. These purchases reduce the bonds outstanding to $99,050.

Personal

Professional men are invited to send news of their engagements and travels. Such news is interesting to friends.

E. H. Nutter is in New York.

M. K. Rodgers is visiting New York City.

Waldemar Lindgren is at El Oro, Mexico.

J. A. Van Mater was in Wisconsin recently.

R. A. F. Penrose, Jr., was in San Francisco.

Archibald Stark is visiting Tucson, Arizona.

L. C. Graton is spending the summer at Butte.

S. S. Sorensen is at 165 Broadway, New York City.

Donald F. Irvin has returned to El Tigre from Los Angeles.

W. W. Mein was in San Francisco and has returned to New York.

John I. Kane is now at the Angangueo plant of the A. S. & R. Co., Michoacan.

Paul S. Couldrey, mining engineer for the Cerro de Pasco, is at New York.

Arthur Thacher is examining the Potosi mine near Good Springs, Nevada.

P. B. Scolland is general mine superintendent for the Arizona Copper Company.

T. W. H. Shanahan has been appointed superintendent of the San Francisco Mint.

W. B. Chidester is with the Globe Consolidated Mining Co., at Dedrick, California.

Robert H. Chapman is with the United States Geological Survey at Yerington, Nevada.

Clement H. Mace is making an examination of the Amalthea mine at Smyrna, South Carolina.

Britton B. Gottsberger has sufficiently recovered to resume his duties as manager for the Miami Copper Company.

A. E. Kitson passed through San Francisco on his way from Australia to Toronto to attend the International Geological Congress.

J. J. Shaw is superintending the first hydraulic placer installation in the Philippine Islands, for the Cansuran Placer Co., at Manila.

Alexander Winchell, of the University of Wisconsin, is in charge of field work for the Oregon State Bureau of Mines with headquarters at Gold Hill.

E. B. Tinker is superintendent for the Superior & Boston, and W. A. Sullivan has been appointed chief clerk and purchasing agent to succeed the late Carlos W. Rice.

M. F. Perry, resident director of Butters Divisadero Co. and Butters Salvador Mines, Ltd., Salvador, will be in Whitney's Point, New York, during August and September.

James F. Kemp has been appointed chairman of the committee on mining geology of the American Institute of Mining Engineers, succeeding Waldemar Lindgren, resigned.

H. A. Morrison has resigned as mine superintendent for the Uwarra Mining Co., at Candor, North Carolina, to accept a position with the Globe Consolidated Mining Co., at Dedrick, California.

Among those who attended the excursion to Sudbury, Cobalt, and Porcupine, of the International Geological Congress, were the following: J. Barrell, H. F. Bain, A. G. Burrows, Jean Cailleboтte, S. Cerulli-Irelli, A. G. Charleton and Mrs. Charleton, A. A. Cole, G. A. J. Cole, A. P. Coleman, W. H. Collins, E. T. Corkill, J. A. Dresser, H. Eckfeldt and Mrs. Eckfeldt, Miss Annie Eubank, F. H. Forest, G. W. Grabham, P. E. Hopkins, R. E. Hore, J. F. Kemp, C. W. Knight, A. E. Kitson, A. C. Lane, E. Lindeman, E. Mattirolo, Charles McDermid, Bedford McNeill and Mrs. McNeill, Guiseppe Mercial, Willet G. Miller, L. J. Morin, J. A. Noiseux, Otto F. Pfordte, Miss C. A. Raisin, F. L. Ransome, L. Reinecke, W. R. Rogers, Heinrich Schulze, Fred Searls, W. E. Simpson, H. S. A. Sjögren, J. Stansfield, Jules Szadeczky de Szadecsne, J. B. Tyrrell and Mrs. Tyrrell, T. L. Walker, Edgar T. Wherry, A. W. G. Wilson, and M. E. Wilson.

New York Metal Market Review

With all the metals is apparently a tendency on the part of consumers to carry no more stock than absolutely necessary. It is also evident that demand for finished products in brass and copper and some other metals has fallen off. Most of the metals were dull, and prices declined steadily in the early part of July, but an improvement in nearly all directions came toward the end of the month, though at the higher prices no great strength was shown. Copper had a good movement emanating from abroad. Lead prices alone remained fairly stationary. In spelter there were a couple of fair buying movements. Antimony and aluminum were dull, and prices of both declined without recovery. Tin was down to 39.35c. on July 9, and although a part recovery followed, prices are far below those of a few weeks ago.

COPPER

The Waterbury average for June was 15.37½c. per pound, or ½c. less than that of the preceding month. A dull market with quotations nominal at 15c. cash New York for Lake, and 14.62½c. cash New York for electrolytic, prevailed when the month opened. Consumers were well supplied and the demand for their finished products had fallen off noticeably. This latter fact explained the reduction of 1c. per pound in prices of copper and brass products which was announced July 1. The second week of July, Lake was down to 14.75c. and electrolytic to 14.50c., both cash New York, and there was talk of electrolytic at ⅛c. lower, with business still lacking. These were resale prices, as producers asked at least ⅛c. more. The June report of the Copper Producers' Association was looked for with anticipation, as the figures were expected to start buying. While the statistics were favorable in that they showed a decrease in stocks of 14,659,619 lb., they were unfavorable in showing a falling off in domestic consumption of about 12,600,000 lb. as compared with May, while the exports were a trifle less also. Production in June fell off nearly 19,500,000 lb. as compared with May, for which the strike at the Nichols refinery on Long Island was largely responsible. The large shrinkage in stocks was not expected. The world's total visible supply of copper at the time of the report was 61,815 gross tons, the lowest on record since the publication of the Association's reports. The lowest previous stock was at the end of June 1912, when the figures were 67,931 tons. So far as inducing business was concerned, the report was disappointing, and the second week of the month brought no improvement. Prices declined and, on July 15, 14.12½c. cash New York was the quotation for electrolytic, with Lake nominal at 14.50c. cash New York. The declines were attributed entirely to lack of business. On July 18 there was a turn for the better, and 14.25c. cash New York was quoted for electrolytic, and this was advanced July 21 to 14.37½c. On July 24 the largest producing interests advanced their asking price to 14.62½c., f.o.b. New York, or 14.75c. cash 30 days. The improved prices began with good buying abroad, some reports stating that as much as 75,000,000 lb. was taken by foreign consumers, though many regarded this figure as excessive. Allegations were heard that the buying had been artificially stimulated to secure action on the part of the consumers before the publication of the July report of the Copper Producers' Association; but, whatever the cause, there was good buying in England, France, and Germany, followed by a fair movement in this country. The domestic buying was not extremely large, as consumers distrusted the situation and were buying no more than was necessary. Early shipment copper was not easy to obtain at this time, partly as a result of the trouble at the Nichols refinery. Up to July 25, inclusive, exports totaled 19,375 tons.

The producers and leading agencies on July 25 raised their quotation for electrolytic to 15c., 30 days, delivered, or 14.87½c. cash New York. Because of the better tone, copper wire in carload lots at the mill was advanced ½c. to 16½ cents.

LEAD

The New York price of this metal was stationary at 4.35c., but at St. Louis there was at times a premium of 2½ points over the price of 4.20c. On July 1 lead was dull, though quotations were firm, with 4.22½c. quoted at St. Louis. This last quotation declined to 4.20c. within a few days, as demand was light and complaint was heard from consumers that their business was falling off. About the middle of July, however, better inquiry developed, and it became apparent that consumers had let their stocks become low, a condition noted in the case of many raw materials and traceable to a disposition to let 'the other fellow' carry the stocks. Buying was done most cautiously. On July 18, some buying worthy of note again started, but it tapered off as soon as the immediate needs of consumers were covered. It left the St. Louis price higher again at 4.22½c. On the whole, the month was not satisfactory.

SPELTER

Good inquiry was in evidence July 1, with 5.30c. New York and 5.15c. St. Louis quoted. In June, prices had been considerably lower. In the first few days of July, more spelter was sold than had changed hands in many weeks previously. On July 8, 5.40c. to 5.50c. New York, and 5.25c. St. Louis, were quoted. Business was good in both prompt and future delivery metal. Consumers' stocks were being replenished after reaching a low ebb. About the middle of the month, the demand having been satisfied, business tapered off again and quotations dropped to 5.30c. New York and 5.15c. St. Louis. About July 21, however, there again was improved inquiry, with a corresponding stiffening of prices, and by July 23 quotations were again 5.40c. New York and 5.25c. St. Louis. The buying was mostly for prompt delivery, confirming again the low state of consumers' stocks.

ANTIMONY

Only such adjectives as dull, stagnant, and neglected have been used in any part of July in describing the state of the market for antimony. July opened with quotations at 8.50 to 8.60c. for Cookson's, 8c. for Hallett's, and 7.50 to 7.60c. for Chinese and Hungarian grades. Near the close of the month, 8.40 to 8.50c. was quoted for Cookson's, 7.75 to 8c. for Hallett's, and 7.25 to 7.50c. for Chinese and Hungarian.

TIN

July started in weak at 41.60c., there having been a gradual decline in the latter part of June. The low price caused a fair demand for small lots from consumers who needed only a few tons and took advantage of the slump. Most of them, however, were sufficiently supplied for July. Incidentally, many of them had paid as high as 48c., or even higher, for the metal they were using. On July 3 there was a flurry in which about 200 tons was sold to dealers who did not wish to remain uncovered on short contracts over the Independence Day holiday. On July 7, the first real business day after the holiday, tin sold at 40.20c., and by July 9 it had dropped to 39.35c., as against 51.12½c. a few months ago. In London, prices had been most erratic, which, of course, was nothing new. But a comparison is almost startling. The quotation in London, July 9, was £178 for spot, while the highest price of the year was £232, thereby making a difference of £54, equal to a decline of about $250 per ton. July 10, with the market at 39.55c., a fair business was done, consumers taking about 250 tons. The London market then showed a higher trend and on July 16 was £5 higher than on July 9. Toward the latter part of the month a better demand appeared, especially for spot and early shipment, showing again that small stocks were being carried by consumers. London continued to advance, and the price in New York on July 23 was 42c., and on July 24 it came down to 40.85c. World statistics available at the beginning of July showed the total visible supply on June 30 to be 11,101 tons, or 1819 tons less than that of June 30, 1912. June deliveries into domestic consumption were 3800 tons. The total domestic deliveries for 6 months of 1913 showed a decrease of 550 tons as compared with the same time a year ago.

The Metal Markets

LOCAL METAL PRICES

San Francisco, July 2.

San Francisco is not a [illegible] for the common metals except quicksilver. The prices [illegible] for lots representing sales of small [illegible] producers could expect to receive. [illegible] call for settlement on the basis of Eastern prices less freight and treatment charges. The prices quoted are in cents per pound, except in the case of quicksilver, which is quoted in dollars per flask of 75 pounds.

Antimony	12–12½c	Quicksilver (flask)	$41
Electrolytic Copper	16½–16¾c	Tin	37½–41c
Pig Lead	4.75–5.75c	Spelter	7–7½c

Zinc dust, 1400 lb. casks, per 100 lb., small lots $9.50–9.75; large $7.50–8.50

SILVER

Below are given the average New York quotations, in cents per ounce, of fine silver.

Date.		Average week ending	
July	24	June 18	59.08
"	25	" 25	58.12
"	26	July 2	58.20
"	27 Sunday	" 9	58.29
"	28	" 16	58.43
"	29	" 23	58.79
"	30	" 30	59.28

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	56.25	63.01	July	60.67	58.70
Feb.	59.06	61.25	Aug.	61.32	....
Mch.	58.37	57.87	Sept.	62.95	....
Apr.	59.20	59.26	Oct.	63.16	....
May	60.88	60.21	Nov.	62.73	....
June	61.29	59.03	Dec.	63.38	....

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.		Average week ending	
July	17	June 11	4.33
"	18	" 18	4.33
"	19	" 25	4.33
"	20 Sunday	July 2	4.33
"	21	" 9	4.33
"	22	" 16	4.33
"	23	" 23	4.34

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	4.43	4.28	July	4.71	....
Feb.	4.03	4.33	Aug.	4.54	....
Mch.	4.07	4.32	Sept.	5.00	....
Apr.	4.20	4.36	Oct.	5.08	....
May	4.20	4.34	Nov.	4.91	....
June	4.40	4.33	Dec.	4.20	....

ZINC

Zinc is quoted as spelter, standard Western brands, St. Louis delivery, in cents per pound.

Date.		Average week ending	
July	17	June 11	4.94
"	18	" 18	4.90
"	19	" 25	4.97
"	20 Sunday	July 2	5.07
"	21	" 9	5.10
"	22	" 16	5.08
"	23	" 23	5.10

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	6.42	6.88	July	7.12	....
Feb.	6.50	6.13	Aug.	6.96	....
Mch.	6.57	5.94	Sept.	7.45	....
Apr.	6.63	5.52	Oct.	7.36	....
May	6.68	5.23	Nov.	7.23	....
June	6.88	5.00	Dec.	7.09	....

TIN

New York prices control in the American market for tin, since the metal is almost entirely imported. San Francisco quotations average about 5c. per lb. higher. Below are given average monthly New York quotations, in cents per pound:

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	42.53	50.45	July	44.25	40.70
Feb.	42.96	49.07	Aug.	45.80	....
Mch.	42.58	46.95	Sept.	48.64	....
Apr.	43.92	49.00	Oct.	50.01	....
May	46.05	49.10	Nov.	49.92	....
June	45.76	45.10	Dec.	49.80	....

COPPER

Quotations on copper as published in this column represent average wholesale transactions on the New York market and refer to electrolytic copper. Lake copper commands normally from 1-8 to 1-4c. per lb. more. Prices are in cents per pound.

Date		Average week ending	
July	1	June 11	14.39
"	18	" 18	14.50
"	19	" 25	14.47
"	20 Sunday	July 2	14.43
"	21	" 9	14.26
"	22	" 16	13.81
"	23	" 23	13.97

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	14.09	16.64	July	17.19	....
Feb.	14.08	14.93	Aug.	17.49	
Mch.	14.68	14.72	Sept.	17.56	
Apr.	15.74	15.22	Oct.	17.32	....
May	16.03	15.42	Nov.	17.31	....
June	17.23	14.71	Dec.	17.37	....

COPPER SURPLUS

Figures showing the visible supply of copper at the beginning of each month are now widely available. Below are given the amounts, in pounds, known to be available at the first of each of certain months. The figures are those of the Copper Producers' Association supplemented by Merton's figures of foreign surplus.

		U. S.	European.
July	1912	44,335,004	107,817,920
August	"	50,281,280	113,285,760
September	"	46,701,376	112,743,680
October	"	63,065,587	107,396,800
November	"	76,744,967	103,803,840
December	"	86,164,059	96,949,440
January	1913	105,311,360	96,859,840
February	"	123,198,352	100,067,520
March	"	122,302,198	95,542,720
April	"	104,269,270	106,565,760
May	"	75,549,108	102,654,720
June	"	67,474,225	93,378,880
July	"	52,904,606	88,471,040

UNITED STATES PRODUCTION AND CONSUMPTION

		Production.	Domestic deliveries.	Exports.
May	1912	126,737,836	72,702,237	69,485,945
June	"	122,315,240	66,146,229	61,449,650
July	"	137,161,920	71,093,120	60,121,600
August	"	145,628,521	78,722,418	70,485,150
September	"	140,089,819	63,460,810	60,264,796
October	"	145,405,453	84,104,734	47,621,342
November	"	134,695,440	69,369,795	55,906,550
December	"	143,353,280	58,490,880	65,712,640
January	1913	143,479,625	65,210,030	60,383,845
February	"	130,948,881	59,676,402	72,168,623
March	"	136,251,849	76,585,471	77,699,306
April	"	135,333,402	78,158,837	85,894,727
May	"	141,319,416	81,158,800	68,286,007
June	"	121,860,853	68,452,572	68,067,901

The fortnightly statistics of copper show that the European stocks, including Hamburg and Rotterdam, on June 30 decreased 1727 tons, while copper supplies afloat decreased 50 tons, making a total decrease in the visible supply of 1777 tons to 38,199 tons, as compared with 39,976 tons on June 14 last.

QUICKSILVER

The primary market for quicksilver is San Francisco, California, being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending			
July	3	41	
"	10	41	
July	17	41	
"	24	41	
"	31	41	

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	43.75	39.37	July	43.00	41.00
Feb.	46.00	41.00	Aug.	42.50	....
Mch.	46.00	40.20	Sept.	42.12	....
Apr.	42.25	41.00	Oct.	41.50	....
May	41.75	40.25	Nov.	41.50	....
June	41.30	41.00	Dec.	39.75	....

ALUMINUM

Early in July, quotations declined ½c., making the price 23 to 24c. for prompt-shipment domestic metal. The foreign product, in bond, was quoted at 18.50 to 19c. There

is little to say of aluminum except that the market was dull all through the month, with proposed tariff changes pointing to lower prices. Toward the middle of the month the range for domestic changed to 23 to 23.50c., and foreign, in bond, to 18.50 to 18.75c. The market steadied a little in the last week of July.

The Stock Markets

SAN FRANCISCO STOCKS AND BONDS.
(San Francisco Stock and Bond Exchange.)

BONDS.

Listed.	July 30. Bid	Ask	Unlisted.	July 30. Bid	Ask
E. I. du Pont 4½s	$ 83½	—	Pac. Port. Cement 6s	$ 99	—
Natomas Con. 6s	79½	79½	Riverside Cement 6s	77	79
Unlisted.			Standard Cement 6s	91½	—
Ass. Oil 1st ref	[illegible]	78½	Santa Cruz Cement 6s	—	81
General Petroleum 6s	—	59	So. Cal. Cement	70	75
Natomas Dev. 6s	—	100			

STOCKS.

Listed.	July 30. Bid	Ask	Unlisted.	July 30. Bid	Ask
Associated Oil	[illegible]	—	Mascot Copper	1½	—
Amalgamated Oil	81½	[illegible]	Noble Electric Steel	—	3
E. I. du Pont com.	—	135	Natomas Consol	5	—
Pac. Coast Borax, pfd	—	[illegible]	Pacific Port. Cement	59	—
do com	—	135	Riverside Cement	—	43
Pacific Crude Oil	—	35c	Standard Cement	—	19
Sterling O. & D.	70c	95c	Santa Cruz Cement	—	34½

NEVADA STOCKS
(By courtesy of San Francisco Stock Exchange.)

San Francisco, July 31.

Atlanta	$ .16	Mizpah Extension	$ .45
Belcher	.25	Montana-Tonopah	1.10
Belmont	6.25	Nevada Hills	.90
Big Four	.42	North Star	.92
Con. Virginia	.14	Ophir	.25
Florence	.30	Pittsburg Silver Peak	.48
Goldfield Con	1.65	Round Mountain	.57
Goldfield Oro	.09	Sierra Nevada	.10
Halifax	1.20	Tonopah Extension	2.25
Jim Butler	.68	Tonopah Merger	.73
Jumbo Extension	.12	Tonopah of Nevada	4.20
MacNamara	.15	Union	.13
Mexican	1.07	West End	1.25
Midway	.45	Yellow Jacket	.21

COPPER SHARES—BOSTON
(By courtesy of J. C. Wilson, Mills Building.)

	July 31. Bid	Ask		July 31. Bid	Ask
Adventure	$ 1	1¼	Mohawk	$ 40½	40¾
Allouez	31½	32	North Butte	27	27½
Calumet & Arizona	63¾	64	Old Dominion	48	49
Calumet & Hecla	401	405	Osceola	—	76
Centennial	11¾	12	Quincy	56	56¾
Copper Range	38¾	39	Shannon	7½	7¾
East Butte	12	12¼	Superior & Boston	2¼	2¾
Franklin	4½	5	Tamarack	26½	27
Granby	59½	60	U. S. Smelting	37	37½
Greene Cananea	6¼	6½	Utah Con.	9¼	9½
Hancock	16¾	17	Victoria	99c	1¼
Isle-Royale	19	19½	Winona	1¼	1¾
Mass Copper	3	3¼	Wolverine	43½	45

NEW YORK QUOTATIONS
(By courtesy of E. F. Hutton & Co., Kohl Building.)

July 31.

	Bid.	Ask.		Bid.	Ask.
Alaska Mexican.	8	[illegible]	Mason Valley...	6½	8
Alaska Tread...	37	39	McKinley-Dar.	1⅞	2
Alaska United..	17¾	18¾	Miami 6s	168	173
Alaska G. M....	18⅝	18⅞	Mines Co. Am..	2¼	2½
Braden Copper..	6½	6⅝	Nipissing	8½	8⅝
B. C. Copper...	2	2¼	Ohio Copper....	½	⅝
Davis-Daly	2	2¼	San Toy	18	22
Dolores	2	4	Sioux Con.	2	4
El Rayo	1	2	S. W. Miami....	5	7
Ely Con.	8	10	So. Utah	⅛	¼
First Nat.	2⅝	2⅞	S. O. Calif.	178	180
Giroux	1⅜	1⅝	Tri Bullion	⅛	¼
Greene Can. ...	6¼	6⅜	Tuolumne	¾	⅞
Hollinger	15½	16½	United Copper..	⅛	½
Kerr Lake	3½	3⅝	Wettlaufer	10	12
La Rose	2¼	2⅜	Yukon Gold....	2	2⅛

COPPER production of the Wolverine Copper Mining Co., during its fiscal year ended June 30, was 8,350,000 lb. The average per ton of 'rock' stamped was 21½ lb. copper.

GOLDFIELD CONSOLIDATED REPORT

During June, according to the general manager, Albert Burch, the total production was 30,486 tons, which resulted in a net realization of $180,782, of which the mining realization was $57,004, and milling and transportation, profit and miscellaneous earnings were $123,777. Costs per ton were as follows:

Mining	$2.69	Construction	0.06
Development	0.65	Marketing ore shipped	0.98
Moving dumps	0.03		
Transportation	0.09	Total costs	$6.79
Milling	1.91	Miscellaneous earnings	0.03
Marketing	0.05		
General expense	0.28	Net costs	$6.76
Bullion tax	0.06		

Development work covered 3323 ft. during the month, at a cost of $5.99 per foot.

On the third level of the Combination, about 100 ft. east of the shaft, the 201-C sill was cut and produced 285 tons of $7 ore. The 414-D winze was continued to a depth of 100 ft. below No. 6 level, where a station was cut and cross-cutting commenced.

On the new No. 1 level of the Mohawk, the 3-R sill was extended and produced 395 tons of $15 ore. On No. 1 level, the 170-BX sill was extended and produced 281 tons of $10 ore, and about 100 ft. farther to the northwest the 170-CX sill was started and produced 204 tons of $15 ore. The ground between these two sills will probably pay to stope. The 205-GY sill on No. 2 level, about 400 ft. northwest of the shaft, was commenced, and produced 309 tons of $16 ore. A considerable amount of preparatory work was done during the month for the purpose of beginning to re-stope the old Truett and Francis-Mohawk lease stopes above No. 2 level, southeast of the shaft.

On the second level of the Laguna, about 600 ft. south of the shaft, the 241 drift is following a streak of ore which is farther toward the hanging wall than anything discovered above or below. It produced 103 tons of $8 ore and is improving in grade as it advances. Diamond-drilling has been commenced for the purpose of exploring the vein below the bottom level of the Laguna.

The 901-E sill of the Clermont-Jumbo was extended and produced 350 tons of $14 shipping ore.

COPPER IN LONDON

Electrolytic copper was quieter on July 29, but there was a big demand for manufactured copper. The Amalgamated agency quotes £69 10s. (15⅛c.) for electrolytic for August and £69 12s. 6d. for September; American Smelting, £69 15s. for September and October; Phelps, Dodge & Co., £70 for October.

THE ABANGAREZ GOLD FIELDS of Costa Rica reports the following yield during May:

Ore crushed, tons	5,663.0
Tailing leached, tons	425.5
Slime treated, tons	4,748.0
Extraction by amalgamation	$12,263
Extraction by cyanidation	29,450
Total extraction	$41,713
Cost of operation, marketing and administration (Exclusive of betterments)	57,441
Profit from operations	*$15,727
Betterment expenditures	$5,641

*Deficit.

United States Steel earnings for the past quarter netted $41,219,813, against $34,426,801 in the March 31 quarter, and $25,102,265 in the June 30, 1912, quarter. The net earnings by months in the past quarter were as follows: April, $13,072,701, increase $5,563,5$3; May, $14,554,566, increase $5,707,744; June, $13,592,537, increa,e $4,846,300.

THE Granby Smelting Co. treated 22,721 tons of ore at its smelter at Grand Forks, British Columbia, during the seven days ended July 21. Of this, 741 tons was custom ore, and the blister copper shipments were 347,000 pounds.

Current Prices for Ores and Minerals

(Corrected monthly by Atkins, Kroll & Co.)

The prices are approximate, subject to fluctuation, and to variation according to quantity, quality, and delivery required. They are quoted except as noted, f.o.b. San Francisco. Buying prices marked *.

	Min.	Max.
Antimony ore, 50%, ₱ ton	*$225.00	$250.00
Arsenic, white, refined, ₱ lb	0.03½	0.04
Arsenic, red, refined, ₱ lb	0.08	0.08½
Asbestos, chrysotile	100.00	350.00
Asbestos, amphibole	5.00	25.00
Asphaltum, refined, ₱ ton	11.50	20.00
Barium carbonate, precipitated, ₱ ton	42.50	45.00
Barium chloride, commercial, ₱ ton	42.50	45.00
Barium sulphate (barytes), prepared, ₱ ton	20.00	30.00
Bismuth ore, 15% ₱ ton	*250.00	upward
Chrome ore, according to quality, ₱ ton	10.00	12.50
China clay, English, levigated, ₱ ton	15.00	20.00
Cobalt metal, refined, f. o. b. London, ₱ lb	2.50	
Coke, foundry, ₱ 2240 lb	14.50	15.00
Diamonds:		
Ballas according to size and quality, ₱ carat	70.00	
Borts, according to size and quality, ₱ carat	2.00	15.00
Carbons, according to size and quality, ₱ carat	55.00	90.00
Feldspar, ₱ ton	5.00	25.00
Firebrick:		
Bauxite, ₱ M	175.00	
Magnesite, ₱ M	190.00	275.00
Silica, ₱ M	42.50	55.00
Flint pebbles for tube-mills, ₱ 2240 lb	19.50	22.50
Fluorspar, ₱ ton	10.00	15.00
Fullers earth, according to quality, ₱ ton	20.00	30.00
Gilsonite, ₱ ton	35.00	40.00
Graphite:		
Amorphous, ₱ lb	0.01½	0.02½
Crystalline, ₱ lb	0.04	0.13
Gypsum, ₱ ton	7.50	10.00
Infusorial earth, ₱ ton	10.00	15.00
Magnesite, crude, ₱ ton	5.00	7.50
Magnesite, dead calcined, ₱ ton	20.00	25.00
Magnesite, brick (see firebrick).		
Manganese ore, oxide, crude, ₱ ton	10.00	25.00
Manganese, prepared, according to quality, ₱ ton	30.00	70.00
Mica, according to size and quality, ₱ lb	0.05	0.30
Molybdenite, 96% MoS_2, ₱ ton	400.00	450.00
Monazite sand (5% thoria), ₱ ton	150.00	200.00
Nickel metal, refined, ₱ lb	0.45	0.60
Ochre, extra strength, levigated, ₱ 100 lb	2.25	3.25
Osmiridium, ₱ oz	50.00	65.00
Platinum, native, crude, ₱ oz	30.00	45.00
Silex lining for tube-mills ₱ 2240 lb	32.50	35.00
Sulphur, crude, ₱ ton	20.00	25.00
Sulphur, powdered, ₱ ton	35.00	45.00
Sulphur, 80%, ₱ ton	16.50	18.50
Talc, prepared, according to quality, ₱ ton	30.00	50.00
Tin ore, 60%, ₱ ton	500.00	550.00
Tungsten ore, 65%	425.00	450.00
Uranium ore, 10% min.	25.00	per unit
Vanadium ore, 15% V_2O_5, ₱ ton	150.00	180.00
Wolframite (see tungsten ore).		
Zinc ore, 50% up, ₱ ton	*15.00	20.00

Current Prices for Chemicals

(Corrected monthly by Braun-Knecht-Heimann Co.)

Prices quoted are for ordinary quantities in packages as specified. For round lots lower prices may be expected, while in smaller quantities advanced prices are ordinarily charged. Prices named are subject to fluctuation. Other conditions govern Mexican and foreign business.

	Min.	Max.
Acid, sulphuric, com'l, 66°, drums, ₱ 100 lb	$0.75	$1.00
Acid, sulphuric, com'l, 66°, carboy, ₱ 100 lb	1.00	1.50
Acid, sulphuric, C. P., 9-lb. bottle, bbl., ₱ lb	0.13	0.18
Acid, sulphuric, C. P., bulk, carboy, ₱ lb	0.09½	0.12
Acid, muriatic, com'l, carboy, ₱ 100 lb	1.60	3.00
Acid, muriatic, C. P., 6-lb. bottle, bbl., ₱ lb	0.15	0.20
Acid, muriatic, C. P., bulk, carboy, ₱ lb	0.10½	0.15
Acid, nitric, com'l, carboy, ₱ 100 lb	6.00	6.50
Acid, nitric, C. P., 7-lb. bottle, bbl., ₱ lb	0.16	0.22
Acid, nitric, C. P., bulk, carboy, ₱ lb.*	0.12½	0.15
Argols, ground, bbl., ₱ lb	0.10	0.20
Borax, cryst. and conc., bags, ₱ 100 lb	3.00	4.35
Borax, powdered, bbl., ₱ 100 lb	3.38	4.50
Borax glass, gd. 30 mesh, cases, tin lined, ₱ 100 lb	10.50	13.50
Bone ash, 60 to 80 mesh, bbl., ₱ 100 lb	5.50	6.50
Bromine, 1-lb. bottle, ₱ lb	0.55	0.65
Candles, adamantine, 14 oz., 40 sets, ₱ case	4.60	4.80
Candles, adamantine, 14 oz., 60 sets, ₱ case	5.25	5.45
Candles, Stearic, 14 oz., 40 sets, ₱ case	5.00	5.20
Candles, Stearic, 14 oz., 60 sets, ₱ case	5.70	5.90
Clay, domestic fire sack, ₱ 100 lb	1.50	2.00
Cyanide, 98% to 100%, 100 lb case, ₱ lb	0.20½	0.24½
Cyanide, 98% to 100%, 200 lb case, ₱ lb	0.20	0.24
Cyanide, 128% 100 lb case, ₱ lb	0.23½	0.28½
Cyanide, 128% 200 lb case, ₱ lb	0.23½	0.27½
Lead acetate, brown, broken casks, ₱ 100 lb	9.50	10.50
Lead acetate, white, broken casks, ₱ 100 lb	10.50	10.55
Lead acetate, white, crystals, ₱ 100 lb	12.50	13.25
Lead, C. P., test., gran., ₱ 100 lb	13.00	18.00
Lead, C. P., sheet, ₱ 100 lb	18.00	18.00
Litharge, C. P., silver free, ₱ 100 lb	11.50	13.50
Litharge, com'l, ₱ 100 lb	8.00	9.50
Manganese ox., blk., dom. in bags, ₱ ton (85% MnO_2—14 Fe)	20.00	25.00
Manganese ox., blk., Caucasian, in casks, ₱ ton	30.00	47.50
Nitre, double ref'd, small cryst., bbl., ₱ 100 lb	7.00	8.00
Nitre, double ref'd, granular, bbl., ₱ 100 lb	6.50	7.50
Nitre, double ref'd, powdered, bbl., ₱ 100 lb	7.25	8.00
Potassium bicarbonate, cryst., ₱ 100 lb	12.00	15.00
Potassium carbonate, calcined, ₱ 100 lb	7.50	9.00
Potassium permanganate, drum, ₱ lb	0.10½	0.13
Silica, powdered, bags, ₱ lb	0.03	0.05
Soda, carbonate (ash), bbl., ₱ 100 lb	1.50	1.75
Soda, bicarbonate, bbl., ₱ 100 lb	2.25	2.75
Soda, caustic, ground, 98%, bbl., ₱ 100 lb	3.15	3.50
Soda, caustic, solid, 98%, drums, ₱ 100 lb	2.65	2.85
Zinc shavings, 850 fine, bbl., ₱ 100 lb	11.50	12.50
Zinc sheet, No. 9—18 by 84, drum, ₱ 100 lb	10.00	11.00

*Extra charge for packing nitric acid for shipment to conform to regulations.

Industrial Materials of California

Advance data from the annual report of 'Mineral Production of California,' by the State Mining Bureau, San Francisco, show the following:

The mineral industry of this state falls naturally into five general divisions: fuels, metals, structural materials, industrial materials, and salines. The value of the industrial materials produced is a small portion of the total mineral output of the state; nevertheless, these substances are attracting more attention every day and show a steady growth from year to year. The following minerals comprise the list: Asbestos is found widely distributed; barytes is found principally in Mariposa and San Bernardino counties; clay and feldspar are produced in many localities; fullers earth comes from Kern and neighboring counties; gems are mined in great variety in San Diego, Tulare, Los Angeles, and Siskiyou counties; gypsum is widely distributed in the desert regions of the state; infusorial earth comes largely from Monterey and Santa Barbara counties; limestone occurs in practically every county in the state; manganese production is nominal to date; mineral paint in numerous deposits is only partly developed; mineral water is one of California's best known products, although the exploitation of the mineral springs of the state is even yet in its infancy; pumice occurs commonly in the southeastern part of the state; pyrite, a constituent of many ores, some of which is utilized in the manufacture of sulphuric acid, and glass sand and soapstone.

The amount and value of these minerals marketed in California during 1912 is given in the following table. Value is for the crude material at the property.

Substance.	Quantity, tons.	Value.
Asbestos	90	$ 2,700
Barytes	564	2,812
Clay	199,605	215,683
Feldspar	1,382	6,180
Fullers earth	876	6,500
Gems	.....	23,050
Gypsum	37,529	117,388
Infusorial earth	4,129	17,074
Limestone	573,282	570,248
Manganese	22	400
Mineral paint	300	1,800
*Mineral water	2,497,794	529,384
Pumice	100	2,500
Pyrite	69,872	203,470
Sand glass	13,075	15,404
Soapstone	1,750	7,350
Total value		$1,721,943

*Gallons.

Metal Output of Idaho

The value of the mine output of precious and semi-precious metals in Idaho in 1912, according to C. N. Gerry, of the United States Geological Survey, was $21,466,521, against $19,100,894 in 1911.

The production of gold was valued at $1,381,214, only slightly more than in 1911. The yield from deep mines was about $220,000 less in 1912 than in 1911, but the yield recovered by dredging and other placer-mining methods was $228,000 larger. The silver output was 8,294,745 oz., an increase of less than 1%. About 84% of the silver yield was derived from lead ores and 6% from lead-zinc ores.

The production of copper increased from 5,152,937 lb., valued at $644,117, in 1911, to 7,492,152 lb., valued at $1,236,205, in 1912, although the Lost Packer smelter was not operated. The lead production in 1912 was 284,185,657 lb., valued at $12,788,355, an increase of 11,629,132 lb. Record shipments of zinc ore and concentrate were made in 1912 when the production of zinc was 13,905,502 lb., valued at $959,479. The increase of 5,565,253 lb. was due mainly to larger shipments of concentrate from the Success and Morning mines.

Of the 408 producing mines in Idaho, 173 were deep mines which shipped or treated 2,266,334 tons of ore, an increase of 95,437 tons compared with 1911. Of this ore tonnage sold or treated, 1,985,517 tons were concentrated, 193,823 tons were shipped crude to smelters, and 82,568 tons were treated at gold and silver mills. Shoshone county, or the Coeur d'Alene region, produced metals valued at $18,314,604. This important region produced 6% of the gold, 90% of the silver, 59% of the copper, 93% of the lead, and nearly all of the zinc reported by Idaho mines in 1912.

Metal Output of Montana

Great strides were made by the state of Montana in 1912 in the production of gold, silver, copper, lead, and zinc, according to V. C. Heikes, of the United States Geological Survey, the value of the output being placed at $64,754,613, against $46,955,287 in 1911, an increase of $17,799,326, due to the greater production and higher value of copper. Most of this increase—$17,798,698—may be credited to the production of Silverbow county, which includes the Butte district. The combined production of the other counties in Montana was only $628 greater in 1912 than in 1911. The value of the silver, copper, and lead production combined was $18,524,437 more than in 1911, while the value of the gold and zinc was $725,111 less than in 1911.

Production of gold was valued at $3,625,235, against $3,710,751; silver, 12,731,638 oz., valued at $7,829,959, against 11,985,196 oz.; lead, 7,446,749 lb., against 6,431,575 lb.; and zinc, 26,918,881 lb., against 43,810,145 lb. in 1911.

The number of deep mines producing metals in Montana in 1912 was 452, against 430 in 1911, and the number of producing placer mines was 152, against 180. The total quantity of ore sold or treated was 5,552,164 tons, and the total average recoverable value per ton of ore produced increased from $9.36 in 1911 to $11.52 in 1912.

The production of copper increased from 272,847,705 lb. in 1911 to 309,738,873 lb., valued at $51,106,914, in 1912, a gain of 36,891,168 lb. The Summit Valley or Butte district contributed all but 1,516,326 lb. of the total.

Silver Statistics

*During the first six months of the current year the imports of silver bullion to England amounted to 62,457,666 oz., a total remarkably close to that of the imports during the first six months of 1912, namely, 62,682,782 oz. Though the total is similar, the proportions furnished by contributing countries differ considerably. For instance, the United States is credited with 3,800,000 oz., Mexico 800,000 oz., and Germany 600,000 oz. less, but Canada about 5,000,000 oz. more. It must not be inferred from the above that the production of Canada has increased to a corresponding degree. The reason for larger figures from that quarter is that a great deal of the silver refined formerly in the United States is now treated in Canada itself. One interesting deduction to be made from these figures is that the undoubted sparsity of supplies, which has been felt during the past month or so, has been compensated for by larger arrivals in the earlier months of the year. Possibly, the comparatively high prices which then ruled led to freer sales than at the lower level of prices which now obtains.

The exports during the first six months of this year are 5,000,000 oz. less than in the corresponding term of last year. The total, 48,186,027 oz., is over 14,000,000 oz. less than the imports, implying an increase in the London stock of £1,750,000.

Exports to China were less by 5,000,000 oz. and to India by 4,000,000 oz. An active coinage demand for the Continent made up a portion of this deficit, and was composed of 1,100,000 oz. for Russia and 1,000,000 oz. for Germany, more than during the same period last year, in addition to an unusually large minting order of 3,700,000 oz. for Holland, mostly for its East Indian possessions.

A shipment of £45,000 was made from San Francisco to Hongkong.

*From Report of Samuel Montagu & Co., London.

Public Lands Reopened for Entry

Six million acres of withdrawn public lands were restored to entry during the months of May and June upon approval by the Secretary of the Interior on the recommendations of the United States Geological Survey. This action was the result of examination and classification of the lands by the Survey, those restored either having been found not to be valuable for power-sites, reservoirs, coal, phosphate, or potash deposits, or having been definitely valued as coal lands, and rendered available for purchase under the coal-land law.

Of these lands relieved from coal withdrawal, nearly 2,500,000 acres were in the state of Colorado. Five thousand five hundred acres were also withdrawn in Colorado as water-power sites. In Idaho 1,100,000 acres of coal and phosphate withdrawals were classified and restored, and for water-power sites approximately 10,000 acres were withdrawn, and about the same acreage restored. In Montana, 250,000 acres were restored as being non-coal bearing, and about 1000 acres as not valuable for water-power sites, while about 150 acres were withdrawn for that purpose. In North Dakota, nearly 1,400,000 acres in coal withdrawal were classified and restored. In Oregon, approximately 75,000 acres were restored as non-oil-bearing lands, and about 12,000 acres were withdrawn for water-power or reservoir sites. In South Dakota over 330,000 acres were relieved from the coal withdrawal. In Utah about 1500 acres were withdrawn for water-power sites. In Wyoming, over 47,000 acres of coal withdrawals were reopened to entry and purchase; approximately 87,000 acres were withdrawn for classification as to whether they are oil-bearing lands, and about 304,000 acres were restored as non-phosphate lands.

For all states the total withdrawals during the months of May and June were over 116,000 acres, and the total restorations were over 6,000,000 acres. The total outstanding withdrawals on July 1 in all the public-land states amounted to 68,609,289 acres, of which more than 58,000,000 acres are in coal-land withdrawals. These lands are held pending classification by the Survey, and as rapidly as they are found to be mineral bearing they are either valued and placed on sale (as in the case of coal lands), definitely reserved pending appropriate legislation by Congress to provide for their disposition (as in the case of potash or phosphate lands), or held subject to development under departmental regulations (as in the case of water-power or reservoir reservations); or if they are found to be non-mineral in character, they are restored to public entry. This work of classification and valuation is being conducted by the Survey as rapidly as the appropriations provided by Congress will permit.

Company Reports

WEST END CONSOLIDATED MINING COMPANY

This Company operates at Tonopah, Nevada, and the property consists of 158.37 acres of patented and 25.70 acres of unpatented claims, as well as a 20-stamp mill and cyanide plant. The report covers the year ended March 31, 1913, and that of the general manager, S. H. Brady, contains the following information.

Development work, consisting of drifts, cross-cuts, raises, shaft-sinking, and winzes, covered 5859 ft., at a cost of $49,591. The result of operations during the past year has been of a more satisfactory nature than were those of the previous year. At the time the last report was written, the south vein had already been discovered in the West End claim, and raising and stoping had been started. During the past year, most of the ore produced has come from the south vein above the 500-ft. level, to the west of the shaft, with the exception of a small amount of ore which has been extracted from above the 400-ft. level. The 500-A, 500-B, and 500-C stopes have produced the necessary amount of ore to keep the mill in constant operation.

During the year the shaft was sunk to the 600-ft. level, and a cross-cut driven to the south to cut the extension of the big stopes on the south vein, known as 500-A. After cross-cutting and driving a considerable distance, this has been accomplished. Drifts have been driven both east and west from the main south cross-cut on the 600-ft. level, and a winze was sunk from the 500 to the 600-ft. level, to the east of the shaft. This winze has practically been in continuous milling ore for its entire depth and gives a total back of 288 ft. of ground on the dip of the vein above the 600-ft. level.

To the west of the main cross-cut, connections have been made with the 550-ft. intermediate level by a series of three raises, and stoping ore is in progress from, and above, these raises. At the 550-ft. intermediate level, a vertical fault has disturbed, and thrown the vein to the south. A south cross-cut has picked up the vein 150 ft. south of the main west drift, which practically assures a considerable quantity of ore for some time to come; but owing to the small amount of development done so far, it is impossible to make an accurate estimate of tonnage, which is also the case in the balance of the workings. Therefore no effort has been made to estimate tonnage in sight.

The shaft was sunk to the 800-ft. level, where a northwest cross-cut has been driven to connect with the 800-ft. level of the MacNamara Mining Co., which was driven from the shaft to the west end-line, in what is known as the lower contact vein. This work was completed on April 23, 1913, an air connection having been made, and the vein cut as expected at this point, showing a width of 18 to 20 ft., with a pay-streak of milling ore 4 to 5 ft. in width.

Experience has shown that, in order to find ore in the West End mine, cross-fissures and faults must be found. These are pre-mineral faults, and are unquestionably the source of mineralization in this particular part of Tonopah. In driving on the veins, as these faults are approached, the metal content improve, and on the junction of the faults and cross-fissures with the veins, are found the best assays. As driving is continued through the faults, they gradually diminish until close to another fault, when they increase again.

That part of the West End claim which contains the lower contact vein just cut, is badly faulted and crossed by many north and south cross-fissures, and development should prove the lower contact vein to be a large producer of fair-grade milling ore. However, this is mere surmise, as the work of development has not yet been done. The first assay from this vein, taken on April 24, was $11.45 per ton, across a face of four feet of ore, with no attention being paid to the high-grade contained in the vein. This vein crosses the side-line at a point 500 ft. east of the northwest corner of the West End claim, and has a strike south 23°, with a dip of 25° to the southeast. This vein, projected on its dip, should be cut by the shaft at a depth of 960 ft., and as soon as sufficient development has been done on the lower contact vein to demonstrate its worth, it is recommended that the shaft be sunk to this point which would give approximately 300 ft. of backs on the slope of the vein.

Before sinking to 960 ft., it will be necessary to install a new hoisting engine, the small hoist now in operation having reached its limit, and is, in fact, at present badly overloaded. The new one should be good for 1200 to 1500 ft. vertical depth, and capable of handling at least a two-ton skip at from 800 to 1000 ft. per minute.

The ore-shoot above the 500-ft. level in 500-A stope, has been proved to be of a total length of over 300 ft., and has also been partly developed by a winze below the 500-ft. level, which proves ore for a depth of 100 ft. on the vein. The downward continuation of 500-B ore-shoot to the east of the shaft has not yet been cut by the east drift on the 600-ft. level. The most easterly ore-shoot, known as 500-C, has been proved by the above mentioned winze to go down for a total depth of at least 288 ft. This ore-shoot is over 200 ft. in length, and the winze partly proves a block of ground 200 by 300 ft., by an average of at least 12 ft. in width, all of a good milling grade, and later, in cross-cutting from the bottom of the winze, 4 ft. of $100 ore has been cut on the hanging wall side of this big vein.

The value of new equipment added to the property totaled $28,480, which included a Leyner drill sharpener, engine house, shaft repairs, 5-ton Pierce-Arrow auto-truck, electric equipment, and hoist, air-compressor of Nordberg manufacture. Other properties were examined and two properties in the Yerington copper district were acquired.

The financial results were as follows:

Ore treated, tons	44,756
Gross value	$770,876
Revenue from bullion, loan, etc.	675,599
Balance at April 1, 1912	27,489
Total revenue	$703,088
Expenditure on mining, treatment, loans, property, etc.	524,662
Balance at March 31, 1913	$178,426
Assets, consisting of cash, shares, bullion, property, etc.	707,459
Liabilities	35,135

COLORADO MINING COMPANY

This Company is operating in the Philippine Islands, and has a capital of 100,000 shares, with a par value of ₱10 each. The report covers the year ended December 31, 1912. During the term, general conditions of the properties improved, the mill was in continuous operation, and development of the mine continued uninterruptedly, while roads were constructed and suitable houses erected for employees. Ore is being supplied by the main orebody, and No. 1 and No. 2 levels have been extended, and the mine is capable of producing all the mill can handle. Development covered 2182 ft. Ore reserves total 217,215 tons, averaging $10.77 per ton, equal to $2,388,885. The stamp-mill operated 293 days, crushing 113.2 tons per day. Operations may be summarized as follows:

Ore treated, tons	33,169
Extraction, per cent	89.84
Gold and silver production	$340,515
Mining, milling, general, development expenses	182,527
Profit	$161,988
Capital expenditure	29,993
Reserve for depreciation	33,825
Interest on convertible notes, 11 months	4,583
Dividend	50,000

GOLD production of Rhodesian mines in June was as follows:

	Tons.	Value.	Profit.
Chartered & General	2,062	$18,000	$8,000
Giant Mines	11,462	60,000	25,000
Globe & Phoenix	6,450	210,000	135,000
Lonely Reef	5,146	62,000	.....

The St. John del Rey Mining Co., Brazil, in June treated 13,830 tons of ore yielding $153,000.

Concentrates

Most of these are in reply to questions received by mail. Our readers are invited to ask questions and give information dealing with the practice of mining, milling, and smelting.

ASBESTOS has been used in recent years as a filler for high-grade paints.

ASPHALT CONTENT of oil from 56 wells at Coalinga, California, averaged 26.5 per cent.

IRON ORE PRODUCTION of the Harz mountains, Germany, was 17,852,571 metric tons in 1912.

COAL was known to exist in the Richmond basin of Virginia in 1700, while it was mined in 1750.

WIRE-NAIL PRODUCTION in the United States in 1912 amounted to 14,659,700 kegs of 100 lb. each, against 13,437,778 kegs in 1911.

PIG IRON PRODUCTION of the United States in June was 2,628,565 tons. At the beginning of July there were 285 furnaces in blast.

ASBESTOS production in the United States in 1912 was 4403 short tons worth $87,959. That from Canada was 131,260 tons worth $2,979,384.

IMPORTS of petrol into Great Britain in 1912 amounted to 80,000,000 gal., of which the Dutch East Indies and United States supplied 46,000,000 and 16,000,000 gal. respectively.

CONCENTRATE at the West End mill, Tonopah, averages 1.80 oz. gold and 408.5 oz. silver per ton. Assays at this mill cost 18c. per assay, and refining bullion costs 0.47c. per ounce.

MERCHANTABLE saw timber standing in the United States is estimated to total 2,826,000,000,000 ft., which, divided by the annual lumber output of 40,018,282,000 ft., gives a supply for about 70 years.

DEVELOPMENT WORK at the West End mine, Tonopah, during 1912 cost as follows, per foot: driving, $6.50; crosscutting, $6.44; raises, $6.66; winzes, $13.39; and shaft-sinking, $27.73 per foot.

ANALYSES of gypsum from various states ranges from 0.10 to 9.37% SiO_2, 0.08 to 0.78% Al_2O_3 and Fe_2O_3, 0.25 to 4.32% $CaCO_3$, trace to 0.35% $MgCO_3$, 68.29 to 79.26% $CaSO_4$, and 16.88 to 20.96% H_2O.

TIN EXPORTS from the Dutch East Indies, in 1912, were as follows: Banca island (government), 15,446 tons; and Billiton island (private), 1766 tons, a total of 17,212 tons, against 16,005 tons in 1911.

ROCK-DRILLING CONTESTS at Valdez, Alaska, resulted in M. J. Callaghan and son covering 37½ in., Hill and Lundstrom 34 in., and Whalen and Johnson 33⅝ in., through hard granite in 15 minutes.

AN OXY-ACETYLENE BLOWPIPE, with two or three jets, playing on the hard scale in a boiler, will make it crack off, due to rapid expansion of the scale. The jet should not be directed onto the bare plate.

QUICKSILVER production of California from 1850 to 1912 totaled 2,124,732 flasks, valued at $95,275,695. The price has decreased from $99.45 to $42.05 per flask during that time, save in 1874, when it averaged $105.18 per flask.

BULLION AND MONEY stored in vaults of the Denver mint on July 1, 1913, was valued at $493,712,787.13. This is the greatest amount of wealth accumulated in any one place in the United States, and one of the three largest amounts at any one place in the world.

DREDGED GROUND at Oroville, California, is responsible for the first shipment of tokay grapes of the present season, being seven days ahead of last season. The reclaimed land is owned by J. H. Leggett, who has made a particular study of growing fruit on this so-called débris.

RESIDUE from tin-dressing plants in Cornwall, England, is being treated by a tailing company, which, during its past fiscal year, treated 78,885 tons of residue at an average cost of $1.10 per ton. The net profit was $86,000, and reserves to be treated amount to about 1,000,000 tons.

PHOSPHATE DEPOSITS of Decatur county, Tennessee, are found in and at the top of the Decatur limestone, of Silurian age. The limestone is very pure, and the phosphates occur in irregular thicknesses, from a few inches to 20 or 30 ft. Analyses show 25.90 to 34.49% P_2O_5 (phosphoric acid). Transport is afforded by railway nearby.

THE new ore-shoot on the 1170-ft. level of the Tonopah Merger is composed of solid black sulphide, and an interesting geological fact is that the vein is out of the contact of West End rhyolite and Montana breccia, in which it occurred on the level above, and is now a fissure vein in the breccia, the oldest formation in this section of the Tonopah district.

LIQUID AIR, and more especially liquid oxygen, is being experimented on in Germany as mine explosives, according to *Echo des Mines*. The latter, mixed with aluminum powder, and detonated, forms an explosive about 2½ times as powerful as black powder, from which there can be no deleterious fumes, as the only products of an explosion are oxygen and alumina.

COAL MEASURES of Queensland cover 73,000 square miles, as far as geologically surveyed, the area of the state being 670,500 square miles. The formations containing coal are (1) Upper Cretaceous, (2) Trias-Jurassic, and (3) Permo-Carboniferous, the second named producing the present output. The percentage of fixed carbon varies from 41.0 to 80.1%. Total production to the end of 1911 was 13,251,883 tons.

AN AERIAL TRAMWAY, 13 miles long, is now conveying salt from the deposits of the Saline Valley Salt Co., of Inyo county, California, to the railway at Swansea. The Company owns 1400 acres of salt-producing ground in the valley. The tramway is made up of five sections, each working independently of the other, and electrically driven. Buckets hold 700 lb. of salt each, and cross the mountains at an elevation of 8700 ft. The capacity of the line is 20 tons per hour, and construction work was started in April 1911. Mules were previously employed in hauling wagons from the deposits.

THE geographical distribution of shafts will give some idea of the immense area of the German potash field: Province of Saxony, 54; Province of Hanover, 34; Duchy of Anhalt, 9; Grand Duchy of Saxe-Weimar, 7; Alsace, 5; Principality of Schwarzburg-Sondershausen, 4; Province of Hesse-Nassau, 4; Duchy of Brunswick, 4; Duchy of Saxe-Meiningen, 2; Principality of Schwarzburg-Rudolstadt, 1; Duchy of Saxe-Coburg-Gotha, 1; and Grand Duchy of Meckelenburg-Schwerin, 1. The German government estimated that the potash production during the fiscal year 1912 would be 1,131,900 short tons.

DRAWN TUNGSTEN FILAMENTS are found to have an entirely different structure from those prepared by reduction of the oxide, the former being fibrous, while the latter are granular. Examination of the filaments, after burning in lamps for 500 hours, with either a continuous current, producing a temperature of about 1900°C., or an alternating current of 42 cycles, shows that in both cases the metal is transformed into the micro-crystalline condition, just as has been previously shown to occur with the old filaments produced from the oxide, according to O. Scarpa. Drawn tungsten filaments should, therefore, be much more durable than drawn tantalum filaments, which form larger crystals under the combined action of temperature and vibration.

Decisions Relating to Mining

Specially reported for the Mining and Scientific Press

Miner's Injuries—Employer Not Negligent

An employer is not negligent in failing to instruct a miner engaged in blasting how long to remain away after an explosion, where the miner had had some months' experience and knows how long he should remain away.

Stanich *v.* Pearson Mining Co. (Minnesota), 141 Northwestern, 1100. May 29, 1913.

No Title to Land in Oil Lease

A grantee under an oil and gas lease of the right to prospect for, extract, and appropriate the minerals together with the right to surface land necessary for such purposes has no such interest in either land or minerals as will entitle him to maintain ejectment thereon, until he goes into possession under his lease. An oil and gas lease is a grant of an incorporeal hereditament, and no title vests in either the oil or the gas until the same is reduced to possession by extraction.

Priddy *v.* Thompson (Oklahoma), 204 Federal, 955. April 25, 1913.

Extralateral Rights—Injunction Denied

Where the owner of the apex of a vein claims extralateral rights thereon beyond his surface boundaries drawn vertically downward, he will not be granted an injunction *pendente lite* against the owner of the surface under which the orebodies in dispute are situated, who for many years has openly and notoriously mined such orebodies, on a mere averment in the bill of complaint that the apex-owner is in possession of the extralateral rights by virtue of being in possession of the apex. The remedy of the owner of the apex lies in ejectment not in equity.

Golden Cycle Mining Co. *v.* Christmas Gold Mining Co. (Colorado), 204 Federal, 939. April 14, 1913.

Oil Pipe Line Companies—Not Common Carriers

The amendment of section 1 of the Interstate Commerce Act, providing that the act shall apply to oil pipe-line companies, and declaring them to be common carriers subject to regulation by the Interstate Commerce Commission, is unconstitutional. The purpose and effect of the amendment as applied to oil pipe-line carriers is to impose upon companies which have been doing a strictly private business, the duties of a common carrier and compel them to devote their property to public use without their consent. It is void as depriving them of property without due process of law within the meaning of the Constitution.

Prarie Oil & Gas Co. *v.* United States (Commerce court), 204 Federal, 798. March 11, 1913.

Extralateral Rights—Vein Cut Obliquely by Fault

Where a mineral vein has been cut off by a great and well defined fault, and the end edge of the vein along the fault is left in such a position that if the fault were eroded or washed away the edge of the vein would stand out as an overhanging cliff with both a dip and a declination in line with the strike of the vein of from 30 to 45°, such faulted edge of the vein is not a part of its top or apex and no extralateral right can be predicated thereon. Where the discovery vein of a claim crosses both end lines, those end lines are end lines for all secondary veins in the claim regardless of the course of their apices, and bound the extralateral planes of the secondary veins. If such secondary veins cross one side line the locator cannot acquire any extralateral rights thereon beyond the point where they are intersected by the end-line plane of the claim. The burden is always on the claimant of an extralateral right to prove the apex on which it is based. Top or apex of a vein within the meaning of the mining laws, refers to the highest point in the vein. It must be the top of the vein proper rather than a spur, and must be a point from which the vein had a dip as well as a strike.

Stewart Mining Co. *v.* Ontario Mining Co. (Idaho), 132 Pacific, 787. May 3, 1913.

Recent Publications

Mineral Industry of Tasmania. Quarterly report compiled by W. H. Wallace, secretary for mines. P. 27. Hobart, 1913. This publication contains details of metal production in this state, and progress of operations.

National Mine-Rescue and First-Aid Conference. By Herbert M. Wilson. Bulletin 62. P. 74. Index. Bureau of Mines, Washington, 1913. This is an account of the conference held at Pittsburgh, on September 23-26, 1912.

Resources of Tennessee. Published by the State Geological Survey. P. 62. Ill. Nashville, July 1913. This is published in January, April, July, and October, and describes conservation and development of the state. This number contains, among other matter, details of the white rock phosphates of Decatur county.

The District of Ungava, Quebec. Compiled from various reports by Theo. C. Denis, superintendent of mines. P. 160. Ill., maps, index. Quebec, 1913. This district was recently added to the province of Quebec, under the name of the Territory of New Quebec. The Indians, *fauna and flora*, geology, and minerals are described.

Sludge Abatement. Report of the Board for 1912. P. 22. Plates 29. Government Printer, Melbourne, Victoria, 1913. This publication gives details of the regulation of milling and dredging in this state, so as to prevent the silting of streams and injury to lands by tailing and débris from such operations. Attention was directed to the development and improvement of appliances for resoiling and otherwise restoring the surface of dredged ground to a useful condition for agricultural, horticultural, and pastoral purposes. There has been little trouble in getting those interested to conform to the regulations.

United States Geological Survey. Advance chapters from 'Mineral Resources of the United States, 1912.' Washington, 1913:

Production of Asbestos. By J. S. Diller. P. 13.

The Gypsum Industry. By Ralph W. Stone. P. 15.

Production of Antimony, Arsenic, Bismuth, and Selenium. By Frank L. Hess. P. 13.

Mining in Queensland in 1912. Annual report of the Department of Mines. Compiled by the secretary, J. George Appel, from the reports of wardens, inspectors of mines, geologists, and others. P. 211. Ill., maps, tables. This report was reviewed in the *Mining and Scientific Press* of May 31, 1913.

Alaska. Our Frontier Wonderland. Published by the Alaska Bureau of the Seattle Chamber of Commerce. P. 93. Ill., map, index. Seattle, May 1913. This is a well compiled booklet, dealing in an interesting manner with every phase of life and industry in a territory covering 586,400 square miles. The population is approximately 70,000, decreasing during the winter months, when many return 'outside'. Imports and exports during 1912 totaled $72,741,060, the latter including gold, silver, and copper $21,940,000, fish and furs, $18,120,133, and miscellaneous, $394,046. The possibilities of the country are great in metal mining, coal, agriculture, and for tourists, more especially if the United States government constructs the railroads now under consideration at Washington.

The Webster Mfg. Co., Tiffin, Ohio, reports a change in management whereby F. S. Shaw, formerly of Chicago, becomes president; E. P. McPherson, vice-president; A. T. Perkins, who has been with the Company for twenty-five years, general manager; L. H. Webster, identified with the Company for twenty-one years, secretary. The affairs of the Company are now in the hands of men of proved ability, and each department will be brought up to the highest efficiency. Minor changes will be made in the organization as occasion demands. The engineering and manufacturing departments will be strengthened and the reputation of 'Webster products' will be maintained and the Company keep its place as a leader in the manufacture of elevating, conveying, and transmission machinery.

Drilling in Mid-Air

By C. M. Hansen

At the mines of the Bullwhacker Copper Co. at Butte, Montana, a great deal of glory-hole mining has to be done which would be extremely difficult if a piston drill were employed. Much of the drilling is done in mid-air in places that are almost inaccessible, and often where there is no opportunity for a foothold. However, by means of a jackhamer drill, the miner is able to make good progress with comparatively little difficulty. The dangerous nature of work of this sort is evidenced by the fact that it is 75 ft. from the operator to the bottom of the cut, where the ore which is broken is loaded into the cars and hoisted on an incline to the surface. A low-grade copper ore, averaging about 4% copper, is mined, the vein averaging about 125 ft. in width at the place where the photograph was taken.

DRILLING AT THE BULLWHACKER PROPERTY.

The jackhamer is fitted with an automatic steel-rotating mechanism, so that the miner simply has to apply the tool to the spot to be drilled, open the throttle, and the jackhamer does the rest. In many cases the operator works sitting on a wooden seat in a rope-sling let down over the side of the cliff. The accompanying illustration shows the method of drilling a particularly difficult hole, where a ladder had to be pressed into service. Here the operator has one foot on the ladder and is braced against it. There was just sufficient footing for the left foot on a projection of the rock. A tripod drill would be out of the question for work of this sort, and even an ordinary hand hammer-drill would be extremely troublesome to operate on account of the difficulty of rotating it in such cramped quarters.

Great speed is made in drilling the rock, the jackhamer drilling about 6 ft. every 6 minutes, operating with compressed air. Of course, this record is high, but the rock, oxidized granite, is not hard. Three-foot starters are used, followed with 6-ft. steel, the holes being drilled to take 1¼-in. powder. A simple steel holder attached to the front head is found to be of material aid in withdrawing the steel from the hole. In addition, it enables the operator to lower and raise the steel in the hole, churning up the cuttings and preventing the steel from sticking or binding. The jackhamer is fitted with a special hole-cleaning device by means of which the operator can at will send a jet of air through the hollow steel to the bottom of the hole, thus keeping the drill-hole clear of cuttings, dirt, etc., without removing the steel. I recently witnessed an interesting performance of this jackhamer drill at the Bullwhacker mine. Drilling was started about 8 o'clock, using only one machine, and by 10 o'clock the same morning fifteen 6-ft. holes had been put in. After these were fired, the shovelers were kept busy until noon of the following day getting the broken rock out of the way. During the month of April 1913 enough ore was mined at the Bullwhacker mine, using one jackhamer drill, to make shipments of 64 cars, averaging about 50,000 lb. each, to the smelters near Butte. The jackhamer drill is one of the products of the Ingersoll-Rand Company.

A Modern Plant for Building Pumps

To take care of the ever increasing demand for its product, the A. S. Cameron Steam Pump Works recently erected a new shop, at Phillipsburg, New Jersey, which is typical of modern practice, in shop construction. Many novel features are to be found in this plant. The Cameron works have grown from a small one-room shop, started in 1860, at the corner of 22nd street and 2nd avenue, in the City of New York, embracing approximately 400 sq. ft. of floor space, to its present extensive modern quarters, giving employment to many men in different departments, and providing for future growth and development.

It is interesting to note the growth attendant upon the manufacture of a product greatly limited in its early scope, to one that is now found as an accessory in various fields. This product has earned a world-wide reputation for quality and efficiency, and it is obvious that true merit alone could be responsible for such growth, both in plant, and the recognition accorded the product as a standard line of pumps, for mining, contracting, boiler plant, and general industrial purposes.

The Phillipsburg plant consists of one main building, 100 ft. wide by 600 ft. long, and a number of auxiliary buildings. The main building is of the central bay type, and is 50 ft. wide at this point, while the wings are each 25 ft. wide. The main bay is traversed by a 10-ton electric crane, taking current from a side trolley. In addition to this large crane, there are a number of small 3-ton traveling cranes, equipped with electrically operated hoists, operating in the wings. The moving question in this plant is a comparatively simple and easy one, due to the splendid provision made, and hand trucks are but very little required. The building itself is of structural steel, brick, and concrete, and is particularly well lighted.—*Compressed Air Magazine.*

Catalogues Received

A. Leschen & Sons Rope Co., St. Louis, Mo. July issue of 'Leschen's Hercules.' 16 pages. Illustrated. 8 by 10 inches.

Power and Mining Machinery Co., Cudahy, Wis. Bulletin No. 45. 'Concentration.' 64 pages. Illustrated. 6 by 9 inches.

Robins Conveying Belt Co., 13 Park Row, New York. Bulletin No. 51., Coal and Coke Crushers, Feeders and Elevators. 8 pages. Illustrated. 6 by 9 inches.

E. I. du Pont de Nemours Powder Co., Wilmington, Del. 'The History of the E. I. du Pont de Nemours Powder Co.' 224 pages. Illustrated. 6 by 9 inches. An interesting handsomely bound book covering the history of this company for the past century. Reprinted from 'Business America.'

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EDITORIAL

IT begins to appear that Congress has slipped up on its proposal to tax bananas.

ESTIMATES give the cost of the Balkan war to date at $1,250,000,000, which seems rather a high price to pay for a slight alteration in the map of Europe.

AN interesting side-light on the testimony of Mr. Daniel Guggenheim in the Ross *v.* Burrage suit in Boston is the bringing out of the fact that it was at first hoped that the Bradley process would prove applicable to the ore at Chuquicamata. Having been supplanted at Chino by ordinary milling, and in Chile and at Anaconda by other wet methods, the devisers of the Bradley process feel that they have come to the time 'when a feller needs a friend.'

IF the insurance rates set by Lloyd's underwriters are to be taken as a standard for judging the security of Mexican investments, the rate of five guineas per cent for six months does not augur well for the future. Eighteen months ago the rate was less than half of what it is at present. This rate, however, was of but short life and soon rose to five guineas per cent for twelve months. At the present but few risks are being accepted, and these only in the undisturbed parts of the country.

ZINC smelting will be the subject of a thorough investigation by the Canadian federal department of mines, according to the plan of Mr. Eugene Haanel, director of this department. This work was started at Nelson, B. C., some time ago, but, like "the best laid plans of mice and man," has not been completed. The lead and zinc industries are to receive special attention under the new program, which includes a recommendation for the erection of an experimental metallurgical plant in connection with the ore-dressing equipment at Ottawa.

THE appointment of Col. George W. Goethals as honorary president of the International Engineering Congress, to be held in San Francisco in September 1915, is an honor well bestowed. As chairman of the Isthmian Canal Commission and chief engineer of the Panama canal, Col. Goethals' name has become so closely associated with this gigantic undertaking that any reference to the greatness of this engineering work is almost synonymous with his name. It is also gratifying to know that Col. Goethals will preside in person over the general sessions of this congress.

THE first International Exposition of Safety and Sanitation will be held in New York City, December 11 to 20, 1913. This will mark the first step toward making a representative exposition of the progress which is being made toward the prevention of accidents. Statistics which have been compiled in the United States show that there are annually killed 40,000 workmen, 2,000,000 injured, and 3,000,000 are ill for reasons which could be prevented by proper sanitary regulation of industrial communities. As mining is generally conceded the most hazardous of the industries from the standpoint of accidents, as well as finance, it is to be hoped that something tangible may result for the good of the industry from the efforts of the exposition.

THE 'lay of the cards' is just as important in the industrial world as it is in bridge whist. A valued correspondent suggests that some should be credited with skillful strategy in the copper world, in that certain directors of the Chicago, Milwaukee & St. Paul railway who are also interested in Montana hydro-electric enterprises, are doubtless therefore easier to convince of the advantages of electrifying the railway system. Similarly, directors who are interested in copper mines may be assumed to be more quick to see the advantages of copper in steel rails. The modern muck-raker would probably find cause for ululation in such relations, but as a matter of fact the moves suggested are based upon sound technology, and the relations which facilitate their adoption are cause for congratulation.

COBALT is becoming deservedly famous for the results attained in metallurgical research, and these bid fair to be as high grade as is the ore. In Mr. Alfred James' annual review last January we published an account of the process developed at the Nipissing high-grade mill, by Mr. Charles Butters and his staff. Fuller details were given in *The Mining Magazine* for June 1912. Aluminum as a precipitating agent was announced in the report of the Nipissing company as reviewed in our columns May 17, 1913. We present this week a general summary of milling conditions at the various Cobalt mills as prepared by Mr. Fraser Reid, the capable mill superintendent at the Coniagas property. It will be noted that a further advance in metallurgy is chronicled in the desulphurizing process developed by Mr. A. J. Denny at the Nipissing low-grade mill. While not permitted at this time to give details, we may state that an advance of first importance in hydrometallurgy has indeed been made and that Mr. Denny's discovery is likely to prove useful in a large number of widely scattered districts. Cobalt is producing much silver, but it is also developing engineers and metallurgists of high caliber and they are adding materially to the fund of technical knowledge.

AMONG the most despicable forms of character assassination practised by journals of a saffron hue is the use of forms of statements so easily misunderstood as to be tantamount to a lie. An instance of this occurs in the Boston *Journal's* report of the suit now in progress between Messrs. Louis Ross and A. C. Burrage. A two-column portrait of Mr. Daniel Guggenheim, who was a witness, is surmounted by the legend, in letters an inch high, "Drinks on the Witness Stand." The curious one who read the smaller type below learned that Mr. Guggenheim drank some milk mixed with vichy, as a cure for indigestion, but the reader of the headline passed on with the vague impression that Mr. Guggenheim's appetite for highballs and cocktails was so overpowering as to make it necessary to serve them to him on the witness stand. The incident is typical of the sort of treatment accorded any man in the public eye, and it was doubtless by just such methods that the impression was spread broadcast that Mr. Roosevelt drank to excess. The most deplorable feature of the situation is that journals that employ such methods do not suffer sufficiently in public esteem to be deterred. When such methods are reflected in a loss of patronage by self-respecting people, they will cease to be employed.

PERHAPS the most marked characteristic of American political life is the sudden changes which occur in the popular estimate of public characters. The most striking instance of this was in the case of Admiral George Dewey, who in a few months shrank from a national hero to a figure of so little import that few people would be able to state with absolute certainty whether or not he is still living. A more recent example of the same sort is Mr. William Jennings Bryan, who emerged from the Baltimore convention of a year ago the dominant figure in the Democratic party, perhaps even in the whole field of American politics. Immediately upon his elevation to the post of Secretary of State his prestige began to wane. Grape-juice dinners and other personal peculiarities became the subject of that type of ridicule which is exceedingly corrosive to public prestige, and, rightly or wrongly, the people have ascribed to Mr. Bryan the responsibility for the appointment of second-rate novelists, and other equally experienced diplomats, to foreign ambassadorships and the pursuing of a foreign policy of delay and indecision. The announcement that he was about to spend six weeks upon the platform as a paid lecturer has now all but deflated the bubble of reputation. The rest of crowned heads is proverbially insecure, but the course of an American political career is frequently like that of a roller-coaster; a rapid alternation of exhilarating upward sweeps and sudden descents that ends upon the prosaic level upon which it began. The recent appointment of Gov. John Lind as ambassador to Mexico gives rise to the question of the advisability of changing horses in mid-stream.

HEED may well be paid by the striking miners of the Lake Superior district to the lesson of the Paterson strike, where the operators returned to work on July 25 after 21 weeks of idleness with no advantage gained, and $5,300,000 in wages lost. Miners whose essential aim is to do a fair day's work for a fair day's wage may profit greatly by thoughtful consideration whether the cost to them of the strike is not too high a price to pay for an attempt to secure recognition of a discredited organization.

In so far as this strike, or any other, is an attempt by honest workmen to secure just recompense and proper working conditions, we are in sympathy with its object, though as a means to an end it has much in common with the burning of a barn in order to rid it of rats. Men are fallible, whether they be owners or workmen, and what the workman believes to be a fair return for his labor may be erroneous. A clear recognition of the viewpoint of the other side would avert most strikes and a fraction of the cost to operators and operatives of a single strike, if expended upon the maintenance of a commission for the impartial study of the industrial situation in each important industry or district would produce better results than are now attained by the present illogical system of strikes and lock-outs. We favor no class or group; a wagon moves ahead only when both horses pull on the whiffletree, and human progress results when all groups progress at their due rate. Capital can indefinitely profit through undue advantage over labor, but labor cannot indefinitely profit at the advantage of capital, for if it does, it destroys that upon which it exists. Not long ago a strike in New York state for higher wages and shorter hours resulted in the abandonment of the plant; the company which owned it finding it impossible to operate at a profit and preferring to divert its capital into more favorable fields of work. The miners are not more desirous than we are that they shall receive fair treatment, but we also wish to point out that unless the demands of the miners in Lake Superior and on the Rand are kept within just bounds there will inevitably result such a decline of the mining industry in those two districts that many of the men now employed will no longer find work to do.

The Geological Congress at Sudbury

The visit of the members of the International Geological Congress to Sudbury, July 24 to 26, was made the occasion for many exchanges of courtesy, the renewal of old friendships, and the forming of new ones. Naturally the members of the excursion were especially interested in the stratigraphical geology and the mode of occurrence of the wonderful bodies of nickel ore that now furnish 90 per cent of the world's supply and which at the same time afford a type example of one of the most interesting modes of ore genesis. Under the active leadership of Mr. A. P. Coleman, whose classic studies of the great norite sill are well known, all parts of the field were visited and typical phases of all the rocks were examined. It will be remembered that, according to the theory developed by Mr. Coleman, the nickel-copper ores represent magmatic segregations at the base of an intrusive sill of norite, whose upper portion has, under the same influence, become a micro-pegmatite. The orebodies occur in embayments representing depressions in the underlying beds or pitching troughs, and in 'offsets' or projections from the main mass of the magma. They contain 4 to 6 per cent of combined copper and nickel in great masses of pyrrhotite. The ores are worked by open-pit and underground methods, hand sorted, and smelted. Wet concentration is unnecessary, and the final product of the district is a high-grade matte, which is shipped to England and the United States for refining.

The interesting feature of a visit to the nickel region just at present is the widespread evidence of the rapidly growing demand for the metal and the evident prosperity of the industry. New mines, new plants, active prospecting, and active construction are to be seen on every side. The Canadian Copper Company, the largest and the pioneer concern, has now a daily output of 2200 tons. Within ten years it is expected that 5000 tons per day will be sent to the furnaces, and as rapidly as possible the output will be increased to 10,000 tons. To supply this amount of ore, extensions of the ore-shoots are being rapidly outlined by diamond-drilling, and extensive changes are being made in underground work. How successful the engineers are in tracing the ore-shoots down the troughs, is suggested by the fact that in the range worked by the No. 3 and adjacent mines, it is now estimated that 50,000,000 tons of ore is known above 1400 feet in depth. There are many interesting phases of the work of this concern, not forgetting the successful firing of reverberatories by means of coal dust; but other mines and plants demand a word or two.

The Mond Nickel Company, Limited, of which Mr. C. V. Corless is manager, is also actively engaged in expanding operations. Drills are at work, a new shaft is being sunk at Froud, and a new and excellently designed smelter has just been put in operation. At present about 500 tons per day is being smelted, but the output is to be doubled by fall. The New Canadian Nickel Corporation is rapidly getting into shape for production. Drilling at the Murray mine has outlined the ore-shoot and proved 8,000,000 tons of ore with a probable 2,000,000 additional. There has been much speculation about the plans of this Company and no authoritative announcement has been made, but it is expected that a refinery as well as a smelter will be built. The great growth of the automobile industry has created a demand for nickel steel that, supplementing the older use in the making of armor plate and that consumed in manufacture of monel metal, affords room for much expansion in the nickel industry. The Pennsylvania station in New York City and the Chicago & Northwestern in Chicago are roofed with monel metal, but with the present active demand for nickel itself there is no incentive to push into this promising field.

The geologists spent an interesting and instructive day at Moose Mountain, where a beginning has been made in marketing the 140,000,000 tons of magnetite that is there available to supplement the hematites of the Lake Superior region. They were also guests at a most enjoyable banquet tendered by the Sudbury Board of Trade, where after a menu that extended from a gossan of lettuce to the "Miners' last luncheon" (angel cake) there were unique features. Sunday the party left for Cobalt and Porcupine well pleased with the beginning of their visit to the 'New Ontario' that is to mean so much in the industrial life of North America.

Milling at Cobalt

By Fraser Reid

*In the first three years of the life of Cobalt, there was practically no attempt made to recover the silver locked up in the low-grade ore. A large percentage of the ore was sacked underground and the balance hoisted to the surface and washed, the high-grade being hand-sorted and the low-grade going to the dump. Later, sorting houses were operated. Here the ore passed over a grizzly, the resultant fine material, averaging 125 oz., being shipped direct to the smelter. The oversize passed on to a bumping table, where the first-class ore of from 2000 to 4000 oz., and second-class ore averaging around 400 oz. per ton, were sorted out by hand, and the discards, with a value of from 15 to 30 oz., went to the low-grade dump. It was this rapidly accumulating low-grade product that caused the mine operators considerable concern, and in the fall of 1907 the first concentrator started to operate on this low-grade ore. It was a 5-stamp mill built and operated by the McKinley-Darragh Mining Co., and had a capacity of from 12 to 15 tons per day.

COBALT LAKE AND NIPISSING MILLS.

THE NIPISSING PROPERTY.

Shortly after this the Coniagas mill started with a capacity of 60 tons per day, then followed the Buffalo, Cobalt Central, and others, until today there are 17 mills in operation, with a total capacity of 2000 tons per day and producing silver at the rate of 14,000,000 oz. per year, or nearly 50% of the present production.

Today there are 500 stamps in operation with a dropping weight of 625,000 lb., and rolls to the equivalent of 150 stamps, giving a total dropping weight (if all were stamps) of 800,000 lb. of metal.

Preliminary Treatment

The general practice is to hand-sort the high-grade ore in the mine as closely as possible and send the remainder, containing a portion of vein matter, to the mill. Here it is crushed in breakers, sized, and given a preliminary treatment on jigs and reciprocating tables, and in some cases again sorted by hand. This preliminary treatment usually yields from 30 to 50% of the total silver, and practically means the recovery of vein matter. The wall rock, containing finely disseminated minerals and fine leaf silver, passes on to the regrinding machines for further reduction and concentration.

About 75% of the total ore milled is crushed by stamps, the stamps being in favor owing to the hardness and toughness of the ore and the simplicity and reliability of the stamp as a crushing device. The stamps in some cases are followed by tube-mills. The remaining 25% of the ore is crushed in rock breakers, further reduced by rolls or their equivalent, and finally ground to the desired size by Chilean or Hardinge mills.

Straight Concentration

In straight concentration mills this reground material is classified, the sand being treated on Deister, Wilfley, or James tables, and the slime on James and Deister slimers or Frue vanners. In some mills the tailing from the slime is re-treated on canvas tables when a further recovery at a profit is possible.

Up to the latter part of 1912 the cyanide process played a minor part in the recovery of silver, but with new additions to the Dominion Reduction mill and the advent of the Nipissing low-grade mill, this process has now become a more important factor in the production. Owing to their complex nature the Cobalt ores present unusual difficulties in cyanidation, and it is in this field that the greatest advances have been made in the development of new processes. These are of sufficient importance to warrant fuller discussion and will be referred to presently.

Amalgamation

Amalgamation is employed in three mills, the Nipissing and Buffalo high-grade mills treating high-grade ore and concentrate, and the Dominion Reduction treating concentrate only. These mills recover the silver in the form of marketable bullion, thus dispensing with smelting. Amalgamation does not play any part in the recovery from the low-grade ores.

In the treatment of low-grade ores two processes are used: mechanical concentration and cyanidation. Some idea of their relative importance may be gained from the following considerations. There are 13 mills using straight concentration; three use cyanide as an adjunct to concentration, namely, the Buffalo mill cyaniding the slime only; and the Do-

*Read at a reception given by the Cobalt branch of the Canadian Mining Institute to the visiting members of the International Geological Congress on July 28.

minion Reduction, and O'Brien, which regrind the sand tailing from the concentrating process and cyanide the whole. One mill only, the Nipissing low-grade, uses an all-sliming cyanidation process after stamping.

Analysis of Silver Production

An analysis of the total silver production would show approximately the following figures: recovered by sorting underground, about 50% ; recovered by preliminary treatment in mills, 20% ; recovered by mechanical concentration after stamping, 17% ; and recovered by cyanidation, 13%. The ratio of concentration by mechanical concentration averages 37 tons of ore to 1 of concentrate. In an all-sliming and cyanidation process below the stamps, the ratio of concentration ranges from 500 to 1000 tons of ore to 1 ton of bullion, according to the richness of the stamp discharge.

The complex nature of Cobalt ore has developed two processes of importance which are a distinct departure from the general hydrometallurgical treatment of gold and silver ores.

Early in the history of the camp, S. F. Kirkpatrick, professor in Queen's University, undertook some experiments on the cyanidation of Cobalt ore. He found the ore as treated by him fairly amenable to cyanidation, but found that zinc as a precipitant had a great tendency to foul the solution and produce a bullion below the market standard. He finally tried aluminum as a precipitant. This had been discovered and patented by Moldenhauer, who claimed that not only was it a satisfactory precipitant for silver, but that it regenerated the cyanide in chemical combination with silver. Moldenhauer used the aluminum in the form of plates, which soon became coated with aluminum hydroxide and the action was seriously retarded and the process was consequently impracticable. Mr. Kirkpatrick substantiated all the claims of Moldenhauer and made the process commercially successful by using aluminum in the form of dust. This aluminum precipitation process has been very successful, as it leaves the solution unimpaired and gives a marketable bullion.

It is now in use in the O'Brien mill, the Deloro smelter, and in a slightly modified form in the Nipissing mill and the Buffalo high-grade mill.

Desulphurizing Process

The other process referred to is the desulphurizing process as worked out by A. J. Denny, resident metallurgist of the Nipissing mine, and is in operation at the Nipissing low-grade mill. This mill represents the very latest practice in cyaniding, and is a credit to R. B. Watson, general manager for the Company, and his metallurgical staff. The details of this process have not yet been made public and are therefore not available.

It can be said that by this process refractory silver compounds such as sulph-antimonides, which are with great difficulty dissolved by the ordinary cyanide process, are broken up and desulphurized and rendered readily soluble. This process not only increases the extraction but shortens the time of treatment. The importance of this discovery may be realized when it is said that the process is equally applicable to the cyanidation of refractory gold ores. The process therefore marks a distinct advance in the art of hydrometallurgy and will undoubtedly be generally used in the treatment of refractory gold and silver ores.

In conclusion I might say that I have not attempted to touch on the relative efficiencies of the different mills, as this is a very delicate question and is as complex to the millman as the origin of ore deposits is to the geologist.

The Bullfinch Proprietary Mill

This is a 200-ton plant which has recently been built by the Bullfinch Proprietary on its property in the Yilgarn goldfield of Western Australia. The following details of treatment and equipment are taken from the report of the Company for 1912. The mine ore will be run over a grizzly with 2-in. openings, the undersize falling into a bin holding 200 tons, and the oversize passing to a No. 5 Symons crusher, driven by a 40-hp. motor, which reduces it to about 1½ in. and passes it into the 200-ton bin, where it mixes with the undersize from the grizzly. Two Challenge feeders deliver the ore to a 16-in. belt conveyor, 275 ft. long, which carries the ore to an automatic tripper over the main mill-bin, holding 400 tons. It is fed from this bin by automatic feeders to 15 stamps (1250 lb.) driven by a 50-hp. motor; from there the crushed ore is delivered to a 40-ft. tailing-wheel on reinforced concrete foundation driven by a 25-hp. motor, which elevates it to two conical classifiers having diaphragms and annular launders. The underflow from the classifiers goes to a 4 by 16-ft. tube-mill, 40-hp. motor, and then through an 8-ft. grinding pan to amalgamate the coarse gold, thence returning to the tailing-wheel and classifiers. The overflow from the latter is delivered to two thickeners (Forbes type), 8 by 25-ft., and holding 24,700 gal. each, and then to two 6 by 25-ft. settling-tanks; both thickeners and settlers have bottom discharge vents and annular overflow. The clear solution then flows to the battery feed (return water) tanks. The pulp underflow from thickeners and settlers passes to four agitation vats holding 43 tons each of 1.454 specific gravity pulp. After agitation the pulp is elevated by a Premier pump to three No. 3 Ridgway filters, each having 800 ft. of filtering area. The gold solution from these filters is elevated by three vacuum pumps to the 6 by 14-ft. gold solution tank feeding the clarifier. The residue from the filters is discharged into two mixers, mixed with water, and pumped away by an 8-in. double plunger pump. The solution from the clarifier passes to three zinc boxes and to the sump. The solution from the sump is pumped by a 2-in. Gwynne's centrifugal pump to the wash baths of the filters, the surplus returning to the battery feed tanks.

Pig iron production of Germany during the first half of 1913 amounted to 9,567,666 metric tons, against 8,564,988 in the previous year. There were increases of foundry pig, Thomas iron and steel, and spiegel iron, but a decrease of bessemer and puddled iron.

Agricola: An Appreciation

By F. Lynwood Garrison

It is refreshing and reassuring to find a scholarly gentleman and his wife ready to devote much time and limitless pains to the preparation of a great literary work. This is especially so in view of the fact that after having achieved professional success and reached a period of life when most of us would fain relax its strain, these good people saw fit to burden themselves with this tremendous undertaking in order to give to their less fortunate and less erudite brethren this justly famous book in scholarly English. "*Scire tuum nihil est, nisi te scire hoc sciat alter.*"

SI ING AND WASHING THE ORE.

A Great Technical Work

Agricola's 'De Re Metallica' is not only for its day, a preëminently great technical work, but is in fact, the earliest text-book on mining that is worthy of mention. Agricola drew from most of the writers before his day, tainted though they usually were by the fantastic vagaries of the alchemist; moreover, he wrote in an age when men still believed in hobgoblins and gnomes. These primitive superstitions were particularly strong among the mining communities in the mountainous districts of Europe.

That Agricola should have given some countenance to such beliefs in that superstitious age, while disappointing to us from a man of such breadth and soundness of mind, indicates that he was for all that a human personality, susceptible to the influences of his environment. It is greatly to his credit and shows that he must have been possessed of a cultivated mind to have resisted these influences as much as he did, for on the whole his writings exhibit little taint of mysticism or leaning toward the supernatural. Indeed, he holds the 'divining-rod' up to scorn and explains the simple manipulation of this ancient humbug, whose efficacy is even today believed in by persons one would suppose knew better.

The period in which Agricola lived and wrote was a notable one; it was the time of the great spiritual awakening which ushered in modern thought and tolerance. The Reformation was at hand, and men's minds were filled with religious disputations resulting in wars and persecutions which had a most profound effect upon the development and history of our own country. Indeed, in many respects the sixteenth century was the most notable in modern history. In 1609 Spain sullenly evacuated the Dutch Netherlands baffled and beaten, although she was then the richest and most powerful nation in the world, having taken from America up to that time, a treasure estimated by Fiske equal to five billion dollars of our present money. This huge sum was used to maintain the gibbet for political reformers and the stake for heretics. The Protestants in northern Europe must indeed have been a sturdy lot to have successfully resisted and finally defeated Spain. At that time the population of England, which formed the backbone of the Reformation, was not over five millions, or somewhat less than that of Pennsylvania today.

Agricola, or to give him his true name, George Bauer, lived in the centre of this religious turmoil,

for Saxony was violently Protestant. And it speaks well for his strength of character and manliness, that he clung to the old faith amidst such inimical surroundings. It is said that he died a good Papist at Chemnitz, March 25, 1555, and the zeal with which he opposed the Protestant in his latter days rendered him so odious to the Lutherans that they let him lie five days unburied. Finally they brought his body from Chemnitz to Zeitz, where it was interred in the principal church. In earlier years Agricola appears to have been influenced by the Reformation, as any thinking man must have been, for he wrote the following verses concerning indulgences, which were posted in the streets of Zwickau. Translated freely from the Latin they read thus:

"If without gold salvation can't be bought,
How cursed the wreach who is not worth a groat;
But if Christ's death has purchased for us peace,
Rejoice ye poor and bid your miseries cease."

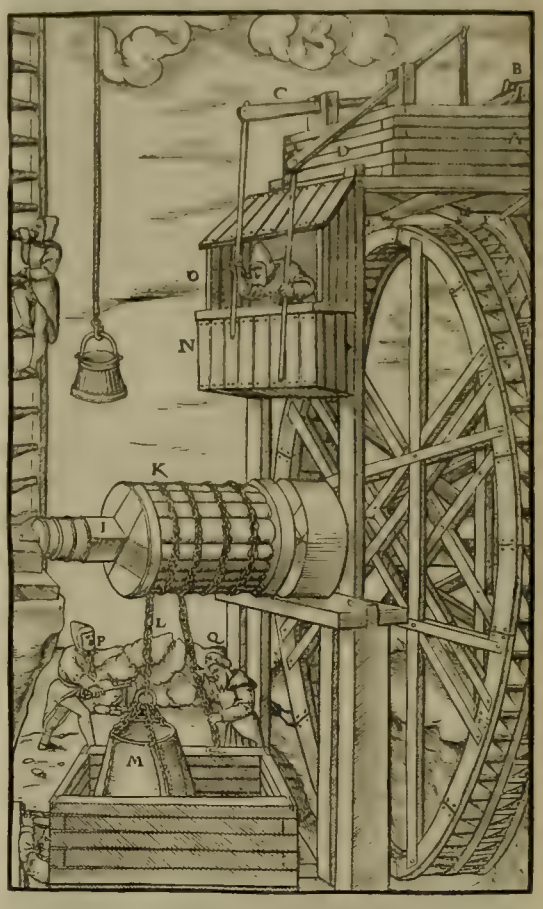
Agricola was called by Cuvier, the first mineralogist, using the term in an old sense as one who knew metalliferous minerals, their extraction and refining, who appeared after the renaissance of the sciences in Europe.

In reading this book one is forcibly impressed with the fact that Agricola was not only learned but an accurate man, who faithfully describes mining and metallurgical operations as he saw them. That the science has advanced little in the fundamental principles underlying these arts in the three hundred and fifty years since he wrote, must be admitted. Especially is this the case in assaying, which may be regarded as the father of modern analytical chemistry.

Mining Laws

Agricola's observations upon the mining laws of his time are of great interest, for it is evident that there has been but little change since that time. The German mining law as a whole, at any rate in the sixteenth century, may be said to have been the product of antagonism, a compromise growing out of the struggle to maintain the right of free mining against the prerogatives of royalty. One can also learn from him that the archaic apex or extralateral law, did not originate, as some have thought, in Gilpin county, Colorado, but in old Saxony, passing thence to Derbyshire, England, and then to the United States, either from Derbyshire or, as the Hoovers believe, directly from Saxony.

One is impressed by the thoroughness with which all mining operations were regulated by the local authorities in Agricola's time. Mining then seems to have been a public privilege, not a private right. The inspections were frequent, thorough, and severe. They even fixed the wages of the miners, which were raised or lowered according as the rock was soft or hard. If a foreman made complaint of any particular miner as being lazy or negligent, the Bergmeister made deductions from his pay. The Bergmeister, the manager, and two jurors in agreement with the owners, regulated the pay of all the miners; the men themselves do not appear to have had anything to say in the matter. If the workmen were reported by the foreman for negligence, the Bergmeister or even the foreman himself, jointly with the manager, dismissed them, or deprived them of part of their pay, and if caught in a fraudulent or dishonest practice were thrown into prison. 'High-grading' was an art yet to be learned and awaited opportunity to develop under more democratic conditions. The German miner of the sixteenth century, like his agricultural brother, was unlearned, simple, and unspoiled. The follies of a socialistic democracy were unknown to him, and he



HOISTING BY WATER-POWER.

was content to live and die in the sphere in which he had been born. One is often told today that illiteracy breeds discontent, whereas the truth is probably to the contrary. The most illiterate people in Europe are the Russian peasants, yet it is a fact they are the least discontented, the most hospitable and kindly in the world. It cannot be proved that the enlightenment of the laboring classes has been productive of contentment, which is in fact the only real essence of happiness, nor may it be successfully demonstrated that the modern facilities for travel and getting about quickly have either made more happiness or increased the leisure time.

Technical Advancement

In so-called social development, great strides have been made since Agricola's time, but how little we have actually advanced in practical matters appertaining to mining, the reader of this book may judge for himself. The question is, is not science rapidly

reaching a dead-level of educated mediocrity. Where today are the Shakespeares, Galileos, and Luthers? Agricola may, it is true, have been surrounded by an illiterate peasantry, but he was also a contemporary with some of the greatest minds in history. And, indeed, if we are not greatly mistaken, he was something of a great man himself.

Ore Dressing and Smelting

Nearly two-thirds of the work is devoted to assaying, ore dressing, and smelting. Less than the other third covers his observations on actual mining operations, machinery, and ore deposits. The relatively less important part, to which he assigns what has come of late years to be believed the most important part of mining, may be explained by the fact that Agricola was a physician, a man of letters living in small mining communities. As such he was probably anxious to avoid the dangers and discomforts so many people unaccustomed to mines experience in going underground. Probably he spent little time there, as compared with the months and even years he devoted to the study of the operations necessary to extract the metal from the ore. Anyone familiar with mining may readily understand this feeling, and it is a valid criticism, I think, of some of our modern mining engineers, that they give too little attention to underground work and the study of geologic phenomena. Millmen, assayers, cyanide-specialists, and smelter-men we have a-plenty, but the engineer who is a good miner and economic geologist, is comparatively uncommon, at least such has been my experience.

It is to Agricola's credit that he does not disfigure his text with the senseless speculation so popular with the semi-learned and charlatan before and since his time. He tells many of the homely rules and facts which experience had taught the miner of those days in his limited environment of central Europe. It is highly improbable the Germans of the sixteenth century knew much of mining conditions outside their own country, or even local districts. Present day knowledge, it should be remembered, is the result of observation and experience gleaned from all over the world as the result of centuries of mining development.

In connection with Agricola's remarks regarding veins, etc., the Hoovers have added a footnote which is in itself an historical essay on the theories of ore deposition prior to the seventeenth century, and as such is an exceedingly valuable contribution to our literature. It should be carefully read and treasured by all students of economic geology (reprinted in *Mining and Scientific Press*, October 5, 1912).

Vein Formation

Agricola likened underground circulation to that of the blood in the veins of the human body. "Veins in the earth, just like the veins of an animal, have certain veinlets of their own, but in a contrary way. For the larger veins of animals pour blood into the veinlets, while in the earth the humors are usually poured from the veinlets into the larger veins, and rarely flow from the larger into the smaller ones." It should be observed in this connection that Agricola's theories on ore deposition are contained chiefly in an earlier work entitled 'De Ortu et Causis Subterraneorum' (Origin and Causes of Subterranean Things), and that in the 'De Re Metallica' they are merely summarized.

The Hoovers, by footnotes, have incorporated into this translation the gist of Agricola's views as given in his other writings.

In order to clearly understand Agricola's reasoning and point of view, it is well to know something of the geology of the districts in which he lived and worked. Chemnitz, Joachimsthal, Annaberg, Altenberg, and Freiberg are typical mining districts in crystalline or metamorphic rocks, whereas at Mannsfield in the Harz mountains, a locality with which it

STAMP-MILLING.

is easy to see that he was familiar, the rocks are sedimentary (Kupfersheifer) impregnated with copper in certain stratified beds or horizons.

Classification of Fissures

One footnote substantially sets forth Agricola's views upon the origin of ore deposits. He regarded the openings in the earth as resulting from the erosion of subterranean waters. The filling of these openings (canales) is due to circulating waters and juices. He divides the fissure fillings into four classes of material. (1) 'Earth,' which comprises clay, ochre, marl, and 'peculiar earths.' These 'earths' had their origin from the rocks and were transported and deposited by the circulating waters. (2) The 'solidified juices' comprise salt, soda, vitriol, bitumen, etc., and were substances he conceived to be soluble in and deposited from water. (3) 'Stones' comprised precious, semi-precious, and unusual stones, as distinguished from country rock. The origin of these he attributed in part to the transportation of fragments of rock, but in the main to deposits from mineral lapidifying juices. (4) 'Metals', comprising the seven traditional metals and the compounds, comprised the metallic minerals, both being deposited from juices, the compounds being due to a mixture of juices. Each substance had its own

particular juice, which became solidified by evaporation (such as salt), or by lowering of temperature below the fusing point. The origin of these juices was two-fold, some being generated by the solution of their own particular substance; but in the main their origin was due to the combination of 'dry things,' such as earth with water, the mixture being heated and the resultant metals depended upon the proportion of earth and water.

Ore Deposits

In a general way Agricola divides metal deposits into three classes (a) *vena profunda*, fissure veins; (b) *vena dilatata*, bedded deposits; (c) *vena cumulata*, and impregnation, a replacement or a stockwork. Two great fundamental principles of ore deposition were established by Agricola, namely, that ore channels were of origin subsequent to their containing rocks, and the ores were deposited from solutions circulating in these openings. These dicta, as the Hoovers state, represent a much greater step from what had gone before than almost any single observation since. He was the first to grasp these concepts and apply them in his deductive reasoning.

FISSURE VEINS.

THIN AND THICK VEINS.

Strike and Dip

In Agricola's time, in fact down to my own student days, thirty years ago, much stress was laid upon the direction of the strike and dip of the veins. While it is often true in certain districts that veins have a more or less uniform direction in this respect, it does not follow that any particular veins having, say, a northeast and southwest strike are likely to be richer than those having a northwest and southeast strike, or an east and west or a north and south trend. Such empirical rules may hold good in one or several closely related districts, and be due to regional geological fracturing or some other local peculiarity, but because one finds the richest veins, for example, in Arizona,[1] to have a more or less uniform direction of strike, it does not follow that one has any right to expect similar tendencies to be exhibited by the veins of Alaska or Ontario. These notions regarding directions of strike and dip were quite popular before the present theories regarding ore deposition began to take shape, but it is certain they should not now be regarded with any degree of favor. It is difficult, even in these present enlightened days, to make people understand that to have ore deposits one must not only have solutions or vapors that convey the metals, but also convenient receptacles for their deposition together with conditions which would bring about precipitation, or at least a replacement of some of the minerals in the associated rocks. Agricola clearly saw that the existence of veins were predicated upon the presence of voids, and that the ore in the veins was simply a filling of later origin than the voids. These views are today as fundamentally sound as they were three hundred years ago, although of course they are much modified by the present vastly more comprehensive and thorough knowledge of the subject. That Agricola apparently did not have much faith in the direction theories regarding veins is evidenced by what he says on the subject. He intimates that the actual experience of miners in this respect does not always accord with their opinions, and he cites a case at Annaberg where a vein striking north and south and "whose head rose toward the west" was no less rich than the other veins "whose heads rise toward the east."

Importance of Geology

It has been assumed for years that Werner was the father of our modern theories of ore deposition. Although Werner had the advantage of writing two hundred and forty years later (1791), Agricola's observations and deductions are sounder and more in harmony with modern views. In fact, it seems that the theories regarding ore deposition not only failed to improve in the long interval between Agricola's time and the beginning of the nineteenth century, but they actually retrograded, and the student's mind was filled with rubbish which would have been repudiated by Agricola. It seems to me that, even today, too little emphasis is laid upon the geologic side of a mining engineer's training; its vital importance is perhaps more fully recognized than thirty years ago, and although it is as essential to a mining engineer as anatomy to a physician, many schools fail to appreciate its fundamental

[1] I do not mean to suggest that such a rule will hold good for Arizona or any part thereof. Some uniformity of this kind may be found in one or more closely related districts, but it should not be accepted as covering any large area, such as a whole state.

character. It will be found, I believe, if the trouble was taken to ascertain, that our most efficient mining engineers of today are also excellent geologists. They may not be able to identify a fossil, or give the exact technical name of any igneous rock at first glance, but it will be evident they are possessed with a thorough understanding of theoretical dynamic geology and chemical phenomena as affecting ore deposition and the formation of alluvial deposits.

By efficient, I do not mean necessarily success in money getting. That is doubtless the easiest and commonest standard for measuring efficiency, but we all know it is not always the correct one. A mind absorbed with technical work has no room for the schemes or the keen watch for opportunity necessary in money getting. Hence, your efficient engineer is often singularly thoughtless of himself in such matters.

Mining and Milling Machinery

The mechanical apparatus used for mining and ore preparation in Agricola's time exhibits some things commonly supposed to be of modern origin. Thus are found illustrations showing the link belt fully developed and in practical use. A careful study of the text and illustrations in this book indicate that the mechanical arts in principle, were well advanced in the sixteenth century, and that while these fundamentals have been enormously elaborated, the original stock of ideas has not been greatly added to. Steam has largely replaced animal force and waterwheels for power generation; explosives now shatter the rock which once yielded only to fire and manual labor. The expansive power of steam was known to the ancients, but that compounds could be produced whose elements were in such a state of delicate equilibrium that heat or shock would change them instantly to gases of a more stable character with the production of power caused by the explosive violence of the change, was something absolutely undreamed of before the introduction of gunpowder into Europe. In other words, chemistry is a distinctly modern science, whereas metallurgy, including assaying as an empiric art, has its roots deep down to the beginning of human history.

It is not my purpose to detail or summarize the various mechanical and metallurgical appliances and methods described by Agricola. This has been excellently done in other reviews of this book; moreover, it is rather tiresome reading except such details as may be of special interest to the reader.

The historical and metallurgical footnotes of the translation are an invaluable addition to the book. They have evidently been prepared with the greatest care and painstaking industry, in fact, each is a historical and technical essay of the particular metal or subject under discussion. The last, or twelfth book, of this great work, Agricola devotes to the preparation of salt by evaporation from natural saline solutions; to the production of nitre, alum, bitumen, etc., and finally a detailed description of the manufacture of glass. It is probably doubtful if Agricola was personally acquainted with many of the processes and much of the apparatus he describes, but he evidently drew from reliable sources for his details.

Perhaps the most interesting feature of the whole work is the illustrations, which are elaborate as to details, quaint, and accurate. Anyone who enjoys looking at 'pictures,' and I confess to this childish weakness, may profitably spend hours studying these old woodcuts. To me, the chief and virile interest of the subject lies in Agricola's personality and the sidelights his writings throw upon his times. They suggest philosophical reflection and the introspection of our own life and times; such musings are perhaps of small interest save to the one who makes them, and modern conventions do not ordinarily invite such confidences.

How much better off are we than the Saxon miner of Agricola's day? Are we happier, more contented and comfortable? Is this fierce modern scramble for wealth and education improving our lives, or homes, and our country? Is this intense effort to exploit and develop the latent resources of the earth justifiable, or is it not rather a consequent phase of social discontent and a fancied political freedom? Are our homes better, more wholesome than the simpler ones of our parents and grandparents? This is the crux of the whole problem, for as the home is, so will be the nation. Will the hand that rocks the cradle, and was once said to rule the world, be better for having a finger on the ballot box? These are grave questions which sooner or later every thinking man and woman must ask him or herself, and the fate of our own great and beloved country will rest upon the correctness with which they are answered. They cannot be solved by the agitator, the newspaper, or the militant suffragette, but must come from deep down in the soul of every man and woman in this great, restless, and often unthinking nation.

Value of the Work

But I am wandering away from my ancient friend Agricola and his book—I have but a few more words to add. Every mining engineer who is interested in his profession as other than simply a means of livelihood, may read this work with profit and interest. I do not wish to advertise, for it needs it not in a commercial sense. I do, however, desire to remind the public that this is a real gift, a great labor of love freely bestowed by an eminent mining engineer and his wife, who, I wot not, have builded better than they knew in this unselfish evidence of devotion to an honorable profession, comparatively little known, and I sometimes fear not fully appreciated by those who would fain sail the stormy seas of mining speculation. The promoter's object is to make money for himself, out of the mines if he is honest, or out of the public if he be unscrupulous. It should be the business of a mining engineer to prevent unwise mining investments or ventures and to make of it a commercial affair, the profit coming from the mine itself. The engineer is, therefore, a check on the promoter, and the investor who listens to the latter without the advice of the former is in the end likely to play the fool. These two classes of men are indispensable to the industry, some men may be both engineer and promoter, but as a rule such a plan spoils the engineer and makes an indifferent promoter.

Hardinge Mills v. Chilean Mills

By Robert Franke

*In view of the prominence which the conical mill has attained in the fine-crushing field within the few years since its introduction, the following comparison with its more mature forerunner, the Chilean mill, based on extensive tests, is submitted in the interest of the milling profession.

Hardinge Mill at Miami

Soon after designing the concentrating plant of the Miami Copper Co. in 1909, the Hardinge conical mill made its appearance in the milling forum. Its possibility as a suitable crushing device for the plant was well recognized, but in view of the lack of commercial demonstration, at the time, as to capacity, efficiency for desired product, and the still more uncertain factors of cost of maintenance and power consumption, it was deemed that the immediate adoption of this machine throughout the plant would be a hazardous undertaking. For these reasons it was decided to equip the majority of the immediately required units of the plant with Chilean mills, the fine-crushing proficiencies of which were better known, and one unit with Hardinge mills, to serve as a test plant for the guidance of future installations and replacements. Thereby, after 1½ years operation with both types of mills, a thorough test as to metallurgical efficiency and cost economy has been obtained.

The conical mill used in these tests is the 8-ft. Hardinge pebble-mill, having a cylinder 22 in. long. The cylindrical part of this mill is lined with cast iron liner plates, and the conical extensions with silex bricks bound together by cement. Each liner plate carries a projecting lifter, the function of which is to increase the height of drop of the lifted material. Danish No. 5 pebbles, obtained from the coast deposits of Denmark, are used for the grinding charge. The Chilean mill used is a fast-running, 3-roller, 6-ft. Saturn mill, with screens of 0.037-in. opening. The feed to these mills is the oversize of Callow screens having 0.029-in. openings, which follow rolls crushing to ½ inch.

Advantages of the Conical Mill

For the ore of this mine, a moderately hard but fissile schist, impregnated with finely disseminated granular chalcocite, the conical mill has proved itself superior, metallurgically and economically, as a fine-grinding machine. This superiority is attained by a combination of commendable characteristics, namely, smoothness and steadiness of operation, delivery of a product enabling better extraction, more economical water consumption, a lower operating and maintenance cost, and a low rate of depreciation.

Steadiness in operation, of paramount importance in plants of such large capacities, is effected in this type of mill by its simplicity in principle and the consequent simplicity in construction. Discharge screens, dies, and mullers are eliminated, and in their place more desirable crushing equivalents are substituted. Thus the screen of the Chilean mill is replaced by a perpetual device; the dies by linings which have long life; and the mullers by flint pebbles which are replaceable without interruption to operation.

Delays with these two types of mills in this plant have been found to be as follows:

Chilean Mills	Per cent.	Hardinge Mills	Per cent.
Screen delays	0.57	Re-lining delays	0.71
Repair delays	1.54	Repair delays	0.58
Total delays	2.11	Total delays	1.29

From the above it is seen that the delays of the Hardinge mill approximate 60% of those of the Chilean mill, and that relining constitutes more than one-half of the total delay. This is mainly due to the fact that when a mill is relined it must be idle about 48 hours, so as to give the cement used for binding time to set. This delay, however, can be materially reduced by means of shell stands, so that a newly relined shell will always be ready to be replaced by an overhead crane when a worn-out shell is to be removed. Allowing 2 hours for this repacement, the delay from this cause will be reduced to about 0.05%. Thus the necessary delays with this mill are reduced to those of repairs to bearings and pinions, lifting out a shell with worn lining and reinstating a new one, and the occasional replacement of feed scoops, which approximate a total delay of about 0.6 per cent.

Labor Charge

Less actual attendance is required by the Hardinge mill. This makes it possible to reduce the operating cost in plants where the duty of the attendant can be so distributed as to include the supervision of other apparatus. Occasional pebble feed, lubrication, and a lookout for obstructed discharge boxes, are the only services required. By their adoption in this plant the operating labor cost of fine crushing has been reduced about one-half.

For the reduction practised at this plant, the conical mill has proved itself to be a much superior fine-grinding machine. Because of the generally granular character of the chalcocite of this ore, it is the aim to make a product of such size as will liberate a maximum mineral content with as small a production of ultra fines as possible. It has been found that a product which contains a maximum percentage between the sizes of 60 and 200 mesh is best. Below is given a typical screen analysis of feed and product for both types of mills. From this it is seen that the Hardinge mill yields 37% of the desired size of material, or about 50% more than the Chilean mill, and with a smaller production of slime.

*To be presented at the Butte meeting of the American Institute of Mining Engineers, August 1913.

Mesh.	Chilean Mill. Feed.	Chilean Mill. Product.	Hardinge Mill. Feed.	Hardinge Mill. Product.
+ 4	13.9	...	12.9	...
+ 10	47.5	...	47.3	...
+ 20	22.9	2.3	26.8	0.2
+ 30	5.2	11.8	5.0	3.2
+ 40	0.9	6.7	0.8	4.9
+ 60	1.0	11.4	0.8	13.8
+ 80	0.5	6.7	0.4	10.4
+100	0.4	5.4	0.3	8.6
+150	0.5	6.3	0.3	8.0
+200	0.7	7.2	0.5	10.0
-200 sand	1.2	10.6	0.8	10.0
-200 slime	5.3	31.6	4.1	30.9

Power

The Hardinge mill also consumes less power. At this plant, a 150-hp. induction motor operates three 8-ft. Hardinge mills or two 6-ft. Chilean mills, and the power consumption for the above reduction is as given below. The consumption is given on the basis of both crude-ore tonnage and actual feed tonnage, the latter being approximated at 70% of the former.

	Crude-ore tonnage. Hp-hr. per ton.	Actual feed tonnage. Hp-hr. per ton.
Chilean mill	7.5	10.7
Hardinge mill	6.7	9.6

A striking feature brought out by the comparative operation of these mills is the difference in the duty exacted of the cone tanks. The units of the plant operated with Hardinge mills have shown an average reduction of nearly 75% in the solid feed and a 40% reduction in the water feed to these tanks, as compared with the Chilean mill. This is to be attributed to the combined result of the smaller quantity of water fed to the grinding mill and of the smaller production of slime. For plants where the production of extreme fines is not desired, the opportunity is thereby offered of lessened outlay for dewatering equipment.

Cost of Maintenance

The maintenance costs of Chilean and Hardinge mills are shown in the accompanying tables. The cost for each mill is based on crude-ore tonnage, so that the cost per ton of actual feed would be 40% greater than the cost shown, as in the reduction practice of this plant about 70% of the crude-ore tonnage passes through the fine-grinding mills.

The figures presented below cover a wide range of operation, and, going into detail as to maintenance, afford an interesting comparison.

CHILEAN MILL

(Tons milled, 826,000.)

		Cost per ton.
Driving mechanism:		
Shafts, pinions, and gears	$0.00230	
Spindles, muller bushings, etc.	0.00275	
Miscellaneous	0.00042	
		$0.00547
Crushing mechanism:		
Dies (12,910 tons per die)	$0.01079	
Tires (7310 tons per tire)	0.00987	
Screens (183 tons per screen)	0.00893	
Miscellaneous	0.00176	
		$0.03135
Total supplies		$0.03682
Repair labor		0.00841
Shop expense		0.00543
Total maintenance cost		$0.05066

HARDINGE MILL

(Tons milled, 450,000.)

		Cost per ton.
Shafts, pinions, and gears		$0.00036
Lining:		
Liner plates and lifters	$0.00403	
Silex	0.00300	
Cement	0.00050	
		$0.00753
Pebbles (2.51 lb. at $0.013)		0.03262
Miscellaneous		0.00012
Total supplies		$0.04063
Repair labor		0.00268
Shop expense		0.00214
Total maintenance cost		$0.04545

From this it is seen that the Hardinge mill, for the practice of this plant, shows a maintenance cost of about 0.5c. per ton less than the Chilean mill. It is to be noted, however, that pebble consumption constitutes 70% of this cost, and the freight on pebbles comprises approximately 50% of their expense in this locality. The item of 'shafts, gears, and pinions' is probably somewhat low, in that these mills have not been operated sufficiently long to obtain a true average. Nevertheless, this part of the cost is small, since these gears have a long life, and, constituting but a small percentage of the total, is inconsequential.

Depreciation

However, the decisive factor of the lower cost of the Hardinge mill is its low rate of depreciation. The life of its shell, if proper care is taken that the lining is not allowed to wear through to it, seems comparatively infinite. Six Chilean mills have shown an efficient life of 825,000 tons, making the rate of depreciation, inclusive of transportation and installation costs, about 3c. per ton. Allowing a life of 10 years for the Hardinge mill, its depreciation cost would be less than 0.5c. per ton.

Summarizing these factors, the net gain in cost by operating with the Hardinge mill, for the practice of this plant, shows as follows:

Operating.	Cost per ton, cents.
Labor	0.50
Power, 0.6 kilowatt-hour	0.75
	1.25
Maintenance	0.50
Depreciation	2.50
Saving	4.25

To the above are to be added other advantages, the more conspicuous of which are: greater capacity by reason of lower power consumption and lower delays; superior product enabling a better extraction to be made; smaller water consumption; and for minimum slime practice requires less dewatering equipment.

Furthermore, this mill is not yet out of the experimental stage, and there are possibilities of still better performances. For instance, by lengthening the cylinder of a 6-ft. middling re-crushing mill from 22 to 38 in., it was found that the capacity of the mill was doubled, the power consumption lessened, and the pebble cost decreased to nearly one-half. It would seem, however, that this idea

can be carried too far, for the more the cylinder of this mill is lengthened, the more it tends to approach a tube-mill, and so become a slimer. For re-grinding middling, however, this variation in dimension is a step in the right direction, in that the liberation of occluded mineral necessitates a fine product. Also large percentage variation in the sizes of feed seems to have a considerable influence on the consumption of pebbles. Thus it was found in a test in which all the feed was sized through 2.5 mm., that the pebble consumption was 1.85 lb. per ton of actual feed as against a consumption of 3.60 lb. with the oversize feed shown in the table.

Mechanical Crushing Efficiency

An interesting comparison which, while based on rather ideal assumptions, is so decisive in result as to be given credit, is the mechanical crushing efficiency of these machines determined by the method of calculation discussed by Algernon Del Mar in his article on 'Mechanical Efficiency of Crushing.'† These calculations, as shown in the accompanying tables, are based on Rittinger's law that "the work done in crushing is proportional to the reduction in diameter." This assumes that all surfaces exposed give the same unit resistance to crushing, whereas it is to be inferred that there are some surfaces which, by reason of inherent fissility of the ore, offer a lower unit resistance than surfaces not so favored. However, in view of the large number of surfaces produced, it would seem reasonable to assume that an average unit resistance to crushing will prevail in a not unduly long test. Furthermore, since in these calculations both machines are treated equitably with regard to the practical variations which do not enter into the law, the comparative results can be considered fairly reliable.

Table I shows the crushing efficiency without regard to quality of product made, from which it is seen that the units of reduction performed by the Hardinge mill exceed those of the Chilean mill by from 18 to 23%, depending upon the degree of accuracy attained in the assumptions made in the calculations, and considering 5% as a safe limit. This evaluation proves that the Hardinge mill converts more of the power consumed into reduction of the charge than does the Chilean mill.

Table II shows the comparative crushing efficiency with regard to size of product made. From this it is seen that in amount of work performed on the various sizes of the feed, the Hardinge mill exceeds the Chilean mill in all cases, again showing that this mill converts more of the power taken by it into actual work done. Furthermore, the excess work done is mostly expended on the grades of product desired, thereby proving that this mill more efficiently fulfills the duties assigned. It is here that the cone comes into play. This geometrical device serves the function of adjusting the crushing en-

†*Eng. & Min. Jour.*, Vol. XCIV, No. 24, p. 1129 (Dec. 14, 1912).

TABLE I.—MECHANICAL CRUSHING EFFICIENCY, HARDINGE *v.* CHILEAN MILLS

On basis of law that "the work done in crushing is proportional to the surface exposed in crushing" and therefore "nearly proportional to the reduction in diameter" or "nearly proportional to the reciprocals of the diameters crushed to."

HARDINGE MILL						CHILEAN MILL					
Mesh.	Reciprocal of average size	Feed, per cent.	Relative surface in feed	Product, per cent.	Relative surface in product	Mesh.	Reciprocal of average size	Feed, per cent.	Relative surface in feed	Product, per cent.	Relative surface in product
+ 4	4.1	12.9	53	...	.....	+ 4	4.1	13.9	57	...	.....
+ 10	7.2	47.3	341	...	.....	+ 10	7.2	47.5	342	...	.....
+ 20	18.3	26.8	490	0.2	4	+ 20	18.3	22.9	419	2.3	42
+ 30	37.7	5.0	189	3.2	121	+ 30	37.7	5.2	196	11.8	445
+ 40	58.4	0.8	47	4.9	286	+ 40	58.4	0.9	53	6.7	391
+ 60	83.6	0.8	67	13.8	1,154	+ 60	83.6	1.0	84	11.4	953
+ 80	138.0	0.4	55	10.4	1,435	+ 80	138.0	0.5	69	6.7	925
+100	163.0	0.3	49	8.6	1,402	+100	163.0	0.4	65	5.4	880
+150	220.0	0.3	66	8.0	1,760	+150	220.0	0.5	110	6.3	1,386
+200	303.0	0.5	151	10.0	3,030	+200	303.0	0.7	212	7.2	2,182
−200	400.0	4.9	1960	40.9	16,350	−200	400.0	6.5	2600	42.2	16,880
		100.0	3468	100.0	25,552			100.0	4207	100.0	24,084

SUMMARY

	Hardinge.	Chilean.
Units of work in product	25,552	24,084
Units of work in feed	3,468	4,207
Units of work done by mill uncorrected for capacity	22,084	19,877
Units of capacities of 2.50 tons and 2.25 tons per horse-power day, respectively	55,210	44,723

Excess units of work done by Hardinge mill, 10,847.
Excess efficiency, assuming method of calculation correct, 23.45 per cent.
Excess efficiency, assuming 5% as the limit of error, 18.45 per cent.

ergy expended so as to be proportional to the force required to reduce the particles to a given size. This is effected by two principles that are inherent with the operation of the mill. First, through the continual displacement of the larger particles of the charge upon the smaller, there takes place a segregation of the particles in the cone according to size—the larger assuming positions at the greater diameter and the smaller receding toward the smaller end of the cone of the mill; second, through the combined action of this segregation and the diminishing action of centrifugal force toward the apex of the cone, varying intensities of energy are imparted to the pebbles—the larger receiving greater inertia by reason of greater mass and greater lift, and the smaller less and less inertia by reason of the smaller mass and lower lift.

Grinding Zones

There exist within the mill an orderly arrangement of zones of ore particles, each requiring a certain amount of impact to be reduced to a given size, and a series of zones of forces so arranged as to impart impacts that tend to be proportional to the crushing energy required by the ore particles upon which these forces are exerted. For these reasons the production of slime is minimized and the accumulated forces are utilized to best advantage, whereas in the Chilean mill the crushing forces are uniform and disadvantageously expended upon a mixed aggregation of coarse and fine particles.

Thanks are due to J. Parke Channing, consulting engineer and vice-president of the Miami Copper Co., for permission to publish these data. I am also indebted to B. Britton Gottsberger, general manager, for his kindness in placing at my disposal the metallurgical data of these tests.

TABLE II.—SCREEN SIZE CRUSHING EFFICIENCY

Mesh	Reciprocal of aperture	Feed (cumulative %)	Relative surface in feed	Product (cumulative %)	Relative surface in product	Relative surface produced
HARDINGE MILL						
4	4.9	87.1	427	100.0	490	63
10	13.3	39.8	529	100.0	1,330	801
20	29.4	13.0	382	99.8	2,934	2,552
30	50.5	8.0	404	96.6	4,878	4,474
40	66.7	7.2	480	91.7	6,116	5,636
60	115.0	6.4	736	76.9	8,844	8,108
80	147.0	6.0	882	66.5	9,776	8,894
100	182.0	5.7	1037	57.9	10,538	9,501
150	272.5	5.4	1472	49.9	13,598	12,126
200	333.0	4.9	1632	40.9	13,620	11,988
CHILEAN MILL						
4	4.9	86.1	422	100.0	490	68
10	13.3	38.6	513	100.0	1,330	817
20	29.4	15.7	462	97.7	2,872	2,410
30	50.5	10.5	530	85.9	4,338	3,808
40	66.7	9.6	640	79.2	5,283	4,643
60	115.0	8.6	989	67.8	7,797	6,808
80	147.0	8.1	1191	61.1	8,982	7,791
100	182.0	7.7	1401	55.7	10,137	8,736
150	272.5	7.2	1962	49.4	13,462	11,500
200	333.0	6.5	2165	42.2	14,053	11,888

COMPARISON OF EFFICIENCY
(With units corrected for capacity.)

Size.	Hardinge Mill, energy units	Chilean Mill, energy units	Diff. in favor of Hardinge	Distribution, %
At 4 mesh	158	153	5	0.02
At 10 mesh	2,002	1,838	164	0.57
At 20 mesh	6,380	5,423	957	3.32
At 30 mesh	11,185	8,568	2617	9.08
At 40 mesh	14,090	10,447	3643	12.64
At 60 mesh	20,270	15,318	4952	17.18
At 80 mesh	22,235	17,530	4705	16.32
At 100 mesh	23,752	19,636	4116	14.28
At 150 mesh	30,315	25,875	4440	15.41
At 200 mesh	29,970	26,748	3222	11.18

The Hardinge ball-mill has also been tested in this plant as a substitute for rolls, for intermediate crushing on ½-in. material. This mill, however, was soon discarded, since it was found that the desired product could only be obtained at too low a capacity, and the consumption of steel balls was too great to be economical.

Compensation for Accidents

On July 12, employees of the Calumet & Hecla and subsidiary companies received the following notice, according to the *Houghton Mining Gazette*:

Beginning August 1, 1913, and until further notice, the Company's employees' aid fund will pay to members injured on and after above date, while at work in the employ of the company, $1 per day for each working day, beginning with the sixth working day, during disability from such injury or until payment under the Employers' Liability and Workmen's Compensation Act begins. Provided such disability is not caused by wilful misconduct or gross carelessness of the injured employee. Where disability lasts more than eight weeks, the Act provides for compensation from the day of the injury. Therefore, any member whose disability lasts more than eight weeks and who has been paid by the aid fund from the sixth day of disability to the date at which compensation under said Act begins, shall pay back to the aid fund a sum equal to that he has received from it.

The above payment of $1 per day will apply only to members whose wages are more than $30 per month; to members whose wages are $30 or less per month, the payment will be 50c. per day.

Over 56% of the gold, or 98,779.72 oz., was derived from silicious ores; 39,010.52 oz., or 22.2%, from placers; and 34,200.83 oz., or 19.5%, from copper ores in Montana in 1912. The placer gold produced in 1912 amounted to $806,419, of which $710,387 was obtained by dredging. The gold won from placers in 1912 was $121,618 more than in 1911, and that taken from the lode mines was $206,954 less. The gold recovered from ore treated at gold and silver mills amounted to $1,039.470, that from concentrates amounted to $666,954, and that from crude ores shipped to smelters, $1,109,255.

Gold-Milling in China

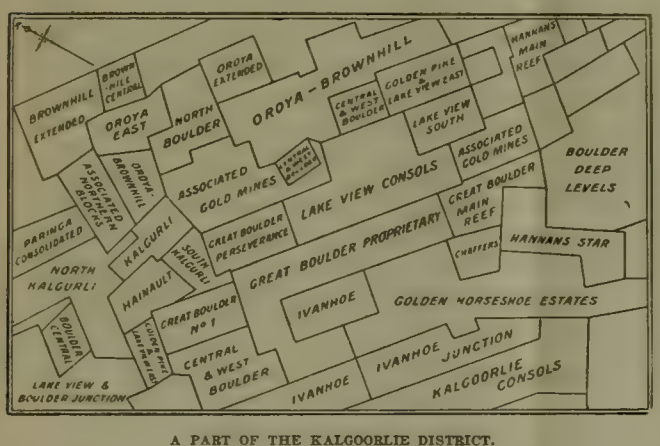
The illustration at the top, left, shows a Chinese gold-mill. The quartz has just been taken from the mine and is ready to be roasted in an open furnace. While the ore is still hot, water is thrown on it to assist in breaking it by hand before being fed to the mill. I have never been able to discover that the natives appreciate the effect which roasting has on sulphides. The baskets, shown in the picture, are used in carrying the ore from the mine to the mill. The right-hand picture shows the mill itself. This is usually operated by a mule or donkey, and the lower stone is slightly sloped toward the centre, so the pulp will not escape over the edges. The ore is fed dry and is not over 1-in. cubes. The lower stone is usually about 5 ft. in diameter, the roller about 2 ft. long, and from one to two feet in diameter. The roller revolves around a wooden post, set in the centre of the lower stone. The capacity of a mill is from 300 to 1000 lb. per day, depending on the hardness of the ore, size of the mill, and motive power. The ore is ground sufficiently fine to liberate the free gold it contains. After the ore has been ground in the mill, it is run over a shallow, smooth, inclined sluice, as shown. The water-supply is regulated so as not to move the pulp too fast, and the pulp is constantly being raked up the incline until it is well concentrated. The operation, in a crude way, resembles that of a Dorr classifier. The concentrate is panned for free gold in wooden pans, or in tin wash-basins, is then allowed to oxidize for a few months, and is panned again, and sometimes reground. The tailing is also panned. There is not much gold left after this process, and there are few, if any, Chinese tailing-piles waiting to yield a fortune to the cyanide man. The lowest picture shows open-cut and ground sluice in Chinese placer working. When washing gold-bearing gravel, a trough similar to the quartz concentrator is used to catch the gold.

The best known gold mine in China is at Chou Yuen, in Shantung, where some years ago ore carrying about $10 was crushed by stamps, amalgamated, and the concentrate chlorinated, as was the practice in California until recently. At periods when the local farmers were not busy in their fields, it was their custom to purchase the tailing from the chlorination plant and carry it home for treatment.

Geology of the Kalgoorlie Goldfield—IV

By Malcolm Maclaren and J. Allan Thomson

The quartz-dolerite greenstone ('North End' type) is petrologically similar to those described in the previous article, but is somewhat more chloritic, and does not, so far as is now known, show any tendency to alteration to white or pink varieties. It may be concluded that it represents an original rock slightly more basic than the typical rock of the 'Mile' area. Its separation in this place is, on the whole, for economic rather than for petrological reasons. It carries no 'lode formations', and whatever gold has been found in it has been derived either from quartz veins or from secondary impregnations in the oxidized zone. This separation is tentative, for it is by no means clear whether its poverty in gold is due, as is probably the case with the quartz-dolerite amphibolites, to an influence deterrent to auriferous deposition and inherent in the 'North End' type, or whether it is merely accidental and is due to the great sheared zones which subsequently form the lode-channels having avoided these narrow tongues.



A PART OF THE KALGOORLIE DISTRICT.

The Brownhill branch of the Kalgoorlie dike is regarded as being composed entirely of this rock, while it also forms a great portion of the Hannan's branch. In this western tongue the North End type of quartz-dolerite greenstone is, however, confined to a long narrow strip, about 300 yards wide, passing from the Sir John Forrest lease through Maritana Hill, Cassidy's Hill, and the Hannan's Reward leases to the Golden Zone and New Reefers leases. It may be looked on as a passage rock to the next type, and differing from the Boulder type simply in having cooled more rapidly and in having largely escaped alteration by vein solutions.

Quartz-Dolerite Amphibolite

This rock-type is, broadly speaking, developed along the western margin, or hanging wall of the main mass of the Kalgoorlie dike. Farther north it occupies the whole of the Hannan's branch from the Ironsides North to the Sir John Forrest leases, while still farther north, in the neighborhood of the Hannan's Reward mine, it lies again on the western side of the branch. To understand its origin, it is necessary to go a long way back in the history of the Kalgoorlie dike—indeed, to the time when it was still fluid. There were then local movements—currents, if such a term can be applied to anything so inconceivably slow as the translation of matter through the viscous mass—that, following the natural tendency of like elements to gather together, and guided by the convection currents due to unequal rates of cooling, took the basic elements toward the cooler margin of the type. The physical process of separation is closely akin to that of matte from slag pot or crucible. While the main mass of the Kalgoorlie dike became more acid (silicious), the western margin and the narrow portions of the northern branches became more basic than the original magma. On cooling, therefore, the greater portion of the dike was a quartz-dolerite or quartz-gabbro, while the narrower branches and the chilled western portions formed a normal dolerite or gabbro and in special cases a hornblende dolerite. Later changes converted the more basic dolerites, after solidification, into amphibolites. The epidiorite and amphibolite rocks thus produced are unfavorable to auriferous deposition. Highly productive lodes, when pursued into amphibolitic rocks, become barren.

The quartz-dolerite amphibolite is easily distinguished in hand specimens from the quartz-dolerite greenstone. It is a coarse-grained dark green to greenish gray rock generally showing bright green cleavage surfaces of hornblende. Two varieties of hornblende are usually present: a bright green variety representing an original hornblende, and a pale hornblende representing an altered pyroxene. Felspar (albite) is often present in columnar crystals, but in many places the original felspar constituent has been scanty. Narrow bands (pegmatite) of coarsely crystalline minerals occur, especially west of Maritana hill (Mt. Gledden). In these the hornblende crystals are often greatly curved, giving a barrel-shaped appearance to large crystals on broken surfaces. A peculiar type of amphibolite shows, on broken surfaces, numerous large but indefinite shining faces which disappear on changing the angle at which the specimen is held to the light. These are termed 'lustre-mottled' amphibolites and are believed to be derived from an original hornblende dolerite. In most specimens the hornblende has been largely decomposed to chlorite.

Ultra-Basic Rocks

This series is best developed near Hannan's Lake, some distance to the south of the goldfield. Within the Kalgoorlie auriferous belt there are three areas underlain by rocks of this group, the internal rela-

tions of which are rather obscure. They comprise serpentine, a dense hornblende rock, talc-schist, and a coarse magnesian carbonate (magnesite) rock. The original rocks, of which the foregoing are merely alteration products, were probably augite-peridotite and pyroxenite. These are best regarded as basic segregations from the same deep-seated magma that furnished the material of the Kalgoorlie dike and that after some time followed it upward along the way already cleft through the Older Greenstones.

The three areas of ultra-basic rock appear to be resolvable into an eastern and a western band. The eastern band lies in the neighborhood of the Hidden Secret lease at Williamstown; the western commences north of the Great Boulder Northern lease, 147°, and runs north as a narrow band probably as far as and beyond the business portion of the Kalgoorlie township. Owing, however, to thick deposits of detrital matter, its width and extension is exceedingly indefinite. It contains the same rocks as the eastern band, but in it the massive hornblende rock is, so far as the band may now be examined, the predominant rock. It is a coarse rock made up of crystals of pale hornblende, weathering readily in dumps to a pale green mud. Good examples are to be found east and southeast of the Kalgoorlie power-station.

The eastern band is composed mainly of coarse carbonate (magnesite) rocks, massive hornblende rock, and talc-schist. Serpentine is not so common, owing to the fact that these rocks have rarely been penetrated below the oxidized zone, or if they have, the workings are now not accessible. Good examples of serpentine have, however, been obtained from deep bore pores from the Kapai lease, where the rock shows as a dense black rock with a characteristic fracture of serpentine.

Porphyrite

This rock lies in the west of the area where it apparently underlies the detrital deposits under the broad valley on the eastern side of which the townships of Boulder and Kalgoorlie lie. Exposures of this rock are few, the best and freshest rocks coming from the old water shafts at the foot of Brookman street on the Coolgardie road, from the old water shaft in the Kalgoorlie power-station yard, and from shafts south of Boulder City.

The porphyrite varies in color from dark green to light gray, but may nearly always be recognized in a hand specimen by the large well shaped crystals of dull white felspar scattered through the rock. Occasionally also fairly large crystals of hornblende are found. Some varieties, especially from the south, show black biotite mica certainly derived from the hornblende. These, as a rule, are all that may be determined in a hand specimen. The power-station rock closely approaches in structure a diorite, and is therefore best termed diorite porphyrite. Porphyrite is nowhere known to be auriferous in the Kalgoorlie area. The porphyrite dike is regarded as a further, later, and more acid emanation from the deep-seated magma that yielded the quartz dolerite and ultra-basic intrusions.

Albite-Porphyry

Numerous small dikes penetrate both the Older and the Younger Greenstones. These are all of one type. They are hard white or pink contact rocks, giving considerable difficulty from their hardness when met with in cross-cutting or sinking. They may be all classed as albite-porphyry, and regarded broadly as narrow tongues sent for the most part along the shear planes of Younger Greenstones from the large mass of felspar-porphyry to the south. The most important is certainly the Great Boulder dike, which proceeds from the main mass northward through the length of the Great Boulder leases and thence through the Western lease of the North Kalgurli ground. This dike dips to the west at a flatter angle than the Great Boulder lode channel, and is intersected by the latter at a depth of about 2250 ft. near the main shaft.

The Hainault porphyry dike runs northward from the Hainault area, splitting into two branches before it leaves that lease. One branch lies west of the Brookman's Boulder shaft; the other lies an equal distance to the east. The western branch continues immediately west of the Golden Gate shaft. Both branches dip steeply to the west. Southward from the Hainault the dike passes into the South Kalgurli ground, and thence probably along the eastern boundary of the Great Boulder Perseverance lease.

The Kalgurli porphyry dike lies to the east of the Kalgurli main shaft, passes north through the long southern tongue of the North Kalgurli, and has been traced as far as the smithy on the last named lease. Southward it has not been found anywhere on the surface, but it is probably the same dike that occurs near the west boundary of the Kalgurli at the 1000-ft. level; also west of the Australia East Lode at the No. 12 level of the Associated Gold Mines, and on the wall of the east lode in the lower levels of the Lake View Consols.

Small porphyry dikes are known on the wall of Morrison's lode, Hannan's Star, below the rich shoot of the Hainault, near the eclipse (Oroya Links) orebody; along the course of the Jasper lode, in the Ironsides North and Union Jack ground, and in the ultra-basic rocks east of the Golden Zone. They are certainly older than the period of ore deposition, but there is probably no connection between these intrusive porphyries and the orebodies, for there is evidence to the effect that the former had solidified and had even been faulted many feet before the passage of auriferous solutions. The walls or the immediate neighborhood of these dikes has, however, yielded occasional pockets of ore. This has been most notably the case along the course of the Kalgurli dike. The Great Boulder dike is a great development of graphitic schist, as this rock is here regarded mainly as a result of local shearing.

All the rocks are altered, but if an attempt be made to classify the rocks by the nature of their alterations, complications arise owing to the superposition of different alterations on the same rock. The important processes of alteration may be summarized as below:

A. The formation of the amphibolites.

1. Pressure alterations.

2. Contact alteration of the massive amphibolites.
3. Combined contact and pressure alteration producing hornblende schists.

B. The formation of the greenstones.
1. By juvenile processes acting on the original rocks.
2. By incipient vein-alteration of the amphibolites.
3. By ordinary hydrometamorphism of the amphibolites.
4. Contact alteration of the greenstones.

C. Vein-alteration.

D. Pneumatolytic alteration.

E. Formation of the jaspers and graphitic schists.

No attempt will be made here to review all of these processes and their results, but the alteration incident to the inflow of vein waters will be briefly described.

By vein-alteration is meant the alteration produced in rocks which are penetrated by veins or lodes carrying exploitable minerals by means of the solutions which brought the ores. The term seems preferable to that of 'metasomatic processes in fissure veins' if only because of its brevity. The rocks affected at Kalgoorlie are chiefly the older greenstones, the ultra-basic rocks and the quartz-dolerite greenstones, each of which will be considered in turn.

Vein-Alteration of the Older Greenstones.

In the immediate vicinity of the quartz-dolerite greenstones of the 'Mile', on their eastern side, there is a considerable development of a whitish grey fine grained rock, much traversed by small green veinlets, to which the field name of calc-schists was provisionally applied. These rocks must be considered as the vein-altered products of the older greenstones, for in the Eclipse mine they are restricted to the neighborhood of the lode, while chloritic rocks form the less altered country on each side.

The name calc-schist is in some respects a misnomer, for the rocks are more often massive than schistose, though after exposure to the atmosphere in a dump, they usually develop a latent schistosity. Besides the dominant carbonate, they contain small lath-shaped sericitic bodies. The rocks are exceedingly dense, and a high power of the microscope is required to distinguish the individual carbonate grains, and to reveal the presence of the quartz between them. They differ from the older greenstones in the paucity or absence of chlorite, which when present occurs in larger flakes. Occasionally fairly large octohedra of magnetite are scattered through the rock.

In the schistose varieties the muscovite is no longer aggregated in pseudomorphic areas, but scattered promiscuously through the rock. Occasionally the carbonates show an individualization into relatively large rhombohedra. The rock is therefore a fine grained quartz-carbonate-sericite schist, differing from that derived from the quartz-dolerites only in its finer grain and in the larger proportion of carbonates. Occasionally the rocks are brecciated and cemented by material which consists in the middle of cherty quartz and on the outside of carbonates. The vein-alteration, as compared with the older greenstones, consists chiefly in the elimination of chlorite. The relation of the calc-schists to the older greenstones is similar to that of the pink and white quartz-dolerites to the quartz-dolerite greenstones. The complete process, however, has converted a hornblende-zoisite-felspar rock into a quartz-carbonate-sericite rock.

Time has not permitted a thorough investigation of the gold deposits in the ultrabasic rocks of the 'North End.' The principal deposits appear to lie along zones in which the peridotites are replaced by rocks consisting chiefly of magnesite with subordinate talc, while these are separated by bands of talc-schists with subordinate carbonates, as well as by hornblende rocks after pyroxenites. It seems logical to conclude that the talc rocks represent an incipient vein-alteration, and the magnesite rocks the complete alteration.

Vein-Alteration of the Quartz-Dolerite Greenstones

As already stated, the rocks described above as non-chloritic or 'pink and white' quartz-dolerites, must be regarded as arising from the quartz-dolerite greenstones by vein-alteration. The lode-matter itself largely consists of this kind of rock. Moreover, though not restricted to the neighborhood of the lodes, and not invariably forming the walls, the white and pink rocks invariably contain at least a low gold tenor, while the chloritic rocks are seldom auriferous. Finally, it is impossible to imagine the deposition of the tellurides from solutions that did not have a marked action on the country, and these rocks are the only ones that can be considered as vein-altered.

The vein-altered rocks from the 'Mile' have already been described; those of the 'North End' present some features calling for notice, and will here be briefly described. In hand-specimens the chief differences are the absence of magnetite or hematite, and the presence of abundant large cubes of pyrite. Very often the change from the green rock to the white may be observed in the space of a few inches on each side of small quartz veins. Near the vein the rock is studded with crystals of pyrite, which diminish in size and abundance with increasing distance from the vein, and finally disappear at a distance of 1 to 3 in. With the development of the sulphides there is a corresponding loss of green color as the vein is approached. Simpson has noticed this sulphide-bleaching, and ascribes it to the formation of pyrite at the expense of the iron in the rock-silicates. The bleached rock is much carbonated and sericitized, and is practically free from chlorite, confirming Simpson's explanation. The quartz veins which brought the sulphur are themselves free from pyrite. A similar but less intense impregnation of the rock with sulphide, accompanied by a more extensive bleaching, is noticed on each side of small veins of quartz and albite.

With the exception of these peculiarities, the vein-altered rocks of the 'North End' are similar to those of the 'Mile,' although there is not so extensive a development of them. The most characteristic feature of the rocks of both localities is the part or

complete removal of chlorite, or its replacement by sericite and carbonates. Corresponding to this the analyses show a slight dehydration. In the much altered rocks the leucoxene is replaced by rutile and carbonates and the ilmenite by pyrite. In some cases there appears to be an introduction of iron, resulting in the formation of magnetite or hematite. Corresponding to this, veinlets of quartz, siderite, and micaceous hematite are of frequent occurrence.

Since albite is found in these rocks as a vein-mineral, it follows that it must have been stable under the conditions of the alteration. Most of the rock felspars are sericitized, but occasionally they are remarkably clear and free from inclusions. It is seldom possible to demonstrate that newly formed albite is present in the rock, but possibly in many cases the older crystals have been 'healed' by the filling up of cracks and cavities with fresh albite. Beyond perhaps a substitution of sericite for the chlorite enclosed in the felspars, sericitization cannot be claimed as a marked feature of the alteration. In the schistose rocks now to be described, however, the felspar has completely disappeared.

Local Shearzones

Probably coincident with the intrusion of the granite and resulting from the pressure thus exercised upon the greenstone buttresses there were developed in them local shearzones striking N.N.W.-S.S.E., and coinciding therefore, as might be expected, with the natural planes of weakness, those of the foliation of the Older Greenstones and of the intercalation of the Younger Greenstones. They were, however, local and would not be worth mention were it not that they served in the immediate neighborhood of Kalgoorlie as channels for the passage of auriferous solutions and for the deposition of gold. Elsewhere in the area and especially near Coolgardie, gold was deposited at or near the contact of granite and greenstone or at or near the contact of pegmatite or quartz-porphyry dikes—tongues from the granite mass—with greenstone. Elsewhere also gold is associated only with the quartz veins developed near these contacts; at Kalgoorlie, by the accidental intermingling of gold and telluride solutions, it has been deposited as 'lode formations' along these shearzones.

Subsequent to the deposition of gold there has been little movement in the region. Horizontal earth pressure has generated several series of over-thrust faults. The most important series has an east and west strike, and the position of the various members of this series is best indicated by the irregularity of the contact of granite and greenstone near Coolgardie. Within the greenstones, owing to the lack of outcrops, they are difficult to trace. One thrust-plane may, however, be made out passing southeast from Mt. Robinson to a few miles south of Feysville (where the shearing that accompanied it is quite evident) to Mt. Monger in the southeast. The pressure generating this over-thrust was horizontal and from the south. Other minor faults of compression (reversed or over-thrust faults) are known, but are comparatively small and are only important where they disturb the auriferous lodes.

Regional Movements

Here, then, was the end of the internal history of the region. During all the eons that have passed since that day it has been above sea-level, perhaps oscillating gently up and down. There is no evidence that it has ever dropped below sea-level, but its history during Paleozoic and Mesozoic times is a sealed book. The northern portion of Western Australia was submerged during part of the Paleozoic age, the coastal portion in the Mesozoic age and southern portions in the Cenozoic age, but there remains no trace whatever of submergence in the central area nearer than Lake Cowan (Horseman), 90 miles to the south of Kalgoorlie, where Tertiary marine shells have been found.

A dry land may therefore be postulate in the Kalgoorlie area during the whole of measurable geological time. And since land above sea-level, when not being preserved by the deposition of a protecting blanket of alluvium, is being subjected to the unceasing onslaught of wind and rain, it will in course of time be degraded nearly to sea-level, provided that the loss caused by denudation is not compensated by a regional uplift. The absence of marine deposits on the central plateau indicates that this compensating action has taken place, and therefore that the amount of denudation has been great. The matter is by no means of academic interest alone, but is of vital importance from an economic point of view. If the orebodies at present worked at Kalgoorlie were deposited near the surface they must be expected to be richer than any to be found in future depth. If they were deposited 2000 or 3000 ft. below the then existing surface they undoubtedly are primary deposits, and local enrichments such as that known at Kalgoorlie at and below the 2000-ft. level may be expected to recur as far as mining may be carried in depth. It is here assumed that the deposits now being worked are primary and that they were deposited far beneath the original surface.

Geological Relation of Auriferous Occurrences

Before leaving the consideration of the area included in the above sketch, it will be of interest to describe the geological relationship of its gold deposits. The principal fields are Kalgoorlie and Coolgardie, with outlying camps at Burbanks, Bonnievale, Kunanalling, Kintore, Black Flag, Feysville, Mt. Monger, Bulong, Boorara, Balagundi, and Kanowna. With two exceptions Boorara (golden ridge) and Balagundi, and these exceptions may be only apparent, for time has not permitted of a close survey of either field, gold occurrences lie either at or near the contact of granite and greenstone or at or near the contact of porphyry and porphyrite dikes and greenstone. The occurrences near granite porphyry and quartz-porphyry dikes are closely allied to those at granite contacts, since the dikes may be regarded as tongues from the Coolgardie granite. Examples of these at granite contacts are Lord Bobs, Bonnievale, Kunanalling; and at pegmatite, granite-porphyry, and quartz-porphyry contacts are Londonderry, Burbanks, and Coolgardie. At and near felspar-porphyry contacts are Kalgoorlie and Kanowna, while Bulong and Feysville are in or near

porphyrite. There is thus a constant association with the more acid intrusive rocks. It is difficult to conceive the actual relation. It is certain that the auriferous solutions appeared after the solidification of the dikes and it can only be suggested that the auriferous solutions were associated with the more aqueous and more silicious residuum of the magma from which the granite and quartz porphyry has been derived.

The relationship has been observed in far too many cases, not only in the area dealt with, but also in other fields in Western Australia, to be accidental, and it may be laid down as the first general axiom in prospecting in Western Australia that search for auriferous deposit should be conducted near contacts of granite and greenstone or of porphyry dike and greenstone. The latter for preference. As bearing out the hypothesis that auriferous solutions are associated with the silicious and products of an acid magma, general experience has shown that the largest and richest gold deposits are not associated with the strongest porphyry dikes. They rather seem to occur (as in the case of the Hainault orebody, Kalgoorlie) just above or beyond the point where a dike runs to a feather edge. Only very small dikes are found near the Great Fingall lode. It therefore follows that most important dikes, from an economic point of view, may never come to the surface. They may be 'blind' dikes. For this reason and since these are most likely to be found on the margins of the greenstone belts, these margins must be carefully searched for a long distance, a mile or even more, from the granite contact. Every contact does not carry gold, but the area likely to repay careful prospecting is greatly restricted when the above considerations are taken into account. It is not too much to say that had a geological map showing all the porphyry and porphyrite dikes of the region been available in 1893 every deposit now known, and some still unknown, would have been discovered within three months, and thousands of pounds worth of useless work and misspent energy avoided.

Mining in Mongolia

In an excellent review of 'Russia in Mongolia,' the *Far Eastern Review* contains the following notes on the mining industry of that country:

The mineral wealth of Mongolia is at present practically undeveloped, but from a geological examination, and from reports from prospectors during the last few years, it appears to be of great value, especially in the north. In addition to salt, coal, and marble (a small quartz crystal used for the manufacture of spectacles is quarried at five 'marches' from Kalgan) the chief development is being carried out by the Societé Mongolor. This private company was formed by a G. Victor van Grotte, of the Imperital customs service, to work a mining concession in Mongolia, and for many years proved a failure. Gold was there in workable quantities, and American engineers and machinery were imported. In 1910 the mine paid 150%, and in 1912 a payment of 300% was hoped for. The Company is at present working seven mines, and employing upward of 7000 Chinese coolies—who work under the usual Chinese method—the Company supplying all gear and the gangs of coolies under the foreman selling all gold found at a fixed rate to the Company, $20 per oz. The Chinese authorities, until quite recently, had at each mine a small guard and an official, who checked the tax payable by the Company on the amount of gold excavated.

New English and American machinery was recently imported, and Mr. Henson, a German, acted as chief engineer and assistant to Mr. van Grotte. A new electric plant for refining the gold has been installed. It is said that the River Yere contains a great deal of gold, and dredging operations have already been commenced. All the directing staff are now Russians, and a number of Russian prospectors are employed in prospecting the valleys. There is a considerable mortality among the Chinese coolies from a mysterious disease. They catch it from the water, and it affects their limbs, in most cases proving fatal.

In addition to gold, there is to be found lead, silver, iron, and zinc, but as yet no attempt has been made to mine these minerals.

Radium Ores in Australia

The Radium Hill mine, near Olary, South Australia, was recently examined by H. Jones, inspector of mines, who made the following report:

A large amount of good development work has been done at different points on the property. Five underlay shafts have been sunk to various depths of from 70 to 100 ft.; driving and stoping has been done in the lode formation at the 60-ft. level, and considerable amount of the lode material extracted from the various workings, crushed and concentrated by the magnetic separator at the mine, and the various grades of concentrates obtained, amounting to 10 tons per week, have been forwarded to the Sydney works for further treatment. Driving and stoping is in progress at the 25-ft. level in No. 2 shaft; the southwestern drift is in a total distance of 31 ft.; the formation disclosed in the workings is from 2 to 4 ft. wide, of schist and iron veins, with incrustations of carnotite through the matrix. The drift northeast, opposite the last one, has been extended in the orebody a distance of 30 ft., and at that point in the drift a small fault in the country occurs, bearing east and west and dipping at an angle of 45°. The fault apparently makes a clean break in the formation of several feet to the east; on the north side of the break (or displacement) two underlay shafts have been sunk in fairly good ore to a depth of 70 and 100 ft. respectively. This proves that the formation has not been disturbed to any great extent by the fault, and that the main orebody continues to extend in a northeastern direction. The plant on the mine consists of rock-crusher, rolls, magnetic separators, one petrol and one oil engine, all being housed with strongly constructed wood and iron buildings, and everything appears in good order for carrying on the work of crushing and concentrating the ore.—*Australian Mining Standard.*

Discussion

Readers of the MINING AND SCIENTIFIC PRESS are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment. Insertion of any contribution is determined by its probable interest to the readers of this journal.

Mining Reports

The Editor:

Sir—Some time ago, a report that was stated to have been the result of an examination made upon a mining property located on the vein formation of the famous Mother Lode of the western foothill region of the Sierra Nevada of California, came into my hands and has been carefully preserved by me as a classic. That it is unique among many documents pertaining to mines and mining situations, a perusal of the following excerpts from the text will convince any fair minded unbiased mining engineer. Certainly in part it is too good to keep, and in a spirit of benevolence and as an offering upon the shrine of professional goodwill toward professional brethren, the following extracts have been exhumed from their obscure place of burial among files containing many another mining report that is less picturesque, less unique. The following contains the rich kernel removed from the enclosing shell.

Value of Orebody.—In sinking the 110-ft. shaft and a small amount of lateral work, $8000 in massive gold was obtained. By measuring the amount of ore removed, this gives a value of $10 per ton in massive gold, and from the assays, the ore left standing averages $1.60 per ton, *making a total of* $11.60 *per ton for the total block of ore* (the italics are not contained in the original), which is 150 ft. long, 100 ft. wide, and 110 ft. deep. Owing to the noted uniformity of Mother Lode veins this block of ore can safely be assumed as developed, but due to the fact that the gold occurs massive there is a factor of chance that can only be assumed, hence using a factor of two we have a value for this block of ore of $5.80 per ton. Treatment charges would be: milling 50c. and mining 50c. The extraction would be 90%, giving a net value of $4.32 and a total value of $475,200.

Probable Value.—Assuming that the vein will continue to the 200-ft. level and 100 ft. wide and 500 ft. long with an average assay value as shown to be $1.30, or a net value of 55c. per ton, the treatment charges being: milling 50c. and mining 25c., with an extraction of 90% there is a probable net value of $935,550. Or more probably, assuming the average value of the Mother Lode mines of this district of $4.60, with the same charges and savings, will give a probable net value of $6,719,000.

Possible Value.—Should the vein continue to the 1830-ft. level or more, as in the —— mine, or to the 3254-ft. level or more, as in the —— mine, and average value of the other mines of the district, this mine would yield a profit anywhere from $30,000,000 to $100,000,000. The mine is not far enough developed to justify these assumptions as positive, but —and here let the report conclude with that reassuring, inspiring, and valiant *but*.

How plain and simple it all is to write a mining report. Not necessarily one that will 'stick,' but a picturesque and unique document that is readable and fairly well filled with data culled in a measure from geologic reports and folios of the region or from other vicarious sources and containing more or less uncertain assumptions and statements as to ore values and to positive, probable, and possible ore reserves that from their very artlessness and ingenuousness should convince, but which somehow fail to carry a satisfactory weight when their authors are brought 'upon the carpet.' And how many reports presuming to describe mining properties are written that should never have been penned —because of the wicked waste of ink resulting therefrom.

WILBUR E. SANDERS.

Sonora, California, July 6.

The Possibilities of Grinding Pans

The Editor:

Sir—the article on 'Grinding Pans at Kalgoorlie,' by M. W. von Bernewitz, in the *Mining and Scientific Press* of May 17, is particularly valuable on account of the fact that the literature on the subject of pans is meagre. Analysis of the table given in Mr. von Bernewitz' article, however, does not seem to bear out the statements of Kalgoorlie operators that pans can hold their own against tube-mills, if they are to be regarded as sliming machines. Only the sizing through the 150-mesh screen is given. In comparing a pan with a tube-mill, it must be borne in mind that in an all-sliming plant the oversize from the tube-mill generally goes to a classifier, which returns it to the mill, and does this as many times as necessary for sliming. It therefore seems just, in estimating the capacity of either machine, to take into account only the ore reduced by it to slime, which is here considered as all the material passing the 150-mesh screen.

I herewith reproduce the part of Mr. von Bernewitz' table referring to the 5-ft. pans, and add the last two columns which I have computed from his figures.

Name.	Feed −150, %.....	Discharge −150, %..	Daily capacity, tons.	Feed slimed, %.....	Actual daily cap. in slimed prod., tons .....
Grinding roasted ore:					
1. Associated	47	85	9	38	3.42
2. Associated Northern..	45	85	7	40	2.80
3. Boulder	70	90	7	20	1.40
4. Kalgurli	47	80	11	33	3.63
Grinding roasted concentrate:					
5. Hainault	29	94	24	65	15.60
6. Horse-Shoe	36	94	24	58	13.92
7. Ivanhoe	46	94	12	48	5.76
8. Lake View & Star....	46	94	12	48	5.76
9. Oroya Links	46	94	12	48	5.76
Following stamps:					
10. Hainault	36	52	16	16	2.56
11. Ivanhoe	36	52	15	16	2.40
12. Lake View	39	60	13	21	2.73

Comparison of 3 with 1 and 4 seems to show the bad effect of having slime in the feed, the slime probably having a lubricating effect in lessening the attrition among the particles of sand. However, the extremely low capacity of 3, only 1.4 tons per day, may in part be due to an insufficient amount of coarse feed. The greater capacity of 5 and 6, 15.6 tons and 13.92 tons, respectively, each taking a feed of 24 tons, seems to indicate that with proper feeding a fair capacity could be attained, but the nature of the material in the feed undoubtedly has a considerable effect on the tonnage, as exemplified by the capacity of 7, 8, and 9.

Mr. von Bernewitz states that the amount of water with the feed must be carefully adjusted. This is probably as important as in tube-mill practice. Will Mr. von Bernewitz or some Kalgoorlieite be so kind as to tell us the amount of moisture in the feed that experience has shown to give the best results.

I have often wondered whether a pan, on account of its low initial cost and the small time lost in reshoeing, might not be advisable in small mills doing all-sliming, but results at Kalgoorlie do not seem to give much ground for hope in that direction.

JOHN RANDALL.

Atlantic City, Wyoming, July 28.

The Editor:

Sir—In reply to John Randall's queries concerning grinding pans, I would say that No. 5 column in his table is not correct, No. 3 from my original table giving the tonnage slimed by each pan per day. I thought my table and explanations made this quite clear. For instance, take the Associated mill, which crushes 350 tons per day through 27-mesh screens, 47% of which will pass a 150-mesh screen. After roasting, it is mixed with weak solution and fed into 20 pans, the average slimed product being 85% through 150 mesh. Now 47% of 350 original tons is 164 tons, which requires no grinding, leaving 186 tons to be ground by 20 pans, which is 9.3 tons each per day, as shown in my table, where I gave the nearest whole number.

I certainly agree that it is best to classify before grinding, and then the pans would show a better result, as is evident at the Kalgurli, where this is done. But with certain Kalgoorlie ores, after roasting, lime compounds greatly hinder the work of classifiers, so all the pulp is run through the pans.

I can assure Mr. Randall, in answer to his last paragraph, that the pan is an excellent machine, and I would certainly advise its installation in a small mill where the expense of a tube-mill was not justified. A pan could be arranged in closed circuit similar to a tube-mill, if necessary, and would show high results. Regarding the percentage of moisture in the pulp for pans, this can only be judged by the general character of the pulp and by screen tests of the overflow. Where the average moisture of tube-mill pulp may be 40%, the pan may have anywhere from 1½ to 4 of water to 1 of ore.

A table on pans was compiled in 1909 by Harley B. Wright, of the Perseverance mine, showing their performance at six mills at Kalgoorlie.

In conclusion, I would say that I am sorry that Mr. Randall drew an incorrect view of the excellent pan practice at Kalgoorlie, where, with several other large mines in Western Australia, they are considered valuable adjuncts to the treatment plants.

M. W. VON BERNEWITZ.

San Francisco, August 7.

Data.	Perseverance	South Kalgurli	Boulder	Associated	Kalgurli	Assoc. Northern
Monthly tonnage, 30 days	19,000	9030	18,000	11,600	10,700	3700
Daily tonnage	633	301	600	386	356	123
Tons on 150 mesh (requires grinding)	209	131	225	181	189	56
Tons through 150 mesh (already ground)	424	170	375	205	147	77
On 150 in percentages	33	43.6	37.5	47	53.1	45.5
Through 150 in percentages	67	56.4	62.5	53	46.9	54.5
Tons requiring grinding through 150	209	131	225	181	189	56
After grinding in pans on 150	28.4	12.6	29.0	10	20.8	12.5
After grinding in pans through 150	71.6	87.4	71.0	90	79.2	87.5
Percentage of total tonnage ground through 150 by pans	4.6	31.0	8.5	37	32.3	33.0
Tons ground through 150 of total daily tonnage	29.1	93.3	51.0	142	115	40.5
Number of pans	17	7	22	20	14	8
Diameter of pans	8	5.8' and 2.5'	5	5	5	5
Area of a pan in square feet	50.2	50.2 and 19.6	19.6	19.6	19.6	19.6
Circumference of pan in feet	25.1	25.1 and 15.7	15.7	15.7	15.7	15.7
Revolutions per minute	10-30 and 7-25	33 and 55	60	55	55	47
Circumferential speed per minute	753 and 627	828 and 863	942	863	863	737
Total die area of pans in square feet	537	183	279	254	177	101
Total shoe area of pans in square feet	272	105	279	254	177	101
Tons ground per pan per day through 150	1.7	13.3	2.3	7.1	8.2	5.0
Horse-power per pan	8.0	12 and 7	7	7	7	5.1
Cost per pan per day at 3c. per horse-power hour	$5.76	$7.68	$5.04	$5.04	$5.04	$3.66
Cost per ton to grind sands through 150	28c.	58c.	18c.	66c.	58c.	72c.
Cost per ton on total tonnage	15c.	18c.	17c.	26c.	20c.	24c.
Area of discharge hopper at top, square inches	275	425	425	425	425	425
Tons requiring grinding per pan per day	12.3	18.7	10.2	9	13.5	7

Special Correspondence

KALGOORLIE, WESTERN AUSTRALIA

DIAMOND-DRILL RESULTS AT FRASERS MINE — THE HOWE VOLATILIZATION PROCESS. — NORSEMAN DISTRICT — DEVELOPMENT OF PRODUCER-GAS PLANTS — THE VICTORIOUS, BULLFINCH, AND PARINGA MINES.

The government mining engineer, Alexander Montgomery, has stopped the first bore on Frasers mine at Southern Cross, at a depth of 1160 ft. From 538 to 542 ft., the bore passed through 4 ft. of ore assaying $20.26 per ton. From 958 to 976 ft., ore was again found, and the core at 968 ft. carried visible gold. From 1087 to 1100 ft., the main lode on the property, in Mr. Montgomery's opinion, was passed through. No assays of these two last developments have so far been published. The machine has now been moved 180 ft. south, where the second bore will be put down at an angle of 80°, so as to cut straight across the lodes. In this bore the lodes are expected to be found at shallow depth, as the site is nearer the outcrop. W. J. Loring has taken an option on the property with a view to forming a company in London.

The new volatilization plant, erected on the Gwalia Consols, is now treating 30 tons of ore per day, and the first return is awaited with interest. Ben Howe, who has devised the process, is confident of success, and states that the process is idealy simple, and a high extraction, 90% or more, at a low working cost, is certain. The latter depends on the price of salt, and the percentage required to volatilize the gold. Originally 5% of salt was the figure given by Mr. Howe, but he has since reduced it to 2%. The ore is refractory, and contains antimony and arsenical pyrite, and the successful treatment of such ore will open up vast possibilities not only in Australia, but all over the world.

The Norseman district has been under a cloud for years, owing to a barren or impoverished zone intruding at a depth of 400 to 600 ft. and causing the premature abandonment of many mines. In 1901, the Norseman Mines, Ltd., a London organization, secured $5 for $5 subsidy from the Government to sink the main incline shaft on the Viking mine from 450 ft. to a total depth of 700 ft. After sinking to 574 ft., work was suspended, and the mine shortly after abandoned after producing $1,105,000 gold and $15,000 silver from 56,000 tons of ore. A local syndicate re-staked the lease in 1906, and has since won $417,300 from 11,000 tons from the shallow ground. Recently work was started at 574 ft., and after sinking to 600 ft., phenomenally rich ore was found, the first 3 tons broken being estimated to contain $30,000, or $10,000 per ton. The lode is now being opened at 600 ft. and further development should prove interesting, especially as the Government is prepared to subsidize boring in any district to the extent of $2 for every $1 local residents are prepared to speculate in diamond-drill work.

A great impetus has recently been given to producer-gas plants by the introduction of the Cambridge wood-burning generator, in lieu of the charcoal-burning generator previously in use. Charcoal in Kalgoorlie costs $14.16 per ton, against $3.12 per ton for wood, and, as firemen, certificated engineers, and water consumption are practically eliminated where producer gas replaces steam, the cost of power is reduced 70 to 80%. As a consequence, all the recently erected treatment plants, such as those on the Mountain Queen, Queen of the Hills, Yuanmi, and Victorious are operated by producer-gas plants. Since the advent of the Cambridge gas generator, Degenhardt and Jordan, of Bewick, Moreing & Co., have patented the Commonwealth down-draught wood-burning generator, and is claimed to be an improvement. This generator is now in operation on the Yuanmi mine, and is said to save $425 per month on a plant treating 5500 tons, or 77c. per ton. A similar generator is to be installed immediately on the Sons of Gwalia in place of the Thomson-Houston charcoal generator, which only started running in October 1912. In addition, a larger Commonwealth generator, together with a 650-hp. gas engine, has been ordered and will operate the vacuum-filter plant to be installed to re-treat the 2,000,000 tons of old residue now accumulated at the Sons of Gwalia mine. The first producer gas tried in Kalgoorlie was at the Great Boulder mine some years ago, for firing the Edwards roasting furnaces, but was not suitable for this purpose. Since then, however, this type of engine and generator has been vastly improved, and before long will probably completely supersede steam plants for operating all surface treatment plants.

G. M. Roberts, general manager of the Associated Northern, is very sanguine of the No. 5 level of the Company's Victorious mine, at Ora Banda, proving a success, because of the high average gold content obtained in the four winzes below No. 4 level. From west to east the gold content is as follows: $31.80, $9.64, $31.44, and $40.80 per ton. The lode ranges from 48 to 80 in. The winzes cover a distance on the ore-shoot of 173 ft., and the two end ones are the richest. The ore-shoot at No. 4 level is 250 ft. long. The station on No. 5 level is already completed, and the lode is expected to be cut in 20 to 30 ft. from the end of the station.

The Bullfinch management has at last published an estimate of ore reserves of the mine, and gives the figures as 158,300 tons assaying $12.42 per ton above the 210-ft. level. The additional 5 stamps and tube-mill have been erected and will start as soon as the necessary motor arrives from England. Then 6000 tons monthly will be treated. The mine is proving irregular in gold content, but until more development has been done it is impossible to say how the mine will open. The lode has resumed its original strike of northeast and southwest, and is not nearly so rich at it was in the bend where it took a sudden turn to the west. The Corinthian North, under the same management, has published its first return as 4209 tons for $13,400, with $22,300 remaining in the residue. A vacuum-filter plant has been ordered and is expected to start in August, with a monthly capacity of 6000 tons.

The Paringa company, Kalgoorlie, recently started driving north on Geach's lode, 125 ft. west of the south shaft at the 100-ft. level. After going through 70 ft. of barren rock, 70 ft. of ore, varying in width from 36 to 60 in., assaying $20 per ton, was passed through. The lode then increased in width to 84 in. and for the next 12 ft. assayed $44 per ton. A start has been made to drive north at the 200-ft. level, and the first 12 ft. driven is in unprofitable ore. This west lode has never been previously worked in the property, and still has possibilities, though in the adjoining Associated Northern, the ore-shoots proved too short to be of any great permanent value.

The June gold return for the state of Western Australia was $2,340,050. The principal producers are as follows:

Name.	Tonnage.	Value.	Profit.	Dividend.
Great Boulder	18,590	$240,480	$118,900	.....
Ivanhoe	20,538	192,300	70,100	.....
Kalgurli	10,985	110,230	46,200	.....
Bullfinch	4,542	68,130	42,300	.....
Golden Horse-Shoe	27,125	192,400	28,200	.....
Fenian	2,954	46,700	24,700	$75,000
Sons of Gwalia	13,410	103,600	24,200	.....
Lake View & Star	18,722	107,200	18,000	.....
Victorious	7,700	47,400	13,800	.....
Yuanmi	10,500	88,900	18,100	.....
Sand Queen	1,400	26,500	12,700	7,500
Associated	11,250	70,900	10,200	.....
Mararoa	2,730	24,400	9,300	25,000
Ingliston Consols	1,849	20,200	8,680	.....
Queen of the Hills	3,397	28,800	8,300	.....
Great Fingall	5,927	58,700	7,900	.....
Mountain Queen	2,089	25,300	5,800	.....
Golden Ridge	3,025	23,000	4,900	.....
Associated Northern	1,429	21,800	4,900	.....
Oroya Links	11,890	58,000	3,400	.....
Paringa	480	8,200	3,400	.....
Lake View Consols	8,775	7,900	1,900	.....
South Kalgurli Consols.	9,604	51,000	1,900	300,000
Perseverance	20,775	100,900	3,300*	.....
Burbanks Main Lode	2,015	20,300	3,300*	9,390
Ida H.	1,305	12,400	800*	.....

*Loss.

BOSTON

HOLDINGS OF FIRST NATIONAL COPPER CO.—ARIZONA COMMERCIAL COMPANY'S POSITION.—EAGLE & BLUE BELL DIVIDEND.

The announcement by the president of the First National Copper Co. that operations are to be resumed, and that a new process for the treatment of ores is to be installed at the properties in Shasta county, California, is of more than passing interest here, as by far the largest number of shares of this Company is held here in New England. There have been so many disappointing developments at the First National property, however, that while Boston is hopeful of success for the new venture, it prefers rather to reserve judgment for the present. The definite action taken by the management of this Company for rehabilitation, taken together with the marked success attending the developments at the Davis-Daly property, leaves only the Ohio Copper Co. now to work out its salvation to have brought back into the fold three of the favorites of the local coterie in the boom times. Ohio, while it is earning between $15,000 and $20,000 per month, seems able to make but little headway, due to the excessive tax of 15c. per ton being levied on the Company's shipments by the Bingham Central Railway Co., controlled by F. A. Heinze.

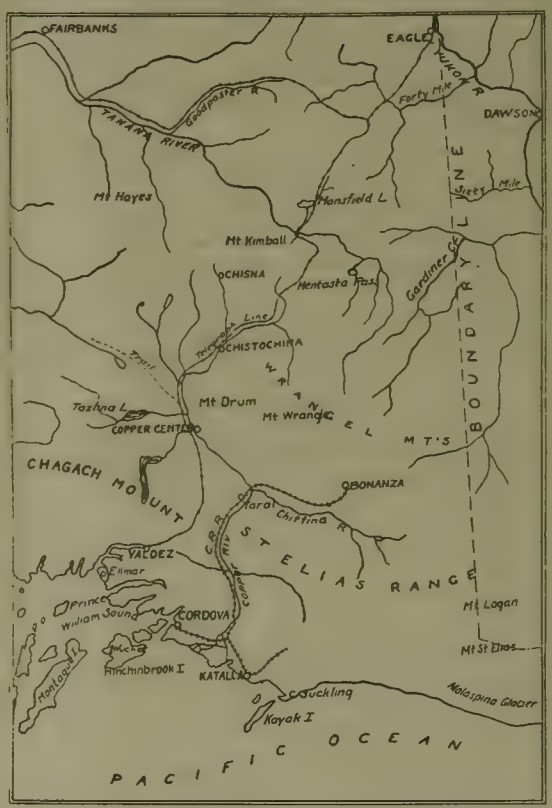
The Arizona Commercial property seems to be making fairly good progress under the new management, headed by C. S. Smith, who is also president of the adjoining property, the Old Dominion. According to the annual statement of the Company, just issued, there was $153,000 on hand on June 20 last, with total quick assets in excess of $193,000. This as against an indebtedness of $14,700 at the close of the previous year. The new Company, when it was formed, levied an assessment of $3 per share, which is exactly the price for which the stock is selling in the open market at the time of writing. Mr. Smith, while not inclined to bolster the hopes of stockholders, issues a frank statement, in which he says that shipments under the 20% leasing system were discontinued on January 1 of this year, because of the tax laws enacted by the state of Arizona. Small stringers of ore have been found and it will be the policy of the Company to follow these up in the hope that they will lead to a body of commercial ore.

The action of the directors of the Eagle & Blue Bell Mining Co. in paying the third 5c. dividend for this year was well received here. This dividend on the $893,146 shares of stock called for the disbursement of $43,657 and brings the total payments for the year to date to $133,972.

SOUTHWESTERN ALASKA

THE NEW GOLD PLACERS ON THE SUSHANNA RIVER; HOW TO GET THERE, AND VALUE OF THE GROUND OPENED.—CONDITIONS IN SOUTHWESTERN ALASKA.

The latest reported discovery of placer gold has been made on the Sushanna river, and stampedes of considerable numbers of placer miners and others have taken place from Seward, Valdez, and Cordova, as well as from points along the Copper River & Northwestern railroad. This is the best route to take to the new 'diggings' for anyone going in from the coast, as the Sushanna river is in that part of Alaska hitherto unexplored near the headwaters of the Tanana river. Kennecott, the northern terminal of the Copper River & Northwestern, is reported as being the best starting point for the creeks on which discoveries have already been made, which are 90 miles distant from that place. From the latest telegraphic reports, Dawson and other towns on the Canadian side are also furnishing their quota of stampeders, these going in by the way of Kirkham Landing with horses to the White river, and pole up that to the mouth of the Snag, then 'mush' overland to the diggings, a total distance of 260 miles from Dawson. Several creeks have already been staked, and Alex. Walstrom and John Linquist write that the former took out pans that yielded as high as $4 and $5 per pan, and that on No. 6 Above, on Bonanza creek, two men are said to be taking out $2500 per day. Laborers are receiving $12 per day, and as bedrock is reported to be shallow, only from 1 to 5 ft. of gravel lying above it, shoveling is comparatively easy. These reports were brought down to McCarthy, on the Copper River railway, by two returning miners named Jim Morris and Dan Stacey, who also state that the trip in at this time is quite difficult owing to the high waters in most of the streams. The latest news from Dawson with regard to these discoveries is vouched for by Fred Best, a partner of Billy James and Nels Nelson, the actual discoverers, who has just returned to Dawson, having 'mushed' across the country to the head of the White river, then down the river in a small boat. He says that the Discovery stream, known as Bonanza creek, seven miles long, and a tributary known as Eldorado, four miles long, had all been staked since May last when the discovery was made, and that now prospectors are staking on Coarse Gold creek, Money gulch, Gold Run, and Wilson creeks, all of which carry pay from the grass roots, and the gravel is thawed and there is



SHOWING COUNTRY ABOUND NEW PLACER DISTRICT.

plenty of water for sluicing. Mr. Best advises that any prospectors going in should take a full winter's supply, because the 'camp' is at the head of the highest watershed, and the winter snows are extremely deep, so that the trails are almost impassable. The new discoveries are on the American side, 30 miles from the international boundary.

Should these new discoveries prove to be as valuable as is claimed, they will be of great benefit to southwestern Alaska, owing to the present conditions there, the tying-up of the coal lands as well as the recent typing-up of the Alaska Northern railway for failure to pay taxes. This portion of Alaska has for some years past proved to a great extent diasppointing, so far as attracting capital or new arrivals is concerned.

Despite the fact that during the past three years the copper mines on Prince William sound and in the Copper River district have been producing a greatly increased tonnage of copper ore, and the further fact that the free-gold quartz mines on Falls creek, 26 miles from Seward, also in the Willow Creek district, about 40 miles from Knik, at the head of Cook's Inlet, the Cliff mines near Valdez are producing bullion on a satisfactory scale.

NEW YORK

Organization of the Cieneguita Consolidated Mines — Messina Mine Development and Production — Santa Gertrudis — Forged North Star Shares — Ohio Copper — Minerals Separation and Butte & Superior

By the reorganization of the Cieneguita Copper Co. and the Cieneguita Securities Co. under the name of the Cieneguita Consolidated Mines, a Mexican property with a shady past re-enters the paths of virtue. The Company was organized 12 years ago with an authorized capital of $10,000,000. Then followed years of high finance that led to the existence of three companies of the same name organized in different states, and finally to the appointment of a receiver in 1910. The Company owns 1100 hectares in Sonora, about 40 miles southwest of Sahuaripa. Such development work as has been done consists chiefly of adits which have disclosed fair quantities of ore containing 2½% copper and 45 oz. silver per ton. The plant, including a small smelter, was poorly built, and transportation facilities to the property are not good. But the property has some promise, and under the new management may make a much better showing. The new board consists of James F. Whitney as president; Frank Fitz, formerly the superintendent, as vice-president; and R. C. Davenport, formerly the treasurer; Theodore Martin, a Los Angeles lawyer; G. D. Christy, a Phoenix banker; R. W. Campbell, who is a son-in-law of E. H. Gary; and David Angus, a New York contractor, as directors.

The Camp Bird management is highly pleased by the results being attained at the Messina, in Africa, according to a report made by the manager of the London office of Catlin & Powell. During June the output of concentrate by the Messina Development Co. was 486 tons averaging 38.6% copper, and 289 tons of middling averaging 11% copper. During the month 497 ft. of development work was done, the east winze from the No. 2 level disclosing 8.6% ore, the west raise from the No. 6 level showing 11.7% ore, and the east raise showing 8% copper ore. The railroad and reduction plant are expected to be finished within a few months. At the Santa Gertrudis, work has been hampered by a shortage of labor and lack of power following a dry season, and ore from the upper levels, which is lower grade, has been milled during the month. It is hoped that normal conditions will be restored during the next two months. Negotiations for taking over the Campo Morado have not been completed. It is rumored that negotiations for another property are also in progress.

Tonopah shares, which had been vigorously traded in on the Curb market recently, experienced a serious bump when it was discovered, early last week, that a considerable number of the share certificates of Tonopah North Star which had been traded in were forgeries. In the resulting excitement it was reported that hundreds of thousands of fraudulent certificates had been sold. Actually, however, between 7000 and 10,000 were sold by a man who used the name of Wells and also that of Ehrich. The certificates were lithographed and the signatures forged, that of Herman Zadig being especially cleverly written. As a result, the shares declined considerably in value, and other Tonopah shares also declined in sympathy. It is reported that negotiations are on for the merger of Montana-Tonopah and North Star, but it seems at least doubtful if so good a property as Montana-Tonopah would go into double harness with a property that has a bar sinister in its escutcheon, on the basis of present share values, at least.

Trouble seems to be brewing in Ohio Copper, and M. W. Atwater has been sent to make a complete examination. It is understood that if this is unfavorable, Al. Frank, the manager, who is regarded as F. A. Heinze's representative, will be displaced. June profits were only a few thousand dollars. The suit over the Hyde process at the Butte & Superior has been decided in favor of the Minerals Separation, Ltd., but the amount of damage has been left to a master. The decision will probably be appealed, but now that the Minerals Separation has legally established the fact that this is an infringement, the two companies are likely to come to a settlement.

LONDON

Development and Prospects of the Rhodesian Holdings of the Consolidated Gold Fields of South Africa Subsidiary Company

The ventures and investments of the Consolidated Gold Fields of South Africa in America have recently been recorded in the *Mining and Scientific Press*. It is opportune therefore to give the latest news of the Company's operations in Rhodesia. This work is conducted through the medium of a subsidiary called the Gold Fields Rhodesian Development Co. In the early part of 1912, the assets of the Rhodesia Exploration & Development Co. (the Sauer-Bailey control) were acquired in exchange for newly created shares. The issued capital now consists of 2,514,220 shares of £1 each, and the investments consist of shares in subsidiary and other companies originally valued at £2,856,337.

During the past year or so, the Rhodesian share market has been extremely dull, and the quotations have dropped seriously. Consequently the Company has been obliged to write down the value of its investments by no less than £508,296. Moreover, the market stagnation has prevented the raising of capital for the further financing of some of the subsidiaries, so that the Company itself has had to provide the money on loan, or on the security of debentures. It is hardly necessary to add that it has been quite impossible to make any profit by the sale of shareholdings in subsidiary companies. The Company publishes a list of its principal holdings. Of these, the most interesting are in the Shamva, Golden Kopje, Falcon, Bell Reef, Antelope, Asp, and Planet-Arcturus companies. The ore blocked out at the Shamva is estimated at 2,319,752 tons, averaging 21s. gold, and the others between them contain 1,703,940 tons averaging 46s. per ton. The Company also owns a large share in the Eldorado Banket company, which has paid handsome dividends, but the ore reserves are not being maintained. This holding was acquired when the assets of the Rhodesian Exploration & Development Co. were acquired.

The Shamva is one of the most notable properties developed in Rhodesia. The gold is found in a wide lode of agglomerate outcropping on the top of a hill. Five levels have been opened and the ore has been proved by numerous cross-cuts and winzes. On the first level, below the prospect level, the orebody is 920 ft. long and 110 ft. wide, averaging 4.14 dwt. gold per ton. At greater depths the dimensions in both directions decrease, though the average content is rather higher. The engineers are hopeful of an improvement in depth; but to those who are not connected with the venture the probabilities are obvious. The treatment plant is to contain 56 Nissen stamps and 10 tube-mills, and it should commence work during the next few months.

The Falcon mine is a pyritic property containing copper and gold, and the treatment of the ore will be done in the usual type of copper-smelting plant. The lodes average 40 ft. in width. Six levels have been opened, and the reserve is calculated at 178,622 tons of oxidized ore, averaging 6.4 dwt. gold per ton and 0.71% copper, and 638,389 tons of sulphide ore averaging 5.57 dwt. gold and 3.15% copper. The smelter should be ready in about a year. The Golden Kopje mine is near the Eldorado, and the milling plant of the defunct Ayrshire mine is being transported to it. Five levels have been opened, and the proved reserve consists of 210,204 tons averaging 6 dwt. per ton. The lode averages 18 ft. in width. The adjoining Union Jack mine is being developed by the Golden Kopje company, and has a reserve of 86,000 tons averaging 13 dwt. per ton. The other mines named are in an advanced state of development, and treatment plants are either ordered or under consideration. Some of the older properties in which the Company is interested have fallen on evil days. The Thistle-Etna mines have been exhausted without ever a dividend being paid, and the present developments at the Selukwe Columbia are disappointing. On the other hand, the Gaika, which after a hard struggle managed to pay two small dividends, seems to be now in a more favorable position. It will be seen from the above notes

that the Company has wide interests in mines that promise to be producers. None of them can be said to be bonanzas, and the margin of profit will be small. The total capitalization is far greater than the profit in sight.

TORONTO, CANADA

CANADIAN NICKEL CORPORATION ABSORBS THE DOMINION NICKEL CO.—MINE DEVELOPMENT AND PROPOSED PLANT.

The Canadian Nickel Corporation, Ltd., is the name of the new company which has taken over the holdings of the Dominion Nickel Co. in the Sudbury district. The capital consists of $10,000,000 6% debenture stock and $20,000,000 common stock, all issued. The debenture stock is redeemable at $100, by means of an annual sinking fund, payable out of earnings. which will enable the entire issue to be redeemed in 12 years. Provision for the interest on debentures and the appropriation for the sinking fund must be made before any dividends can be declared on the common stock. The Company's property comprises several well known groups, the best of which is the old Murray mine, which was first operated by the Vivians in 1888. The Company's engineers estimate that up to May 1 development and prospecting work is estimated to have developed 6,800,000 tons of ore. The greater portion of this ore has been proved by diamond-drilling and is not yet available for stoping. There are 12 diamond-drills testing the property at various points, six of which are at the Murray mine, where it is reported that 1,000,000 tons per month is being developed. The Company has strong backing, and among the sponsors are F. S. Pearson, president of the Brazilian Traction, Power & Light Co.; J. F. Taylor, of the Lake Superior Corporation; J. E. McAllister, B. B. Lawrence, E. R. Wood, Walter Gow, and Miller Lash. The majority of these men are heavily interested in Mexican and South American traction, light, and power companies. A plant will be installed which will have a capacity of 540,000 tons per year, from which an average of 30 lb. of nickel, 12 lb. of copper, and $1 in precious metals will be recovered at a cost of $6.60 per ton.

The Canadian Copper Co., at the present time, is treating about 45,000 tons of ore per month, the greater portion of which comes from the Creighton mine. No. 3 mine is being developed as rapidly as possible, and on this property the Company has an enormous tonnage, a large portion of which it expects to be able to smelt direct without roasting. The plant is being enlarged, and the mines are being developed with the idea of mining 1,000,000 tons per year.

Ores sampled at the Hurricanaw district, in the north, returned tellurium 31.64%, silver 40.60%, and gold 24.80%, a true telluride of silver.

CANANEA, MEXICO

PROGRESS AT THE CAPOTE SHAFT, WHERE AN ELECTRIC HOIST IS TO BE INSTALLED.—SMELTER WORK.—EXPORTS FROM SONORA DURING JULY.—TAJITOS AND LA PAZ MINES.

The new Capote shaft of the Cananea Consolidated Copper Co. will soon be completed down to the 1000-ft. level; in fact, it is already in use as far as the 900-ft. level, and is being raised from the 1000 to the 900-ft. level at present. This work is to be completed during the coming week. A new electric hoist is to be installed and will be of a similar pattern to that at the Duluth mine, as described in the *Mining and Scientific Press* of May 10 by H. L. Gooding and T. T. Read. A small temporary hoist is now used. The concrete foundation for the new hoist is being laid. The mine is being operated with three shifts, the only property of the Company being worked with anything near a full force. The Capote orebody has proved to be the largest in the district, and extends from near the surface to the 1000-ft. level. The old Chivatera dump is being shipped to the smelter, and yields about 3% copper and 12 oz. silver per ton. Between three and four carloads of the ore is being shipped direct to the smelter daily. The output of the Company for July was approximately 6,000,000 lb. of blister copper, gross, the largest in some months. No. 1 reverberatory furnace is closed at present, as it is being relined, and No. 2 was down for a short time, due to a cave-in of the lining.

375-HP. HOIST WITH POSITIVE ELECTRIC BRAKE AT CANANEA-DULUTH MINE.

Shipments through the 'port' of Agua Prieta from mines in northeastern Sonora showed quite a gain over June, and in fact was a record. It is figured that the ores and bullion exported during the month was valued at ₱3,167,200, while in June the total was ₱2,052,000. A number of properties have resumed shipping, while new ones have joined the ranks of producers during the month, among those being the following: El Gallo, Rivera, Matilda, Archipelago, Monte Cristo, Batuc, La Sonora, Vaquero, San Francisco, Estrella, and Santa Margerite. El Tigre shipped 63 bars of silver bullion during the month, weighing 9475 lb., and 10 cars of ore. The Moctezuma Copper Co. shipped 330 cars of ore and concentrate, while the Churunibabi Leasing Co. shipped 10 cars.

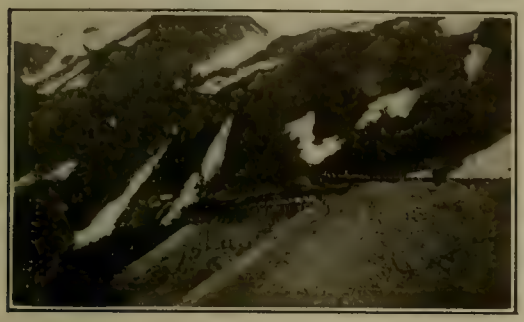
A large body of free-milling gold ore has been opened at the Tajitos property, situated in the vicinity of Carbo. There is a large force of men employed at present, and the ore mined averages ½ oz. gold per ton. The automobile road from its property to the Gulf of California is soon to be commenced by the West Coast Smelting & Refining Co. Grading for the new smelter will also soon be started. A group of Douglas, Arizona, men have purchased La Paz mine, situated in the Tigre district, from Jesus Urcades. A mill is to be installed as well as a power-plant.

General Mining News

ALASKA

Juneau

(Special Correspondence.)—Although Juneau is the oldest mining district in Alaska, and although prospecting has been going on more or less continuously and energetically since 1880, yet there are still quite extensive unexplored areas along the coast and on the islands, and during the past eight years at least, the number of prospectors has been far less than was the case 12 or 14 years ago. Indeed, many of the men who devoted all their time to prospecting up to about 1904 have since found that fishing is a much more profitable occupation, because of



DUMP AT PERSEVERANCE MINE, JUNEAU.

the many disappointments the prospectors have met with when attempting to invest capital to develop their discoveries.

Juneau, July 30.

Cochise County

The second drill-hole being put down to tap the gas from the Holbrook shaft's old fire zone will probably enter the gas area shortly. The first drill-hole, which got the gas at about 400 ft., is continuing to bring out a large volume daily. Behind the supply-house at the Holbrook there is a raise which is also being used as an outlet for the gas. With the additional drill-holes that are to be put down, there would seem to be excellent prospects for ridding the mine of this trouble and danger permanently.

ARIZONA

Pinal County

(Special Correspondence.)—The Ray Consolidated Copper Co. produced 195,000 tons of ore in June, and there is now being mined 7000 tons of ore per day. There are 1600 men at work in the mine, and the payroll for June was $140,000. At this rate there is being expended in wages $1,680,000 per year. There has been no time lost in bringing the mine up to its present producing capacity. Six months ago the daily output was 5000 tons and will shortly be 8000 tons per day. The continued subsidence of Ray mountain is still noticeable, and the caved area between here and the town of Sonora has extended during the past few weeks. The surface continues to drop gradually near the M. & H. shaft, and a break has appeared on the old Ray Central hill where houses formerly stood.

Ray, July 31.

CALIFORNIA

Butte County

G. W. Wooley, manager of the Klondyke Gravel Mining Co., is authority for the statement that he recently uncovered at his mine here a large body of manganese ore. Samples sent to Salt Lake City gave a good result.

Calaveras County

(Special Correspondence.)—The Reiner Mining Co., operating near Altaville, recently published a folder giving details of its properties and plant, and is offering stock for sale for further equipment. The area of ground is 550 acres and part contains a gravel formation. On July 21, 1913, bedrock in the old river was reached. Estimates of the channel owned by the Company give 200 ft. width, 2¼ miles long, and gold-bearing gravel is about 50 ft. thick, containing probably 4,600,000 tons of gravel averaging $2.50 to $11 per ton, besides some rich black sand. Profits from this are estimated to be large. The 20-stamp mill was destroyed by fire on December 7, 1912, and more money is required to replace it; hence the appeal.

The other equipment is in good order, but it is said locally that there is a heavy mortgage on the plant, due immediately. A few weeks ago the property was shut down, and some of the employees have two months' pay owing them. Local opinion is that, under proper management, the property might make good; but stock operations in the East have been heavy.

Altaville, August 3.

Eldorado County

The old Union mine, which has been idle for several years, is to be reopened. For 17 years it was a steady producer.

Nevada County

In the damage suit of J. Cornelius *v.* the Brunswick Consolidated Gold Mining Co., the court found for the defendant. The Union Consolidated Mining Co., operating at Virginia City, Nevada, has purchased a controlling interest in the Blue Quartz Mining Co., of Nevada City, in this county.

Placer County

The Plumas Bonanza mine, on Winers creek, is opened to a depth of 100 ft. on a vein of white quartz. The ore is estimated at $8 to $10 per ton. Ore obtained from the cross-cut will be crushed in the 3-stamp mill placed on the property last fall.

Shasta County

(Special Correspondence.)—The shaft and lower level of the old West End mine, east of Whiskeytown, is being unwatered by Briceland Blair, Newton Eaton, and other people of Kennett, who have installed an efficient steam-hoist and pump on the property. The property was a good producer 30 years ago from the upper levels, and a short extension of a level run from the bottom of the shaft is expected to give about 100 ft. of new stoping ground. The Gambrinus mine on Whiskey creek, after a temporary idleness, due to shortage of water-power, will soon resume development work, the ditch having been repaired and water-supply increased. Development consists in the driving of a cross-cut from the lower level, 125 ft. on the branch of the main vein. Before the present shut-down, this cross-cut had been driven about 20 ft., and in another 20 ft. should cut the vein. The mine should soon be on a profitable footing, as this vein in the upper levels paid handsomely to the early operators. On July 26, John S. Strode, John W. Strode, and James Hener started the 10-stamp Straub mill which they recently erected on their Blackhawk claim on the headwaters of Mad Ox creek, above the old Mad Ox mine. They report the operation satisfactory. They spent several years prospecting and developing the property, and had a large tonnage of milling ore blocked out and on the dump before purchasing the mill. If all prospective mine operators would proceed in this practical way there would be many less idle mills in the country. Seven auto-loads of 'boosters', including some state officials, passed through here on July 26, bound for up-country points and to look into the possibilities of a state highway passing through this district into Trinity county. This is of vital interest to mining as well as other people, as transportation is one of the most expensive features of mine operation in these counties, and there is much room for improvement in the roads.

Whiskeytown, July 27.

The Russell placer mines near Igo, bonded by Los Angeles people, are to be worked with new equipment. The Company has been mining rich gravel for several weeks with a hydraulic elevator, but recently completed a combination dredge drag-line excavator steam-shovel device.

The machine was especially designed to meet the varying requirements of the ground and is an interesting piece of machinery. Fred Grotofend has arranged for the immediate installation of a modern hoisting and pumping plant at the Donkey zinc-copper mine, near Ingot, and will sink the shaft below the present workings. The working force has been increased. Consignments of the richer ore will be shipped to Utah plants while the new development is in progress. Later on activities will be resumed at the Baker.

Siskiyou County

The new company recently acquiring the new coal deposits near Ager from the Yreka Development Co. has two diamond-drills at work, exploring the coal seams. Michigan people have acquired the Blue Ledge copper mines on the upper Applegate river. About two miles of development has been done, and high-grade ore opened. Transport difficulties have handicapped the district so far, but it is proposed to build a railroad from the field to Medford or some town in Oregon.

Trinity County

(Special Correspondence.)—Robert McIlwaine and Chas. Kingsberg have leased the Blue Jay for another year and will begin active operation about the latter part of August. The Dorleska, situated near the head of Coffee creek, has recently been examined for an English corporation, and it is likely that this good property will again take its place among the producers of Trinity county. The Sikes Mining Co. has discontinued work on the 'Poverty Slide' at Trinity Center owing to lack of water to operate the giants. A few men are still at work cleaning the flumes.

MAP OF TRINITY COUNTY.

The body of oxidized ore at the Headlight mine has been worked out, and the mill is closed pending the development of a process to treat the large body of sulphide ore underlying the gossan. This ore carries about 47% sulphides, including 3 to 4% copper. The ore cannot be roasted, owing to Government forestry restrictions, but a wet process is giving good results on small tests, and it is probable that this property will be producing again in the early part of next year. The 13-cu. ft. dredge of the Alta Bert Gold Dredging Co. has been in continuous operation since it was completed last February. The Company owns 600 acres along the Trinity river, at Trinity Center, and is turning over about two acres of ground per month. A 60-ft. steel spud, weighing 72 tons, is being assembled on the ground, and will be installed within the next few weeks. To the present time a headline has been used to hold the dredge up to the working face. A company has bonded the Carr ranch, at Carrville, and a drill is at work prospecting the ground.

Trinity Center, July 5.

Tuolumne County

(Special Correspondence.)—Gold-bearing gravel was opened this week in the Humbug mine, at Table mountain, and it is the belief that the ancient river channel has at last been uncovered. The company has been carrying on development for several years, during which an adit was driven into the lava-capped mountain almost 1000 ft. The work has been done under the direction of J. L. Witney.

The Gross mine, at Tuttletown, has been bonded to George Weston, Percy E. Weston, and A. J. Dutton, of Salt Lake City, and active work will begin at the property during the coming week. According to the terms of the agreement, permission to stope ore is given only on condition that the shaft first be sunk an additional 100 ft. Large orebodies have been developed by former operators, and it is said that a mill much larger than the one now on the property will probably be installed when the sinking specified in the bond is completed.

The San Francisco company which is preparing to mine the bed of the Tuolumne river at Kanaka bar, one mile above Jacksonville, expects to begin operations by August 15 with a crew of 12 to 15 men, Henry Keith in charge. A wing-dam 180 ft. long has been constructed to divert the stream and expose the channel several hundred feet, and a 'China' pump, now being installed, will handle the seepage. An elevator will be used to convey the gravel to the sluice for washing. The gravel deposit is several hundred feet wide and varies in depth up to 25 feet.

The first clean-up since the resumption of operations at the Atlas, near Tuttletown, was made last week, and is most satisfactory to the management. B. C. Haywards, interested in the Santa Ysabel mine, at Stent, is reported as saying, while on a visit to the property last week, that operations would likely be resumed in the near future. Howard Pollion, of New York, this week secured an option on a portion of the Carlin property, between Jamestown and the Harvard mine, and will at once begin development work. The property will be explored by means of an adit. The Clark Development Co., a new corporation having a capital stock of $10,000, with shares at $1 each, will shortly begin the development of the Clark ranch mine, situated near the Hazel Dell. The Company's principal place of business is Sonora, and the directors are H. F. Clark, of Soulsbyville, A. Y. Werner, of Carson City, Nevada, and Rowan Hardin, of Sonora.

Sonora, August 2.

Yuba County

During the six months ended June 30, the Natomas Consolidated of California reports a gross income of $1,272,626, operating expenses $622,433, mortgage interest $416,937, leaving a profit of $233,256. The June earnings were $240,878, with a profit of $66,278. No. 5 gold-dredge of the Natomas Consolidated, situated about a mile from Hammonton, capsized on July 31, owing to the breaking of one of the guy lines. The loss may be heavy, as the dredge may have to be entirely dismantled before being righted.

COLORADO

Clear Creek County

(Special Correspondence.)—James Teeters, operating the Gold and Silver property on Ute creek, has opened an 8-in. streak of solid ore which assays 1316 oz. silver, 5.24 oz. gold, and 30% lead. The find was made at the bottom of the 70-ft. shaft. The Idaho-Bride company, operating the Seaton mine, is shipping to the Argo mill $3.50 ore, a net profit of 50c. per ton being received in settlement. E. D. Payne is manager. A shoot 2 ft. wide and worth 40 oz. gold and 186 oz. silver per ton has been opened on the 800-ft. level of the Little Mattie mine. The discovery was made 200 ft. west of the shaft. Shipments have been started. W. L. Leebrick is manager. Work has been resumed on the Katie Emmett mine on Chicago mountain. The 10-stamp mill is crushing dump ore. W. W. Cannady is manager. The old United States mill, on lower Fall river, has been leased to Bartlow & Mason. The machinery is being overhauled and ore treatment will be started in a few days. Work has been resumed at the Keystone

mine, situated on Bellevue mountain. Stoping is in progress on an orebody which is from 3 to 6 ft. wide and assays $14 per ton. The product is consigned to a zinc plant at Denver. N. C. Brauch is the owner. An orebody from 8 to 10 ft. wide has been opened at the bottom of the 120-ft. winze sunk from the Two Brothers adit on the Specie vein. It is worth $16 per ton in gold and silver. On the hanging wall an 8-in. streak of smelting ore is exposed that mills $85 per ton. John Owen is manager. Shipments have been started from the Bald Eagle mine on Seaton mountain, the product being consigned to the Combination mill. H. T. Rogers is manager. It is stated that the 150-ton mill at the Oneida mine, at Freeland, will be completed during the next 30 days. The building is finished and the machinery ordered. This plant will be equipped for concentration, amalgamation, and an electrolytic process. John Owen is lessee. Heavy shipments are going out from the Golden Edge mine, the ore being of milling grade. J. P. Ruth is operating under lease.

Idaho Springs, August 2.

GILPIN COUNTY

New equipment is to be added to the Castle Rock mine, in Chase gulch, and machine drills are to take the place of hand work in the mine. The main shaft is 416 ft. deep, and the 300-ft. level cross-cut was driven north 100 ft., cutting ore, and a winze 60 ft. deep has produced 22½ cords (200 tons), which was treated at the Polar Star mill, at Black Hawk, yielding 48 oz. retorted gold. The tailing is worth $10 per ton. Joseph Tuckfield is mine manager. Klein & Co. has taken a lease on the Sterling property on Bates hill.

The 'pool' working the Alps mine, on Quartz hill, is keeping a battery working at the Polar Star mill, on ore from the 800-ft. level. A streak in the vein is yielding smelting ore. Lessees at the Corydon are doing well. The 10-stamp mill of the Gilpin-Eureka company is working two shifts. The Barnes mine, on Quartz hill, is being dewatered below the Quartz Hill adit-level.

TELLER COUNTY (CRIPPLE CREEK)

According to local statistics, the July output of the district was as follows:

Plant.	Tonnage.	Av. val.	Total val.
Golden Cycle	32,000	$20.00	$ 640,000
Portland (Colorado City)	9,665	22.00	212,630
Smelters	3,825	65.00	248,625
Portland (Cripple Creek)	13,600	2.60	35,360
Stratton's Independence	11,073	2.23	24,693
Colburn-Ajax	4,400	2.84	12,496
Kavanagh-Jo Dandy	1,700	2.20	3,740
Gaylord-Dante	1,600	2.50	4,000
Rex M. & M. Co.	1,200	1.10	1,320
Wild Horse	1,100	2.20	2,420
Isabella	700	2.00	1,400
Total	80,863		$1,186,684

Owing to the Fourth of July holidays the yield shows a small decrease on that of June. Dividends paid were as follows: Portland Gold Mining Co., 2c. per share, $60,000; Vindicator Con. G. M. Co., 3c. per share, $45,000; Golden Cycle Mining Co., 2c. per share, $30,000; and Mary McKinney Mining Co., 2c. per share, $26,185; a total of $161,185.

The Homestake mill, on Ironclad hill, owned and operated by Thomas Kavanagh, will be operated as a custom low-grade plant some time in August, when ore in 100-ton lots will be accepted. The ore will be purchased outright, a charge of $3 being made for treatment, which will be the minimum. The ore must be delivered to the mill. Before one lot can be started through the mill, the ore before it must be cleaned up.

IDAHO

SHOSHONE COUNTY

(Special Correspondence.)—Placer mining is active in the Murray section of the Coeur d'Alene, the late rains and heavy snows of last winter giving ample water-supply for extensive operations. One of the largest crews at work is on East Single creek, where Dunlap & Smith, pioneer placer miners, are handling a large strip of rich 'pay dirt.' Ten miners are employed in the work, the booming method being employed in getting to bedrock, which ranges from 8 to 12 ft. in depth. Assured of a good water-supply, the owners are working a larger strip this summer than for many seasons, and from present outlook will make one of the largest clean-ups of the north side. The gold is coarse and averages $18 per ounce. Nuggets running from $25 to $55 have been taken from the creek, but most of the nuggets average from $1 to $5 each. The season's clean-up in this district will probably run close to $10,000, it is stated at Wardner. The work is under the management of Archie Smith, one of the early settlers in the Murray district and one of the best placer workers operating in the Coeur d'Alene.

Spokane, July 30.

The Snowstorm Mining Co., operating at Larson, reports the following during the year ended June 30, 1913: Men employed, 130; development below No. 1 adit, shaft-sinking and winze; ore milled and concentrate shipped, 99,545 tons; operating profit, $228,563; dividends, $142,452.

Property valuations fixed by the County Commissioners are as follows: Coeur d'Alene Development Co., concentrate increased from $22,500 to $24,800; Gold Hunter Mining & Smelting Co., concentrate from $45,000 to $49,000, compressor from $8000 to $8700; Success Mining Co., mill from $25,000 to $30,000. Decreases were: Hecla Mining Co., mill from $22,000 to $17,000, machinery from $52,935 to $49,800; Bunker Hill & Sullivan Mining & Concentrating Co., mill from $350,000 to $250,000, and power-plant from $100,000 to $89,000; and Hercules Mining Co., mill $125,000 to $105,000, and machinery $32,215 to $28,000.

MICHIGAN

HOUGHTON COUNTY

The miners' strike still continues, but the present labor disturbance is countenanced by about 15% of the employees of the various operating companies; certainly not over 20%, and probably less than this number on the Calumet & Hecla and subsidiaries. It is being made at a time when the mines are paying the highest wages in the history of copper-mining in this district. Trammers receive from $2.60 to $3.16 per shift, while the average wage paid to miners is $3.50. The Western Federation of Miners denies the above statement made by the companies. Work has been resumed at several of the mines in pumping and underground work. There have been several slight disturbances, but there is a feeling among the men against the strike. The companies will not recognize the Federation.

MONTANA

MISSOULA COUNTY

(Special Correspondence.)—The East Butte company is maintaining a production of about 2,225,000 lb. of copper per month in spite of the improvements being made to the smelter. These will be completed in about another month, and then the Company will be in a position to increase the production, if necessary, by at least 500,000 lb. per month. Development is being vigorously conducted, and the ore reserves are considerably larger today than at any time in the history of the property. The East Butte ought to be paying dividends early next year. The North Butte company has passed the 2500-ft. point in the sinking of the Granite Mountain shaft, and at the present rate of progress it is estimated that a depth of 2800 ft. will be reached by the middle of October. Then a sump will be sunk and connection made with the 2800-ft. level of the Speculator shaft. It has not yet been determined when the Speculator shaft will be closed for retimbering, and all the ore hoisted through the Granite Mountain shaft, but it is believed that so long as the Speculator shaft remains in a perfectly safe condition it will be operated.

Butte, July 26.

The King and Queen mine is situated near Keystone, in the Spring Gulch district, and over 5000 ft. of development has been done to date. The present mill product

comes from an intermediate cross-cut adit driven to the vein, and from the mouth of this, ore is delivered by gravity tramway to a track-level above the mill crusher. An adit from this point is in 1800 ft., and should cut the vein a 100 ft. farther. This will be the main working level. The vein at present is 15 ft. wide over a length of 300 to 350 ft. The ore is similar to the galena product of the Coeur d'Alene mines. The mill is of 75-ton capacity, consisting of a crusher, rolls, jigs, and tables. Concentrate is shipped over the Milwaukee railroad. Water is fairly scarce, and direct means of transport is necessary. John F. Hinckley is in charge, and Pittsburgh people are interested.

The quarterly report of the North Butte Mining Co. for the term ended June 30, shows that development covered 4769 ft. The continued development of the Edith May and Adirondack veins on the 2400 and 2600-ft. levels, together with the continued eastward development of ore in the Snowball vein on the 2000 and 2200-ft. levels, has more than replaced the ore which has been mined during the quarter. The Edith May shows from 4 to 7 ft. of 4 to 5% copper and 1.3 to 2 oz. silver per ton; the Adirondack shows 4 to 10 ft. of 3 to 5% copper and 1.5 to 2.25 oz. silver; and the Snowball shows from 4 to 5 ft. of 3 to 8% copper and 5.5 to 8 oz. silver ore over good lengths opened.

NEVADA

Clark County

(Special Correspondence.)—Work by lessees in the Quartette property is as follows: The original Holmes lease, on the 100-ft. level east of the Crocker shaft, is producing 40 tons of $12 ore per day. About 5000 tons of ore is opened in this lease. The Post lease is shipping 20 tons of $15 ore per day from the 140-ft. level. Holmes and Mc-

GENERAL VIEW OF QUARTETTE PROPERTY AND DISTRICT.

Clelland, operating the No. 3 lease on the 200-ft. level east of the Crocker shaft, are breaking down 18 in. of $40 ore. On the 600-ft. level, east of the main shaft, Pemberton and Jonas are taking out about 30 tons per day. The ore-shoot has been developed for a distance of 85 ft. to date, disclosing 10 ft. of ore assaying about $35, with 15 in. on the hanging wall yielding about $200 per ton. At the present time there are 55 men employed on the property in the mine, mill, and cyanide plant. The 40-stamp mill is running three shifts, but on account of the overhauling of the mill, only 20 stamps are available until new parts now ordered have arrived. Costs are: mining, including development, $2.37; milling, $1.01; and cyaniding, $1.65 per ton.

Searchlight, July 26.

Elko County

(Special Correspondence.)—There is a fair amount of activity at Tennessee Gulch, 15 to 20 miles west of Jarbidge, which was first prospected about sixteen years ago. Work is to be resumed at the Gold Bug and Oro Fino mines by Theodore Parks and associates. In the former property there are a number of veins, and one has been opened to 185 ft., showing rich ore. A 3-stamp mill is on the ground and crushed some ore. A vein in the Oro Fino, three miles from the Gold Bug, can be traced for 3000 ft., and 10 ft. of ore has been opened at one point. A group of claims at Martin Gulch, four miles distant, is opening silver-lead ore.

Jarbidge, August 1.

The South Nevada Gold Mining Co. is erecting a good deal of equipment and houses at its property, six miles east of Las Vegas. The mine has been opened on four levels, and two Beers type roller mills will crush 100 tons per day.

Esmeralda County

The Goldfield Consolidated Mines Co. reports the following results for the quarter ended June 30:

Ore treated, tons	87,718
Gold production	$1,187,345
Costs	593,763
Profit	$ 593,582

The Goldfield Oro shaft is being sunk by two shifts, using machine-drills in the dacite rock. The Silver Pick shaft is down 400 ft. in dacite, and the station at 513 ft. is being cut in the Booth shaft in a contact of alaskite and shale.

Eureka County

An important ore discovery has recently been made below the big fault in the Buckhorn. The find was made in the long haulage level below any ore known up to that time. It shows 28 ft. of ore assaying about $20 per ton, but no development work has been done on it outside of cross-cutting it with the level, and none is likely to be done until the milling plant is completed. Work on the new mill is progressing well, and there is only 9 miles of electric transmission line to complete. Heavy rain has interfered with haulage of supplies.

The option on 41 claims at Prospect mountain, including the old Dunderberg mine, by Samuel Newhouse and associates, was given in our last week's issue as being in Juab county, Utah, instead of Eureka, Nevada.

Humboldt County

The Charleston National mine, at National, is employing 15 men, and another shift is to be started soon. The shaft is 250 ft. deep, and at 300 ft. a cross-cut will be driven to the vein. The National Mines Co. has opened high-grade ore within 150 ft. of the Charleston end-line.

The Kennedy mining district, situated 55 miles south of Winnemucca on the Southern Pacific railway, has been described in an interesting paper by Paul Klopstock, in the *Transactions* of the A. I. M. E. In 1893, C. E. Kennedy first opened a rich vein, and shipped ore to the Utah smelters. The district is embraced practically in a belt of eruptive rocks which begins to the south of Gold Note mountain, and then runs north for a distance of 2½ miles to Water cañon, where the porphyries are capped by a flow of basalt. Beyond Water cañon no extensive evidence of mineralization is evident. Quartz-porphyries, grano-diorite, gneiss, and diabase are mostly associated with the ore-bearing veins, while the southern portion of Gold Note mountain is chiefly composed of andesite. At the surface, and to depths ranging from 50 to 125 ft. on the dip of the veins, the ores are entirely oxidized; the following analysis is submitted as representative of these ores: Insoluble, 75%; iron, from 9 to 15%; and sulphur, 3%; Au, 0.75%; and Ag, 12 oz. The assays range from $8 to $200 per ton, but average $14 per ton. At the bottom of this ore a secondary sulphide ore is found, and ore from 50 to 75 ft. deep, assaying iron 30% and sulphur 25%, after which the primary sulphides are encountered. These contain 33.5% iron and 14% sulphur.

The Imperial mill consists of 20 stamps, sand leaching and slime decantation plants using cyanide, and is to be increased to 125-ton capacity. Tests on the sulphide ore show that fine grinding is necessary, while agitators and a filter-press are to be installed.

Lyon County

At the Casting Copper mine of the Nevada-Douglas, the 40-ft. level is in 5 to 6 ft. of 6% copper ore, while on the 100-ft. level the cross-cut has opened 16 ft. of 5% ore. Shipments from this property average 5% copper. The middle-level drift on the Maybe shoot in the Douglas Hill has gone through 25 ft. of ore before reaching the east limit. Ore averages 4 per cent.

On the 800-ft. level of the Ludwig mine, driving is being pushed steadily south in the hanging wall country. This material is at present heavily mineralized with iron pyrite

and a small amount of chalcopyrite. On the 750-ft. level, work of blocking out the ore is still being carried on. The body was cut upon its north extremity, and is extending southward in the workings now being pushed. The ore averages 10% copper.

During the week ended July 25 the Thompson smelter received 4198 tons of ore, of which 1126 tons was from the Nevada-Douglas and 2026 tons from the Mason Valley. There were four cars of matte shipped.

Mineral County

There are now 131 men on the payrolls at Rawhide, more than at any time in the history of that 'camp,' not excluding the 'boom' period of five years ago. The Nevada New Mines Co. is owner of nearly 200 acres of ground, from which lessees have taken over $50,000 worth of gold ore from surface or shallow workings, and in which orebodies are developed for 500 ft. in depth and for nearly 600 ft. in length. The Company is the owner of a milling plant that has cost over $70,000, and the plant is in full operation and producing enough bullion to make the Company self-sustaining while carrying on development, which is adding to the reserves right along.

The Cinnabar King quicksilver mine, at Cinnabar, 11 miles east of Mina, is showing 5½ ft. of high-grade ore, and an option for $60,000 has been given to Eastern capitalists. The West Extension group is under option to Los Angeles people for $40,000.

White Pine County

For some time past the Nevada Consolidated Copper Co. has been experimenting with the oil-flotation process on porphyry ores at McGill. It is understood that the laboratory experiments have been highly satisfactory; in fact, beyond expectations. The tests were made on a small scale, but have been of sufficient magnitude to demonstrate that the ores of the Ely district are susceptible to treatment by this new process, and therefore ground is now being broken for the erection of a testing plant with a capacity of 100 tons per day. The slime from the mill contains about 25% of the copper content of the ore, and flotation will be tried on this product.

OREGON

Baker County

In No. 3 adit of the old Cougar mine, in the Granite district, ore worth $12 was recently opened, and on driving 300 ft. the shoot was proved to be 300 ft. long, 4 ft. wide, and assaying up to $90 per ton. The property is equipped with a stamp-mill and cyanide plant and is owned by Spokane people.

Jackson County

(Special Correspondence.)—The old Whitney mine, on the east side of Gold hill, is being reopened by Humphrey & Son, of Bellingham, Washington, who have it under lease. Years ago it produced a great deal of gold from its rich deposits of free-milling ore. Legal entanglements were responsible for its closing down and years of idleness. Now all points in dispute have been settled, and the new management has set to work to retimber, overhaul, and set it going again. The Braden is another Gold Hill property which is being opened. Under Mr. Horn, the manager, a new adit is being driven on a lower level to cut the main orebody, lost by a cave-in of the old workings. A new and rich discovery was made during the past week on the Lucky Bart mine, at Sardine creek, near Gold hill. A 3-ft. vein was found that is averaging $40 per ton in the mill. R. Bordier, of Paris, France, secretary of the French company that owns and operates the Bill Nye mine in the Gold Hill district, is inspecting the property. With the local manager of the mine, F. C. Bellamy, Mr. Bordier is planning better equipment and deeper development. The mine is equipped with a 10-stamp mill and has been one of the leading producers of the district. A deal was completed last week by which the Blue Ledge copper mine, in the upper Applegate district, and on the Oregon-California divide, was sold by Robert S. Towne and associates to a company of Michigan people, among the latter being H. C. Russell, of Marquette.

Philomath, July 15.

UTAH

Juab County

The Emerald Mining Co. has filed suit against the Centennial Eureka Mining Co. for alleged wrongful extraction of 3000 tons of ore from its Emerald lode claim in the Tintic district. Damages are assessed at $100,000.

Salt Lake County

Fire said to have been caused by lightning resulted in the destruction on August 3 of the transformer and compressor plant of the Utah Copper Co. at Bingham. The plant was practically new, and the loss is estimated at $100,000.

Summit County

The Snake Creek tunnel is in over 6000 ft., and during 26 days in July it was driven 300 ft., and 400 ft. is expected during a full run.

The last installment, $485,000, of the judgment held against the Silver King Coalition Mines Co., in the Silver King Consolidated Mining Co.'s suit, was paid on August 1, thus concluding the case. There is some dispute over the fees to be paid the lawyers by the Consolidated company, they asking $100,000; but this will be settled by the court.

WASHINGTON

Ferry County

The Granby company, of British Columbia, has taken an option on the Lame Foot group of mines, near Curlew lake, in this county, for $150,000, from 'Dutch Jake' Goetz and Harry Baer. The group, comprising 15 claims, is 8 miles north of Republic; the Granby company already has a diamond-drill at work. The contract stipulates that not less than $25,000 shall be expended in prospecting the deposits, principally an iron fluxing ore, within 18 months from May 1, 1912.

CANADA

British Columbia

During the three months ended June 30, the Standard Silver-Lead Mining Co. made net earnings of $195,667, while the surplus is $234,601.

Ontario

During the week ended August 2, members of the International Geological Congress visited Cobalt, where various tours of inspection were made, and interesting papers read on work in the district.

During June the Buffalo Mines, Ltd., operations resulted as follows:

Ore treated, tons	5955
Average assay of ore, ounces	31.15
Silver recovered, ounces	161,331
Silver paid for during month (shipped previously), ounces	33,621

No estimates are made of high-grade ore, but returns are included under 'ounces of silver paid for' as smelters make settlement.

MEXICO

Chihuahua

It is estimated that 7000 refugees from different parts of the state arrived at Chihuahua during June. The present population of the city is estimated at 47,000 as a result. This influx is due chiefly to the activities of rebels now all through the state.

Jalisco

A great deal of the structural iron for the framework of the reduction plant of the Cinco Minas Co. in the Hostotipaquillo district has reached the property, and the work of erecting it has been commenced.

Two American mining camps in the Parnaso district of Jalisco, those of the Boca Ancha Mining Co., a Chicago concern, and the Gold Standard Mining Co., in which Philadelphia men are interested, have been held up by bandits under the leadership of Celso de Santiago. After looting they set fire to the buildings. Those of the Gold Standard company were entirely destroyed, according to reports.

Schools and Societies

The new officers of the CHEMICAL, METALLURGICAL AND MINING SOCIETY OF SOUTH AFRICA are as follows: president, Alex. Richardson; vice-presidents, G. H. Stanley, H. A. White, and J. E. Thomas; honorable treasurer, J. Littlejohn; members of council, K. L. Graham, J. A. Wilkinson, J. Gray, F. W. Watson, C. Toombs, T. Donaldson, A. Whitby, A. Salkinson, E. Pam, F. Wartenweiler, John Watson, and H. Meyer.

The annual meeting of the AMERICAN MINE SAFETY ASSOCIATION, composed of leading coal and metal-mine operators, mining engineers, mine-safety engineers, and mine surgeons, will be held at Pittsburgh, September 22 to 24. This Association, which held its first meeting a year ago, has for its purpose a reduction of the number of accidents in the mines and quarries (3602 in the year 1911) and the alleviation of the more than 60,000 men who are injured each year.

The IMPERIAL TOKYO UNIVERSITY, Japan, held its annual commencement on July 11. There were 954 graduates, namely: law, 391; medicine, 141; engineering, 188; literature, 86; science, 31; and agriculture, 117. The distinguished visitors were shown the university collection of historical documents and scientific specimens. Among them were ancient art objects of Korea, maps and documents illustrating the communications between ancient Japan and Annam, and scientific apparatus showing radium emanation.

The AMERICAN MINING CONGRESS will hold its convention and mining exposition at Philadelphia, during the week of October 20. The two-fold attraction of the convention and exposition gives every indication that it will be one of the greatest meetings of mining men in the history of this country. The plans have gone far enough to satisfy the officers of the Congress that the industrial show will be a success, and promises from members and other mining men leave no doubt as to the outcome of the convention. Manufacturers of mining machinery, rescue and first-aid apparatus, and safety appliances are to be given an opportunity to display their apparatus before the mining men of the country at this industrial exposition. J. F. Callbreath is secretary at the permanent headquarters, Majectic building, Denver, Colorado.

Among the fifty papers to be read at the Butte meeting of the AMERICAN INSTITUTE OF MINING ENGINEERS from August 16 to 21 are the following: 'The Ore Deposits at Butte, Montana,' by Reno H. Sales; 'Mineral Associations at Butte,' by Darsie C. Bard and M. H. Gidel; 'Applied Geology in the Butte District,' by F. A. Linforth; 'Timbering in the Butte Mines,' by B. H. Dunshee; 'Shaft-Sinking Methods at Butte,' by Norman Braly; 'Development of the Basic-Lined Converter for Copper Mattes', by E. P. Mathewson; 'Great Falls Converter Practice,' by A. E. Wheeler and M. W. Krejci; 'The Development of Blast-Furnace Construction at the Boston & Montana Smelter,' by John A. Church, Jr; 'Thermal Effects of Blast Furnace Jackets,' by Robert P. Roberts; 'Increasing the Efficiency of McDougall Roasters at the Great Falls Smelter of the Anaconda Copper Mining Company,' by F. R. Corwin and S. S. Rogers; 'The Great Falls Flue System and Chimney,' by C. W. Goodale and J. H. Klepinger; 'Determination of Gases in Smelter Flues; and Notes on the Determination of Dust Losses at the Washoe Reduction Works,' by Edgar M. Dunn; 'Arsenic Trioxide from Flue Dust,' by James O. Elton; 'The Determination of Arsenic and Antimony in Converter and Electrolytic Copper,' by E. E. Brownson; 'Notes on the Great Falls Electrolytic Plant,' by W. T. Burns; 'The Distribution of Precious Metals in Converter Copper, and the Relation Between the Precious Metals and Arsenic and Antimony,' by A. E. Wheeler; 'The Great Falls System of Concentration Installed in Section No. 1, Washoe Concentrator, Anaconda,' by Albert E. Wiggin; 'Concentration of Slimes at Anaconda, Montana,' by Ralph Hayden; 'Application of Hindered Settling to Hydraulic Classifiers,' by E. S. Bardwell; and 'The Anaconda Classifier,' by Robert Ammon.

Personal

Professional men are invited to send news of their engagements and travels. Such news is interesting to friends.

H. F. FOX is in Michigan on a visit.

C. C. BROADWATER has gone to London.

JOHN D. RYAN has returned from Europe.

JOHN ROOKE-COWELL was in Boston recently.

JOHN B. FARISH was in New York City recently.

R. B. LAMB was at Cobalt during the week ended July 27.

C. S. HERZIG was in New York and has gone to Oklahoma.

A. E. BORIE has returned to New York from a holiday trip.

A. H. BURROUGHS, Jr., has left New York City for Nome, Alaska.

CHARLES JANIN was in London recently and has returned to Geneva.

L. D. RICKETTS has returned to New York from the southwestern states.

W. H. STORMS is in Tuolumne county, California, on a professional visit.

E. M. HAMILTON has gone to Salvador, where he will be for several months.

C. W. MERRILL has returned to San Francisco from his vacation at Lake Tahoe.

KIRBY THOMAS has been visiting Sudbury and Cobalt, and has returned to New York.

WILLIAM H. RADFORD, of San Francisco, went to Arizona on August 2 on professional work.

H. WHITTINGHAM, who has been assisting George H. Garrey on mine examination work in Mexico, has returned to El Paso.

JOSEPH MACDONALD, formerly of the Alaska Treadwell Mining Co., has been acquitted of the charge against him at Juneau, Alaska.

J. ALLEN VEATCH has returned to Napa, California, from Panama, where he has been for the past eight months investigating the oil resources of the isthmus.

GEORGE H. GARREY is in the state of Coahuila, Mexico, making a geological examination of a number of mines for the American Smelting & Refining Company.

FELIX MCDONALD, mine superintendent of the Ohio Copper Co., Utah, has resigned to take a similar position with the Inspiration Consolidated Copper Co., Arizona.

Obituary

ALFONSO A. TREGIDGO, well known among miners in Nevada county, and once president of the State Miners' Association, died at San Francisco on August 1.

FERGUSON DOAK, manager of the American Smelting & Refining Co.'s agency in the Parral district, and one of the best known mining men in northern Mexico, died on June 8 from a stroke of apoplexy.

JOHN MILNE, best known as a seismologist, but whose earlier work was in geology and mining engineering, died July 31 at his home, Shide House Hill, in the Isle of Wight, at the age of 63. He was born in Liverpool in 1850 and after graduating from Kings College and the Royal School of Mines, he engaged in mining work in Newfoundland, in the employ of Sir James Anderson, Cyrus Field, and others. Later he served as the geologist of an expedition into northwestern Arabia. In Japan, where he spent twenty years in the establishment of nearly 1000 government stations for the observation and study of earthquake phenomena, he married Tone Noritsune, daughter of the abbot of Ganjo-i, in Hakodate. His work in Japan has served to make that country the leader in the recording and study of earthquakes. Returning to England in his later years, he organized a seismic survey of the world for the British Association for the advancement of Science, and in this connection traveled extensively in Russia, Siberia, Mongolia, China, the Kurile islands, Korea, the Philippines, Borneo, Australasia, and the United States. Ripe in years and rich in honors, he goes to his long home lamented by many friends the world around.

The Metal Markets

LOCAL METAL PRICES

San Francisco, August 7.

Antimony	12—12½c	Quicksilver (flask)	$41
Electrolytic Copper	16—16½c	Tin	46—47c
Pig Lead	4.75—4.76c	Spelter	7—7½c

Zinc dust, 1400 lb. casks, per 100 lb., small lots $9.50—9.75; large $7.50—8.00

EASTERN METAL MARKETS

(By wire from New York.)

NEW YORK, August 6.—Metal market is showing an improvement generally. Copper continues strong with considerable September copper still to be purchased. A general improvement in copper stocks is to be noted, in which the Lake Superior stocks have also participated, regardless of the strike in that district. An advance of ¼c. in copper is announced. Little metal is on hand for immediate delivery. London market is reported steady. Copper opened at £68 5s. The Amalgamated and American Smelting agencies in London quote £71 10s. for September and £71 15s. for October delivery. Lead market firm and spelter strong. The Granby dividend is $1.50 for last year.

SILVER

Below are given the average New York quotations, in cents per ounce, of fine silver.

Date.		Average week ending	
July	31	June	25
Aug.	1	July	2
"	2	"	9
"	3 Sunday	"	16
"	4	"	23
"	5	"	30
"	6	Aug.	7

	59.37		58.12		
	59.25		58.20		
	59.37		58.29		
			58.43		
	59.37		58.79		
	59.25		59.28		
	59.12		59.29		

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	56.25	63.01	July	60.67	58.70
Feb.	59.06	61.25	Aug.	61.32	....
Mch.	58.37	57.87	Sept.	62.95	....
Apr.	59.20	59.26	Oct.	63.16	....
May	60.88	60.21	Nov.	62.73	....
June	61.29	59.03	Dec.	63.38	....

Silver prices have been well maintained, according to Samuel Montagu & Co., on July 17, although the undertone of the market cannot be considered as strong, for rates have been controlled by the very small size of the amounts offering from the usual channels of supply. At advancing prices, however, there is a disposition to sell with some freedom, and for that reason, much higher prices appear unlikely. Buying has been confined chiefly to the covering of sale contracts as they fall due. Indian purchases, except those made by speculators to support the market, are noticeably absent; this is only to be expected while the stock of rupees in the Indian treasuries is so plentiful. The stock in Bombay is slightly higher in value—£320,000—as compared with £290,000 last week. The offtake is about the same. The centre of interest lies rather in China, where it is said that the harvest has been good as a whole. On this account, in normal circumstances, there would be an exception of rising exchange, with the possibility of a demand for silver, but, unfortunately, as yet, trade is far from active. Shanghai reports a stock of £5,750,000, and increase of £100,000.

QUICKSILVER

The primary market for quicksilver is San Francisco, California, being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending			
July	10	July	24
"	17	"	31
		Aug.	7

	41		41
	41		41
			41

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	43.75	39.37	July	43.00	41.00
Feb.	46.00	41.00	Aug.	42.50	....
Mch.	46.00	40.20	Sept.	42.12	....
Apr.	42.25	41.00	Oct.	41.50	....
May	41.75	40.25	Nov.	41.50	....
June	41.30	41.00	Dec.	39.75	....

ZINC

Zinc is quoted as spelter, standard Western brands, St. Louis delivery, in cents per pound.

Date.		Date.	
July	24	July	31
"	25	Aug.	1
"	26	"	2
"	27 Sunday	"	3 Sunday
"	28	"	4
"	29	"	5
"	30	"	6

	5.13		5.10
	5.15		5.40
	5.18		5.40
	5.23		5.40
	5.25		5.40
	5.28		5.43

Average week ending

July	25		4.97	July	23	5.10
"	9		5.10	"	30	5.20
"	16		5.08	Aug.	6	5.40

Monthly averages.

	1913.	1913.		1912.	1913.
Jan.	6.42	6.88	July	7.12	5.11
Feb.	6.58	6.13	Aug.	6.96	....
Mch.	6.57	5.94	Sept.	7.45	....
Apr.	6.63	5.52	Oct.	7.36	....
May	6.68	5.23	Nov.	7.23	....
June	6.88	5.00	Dec.	7.09	....

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.		Date.	
July	24	July	31
"	25	Aug.	1
"	26	"	2
"	27 Sunday	"	3 Sunday
"	28	"	4
"	29	"	5
"	30	"	6

	4.35		4.50
	4.35		4.50
	4.35		4.50
	4.35		4.50
	4.50		4.50
	4.50		4.50

Average week ending

June	25		4.33	July	23	4.34
July	2		4.33	"	30	4.40
"	9		4.33	Aug.	6	4.50
"	16		4.33			

Monthly averages.

	1912.	1913.		1912.	1913
Jan.	4.43	4.28	July	4.71	4.35
Feb.	4.03	4.33	Aug.	4.54	....
Mch.	4.07	4.32	Sept.	5.00	....
Apr.	4.20	4.36	Oct.	5.08	....
May	4.20	4.34	Nov.	4.91	....
June	4.40	4.33	Dec.	4.20	....

COPPER

Quotations on copper as published in this column represent average wholesale transactions on the New York market and refer to electrolytic copper. Lake copper commands normally from 1-5 to 1-4c. per lb. more. Prices are in cents per pound.

Date.		Date.	
July	24	July	31
"	25	Aug.	1
"	26	"	1
"	27 Sunday	"	3 Sunday
"	28	"	4
"	29	"	5
"	30	"	6

	14.30		14.75
	14.43		14.85
	14.60		14.90
	14.75		14.98
	14.70		15.03
	14.70		15.03

Average week ending

June	25		14.47	July	23	13.97
July	2		14.43	"	30	14.58
"	9		14.25	Aug.	6	14.92
"	16		13.81			

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	14.09	16.54	July	17.19	14.21
Feb.	14.08	14.93	Aug.	17.49	....
Mch.	14.68	14.72	Sept.	17.56	....
Apr.	15.74	15.22	Oct.	17.32	....
May	16.03	15.42	Nov.	17.31	....
June	17.23	14.71	Dec.	17.37	....

TIN

New York prices control in the American market for tin, since the metal is almost entirely imported. San Francisco quotations average about 5c. per lb. higher. Below are given average monthly New York quotations, in cents per pound:

Monthly averages.

	1912.	1913.		1912.	1913
Jan.	42.53	50.45	July	44.25	40.70
Feb.	42.96	49.07	Aug.	45.80	....
Mch.	42.58	46.95	Sept.	48.64	....
Apr.	43.92	49.00	Oct.	50.01	....
May	46.05	49.10	Nov.	49.92	....
June	45.76	45.10	Dec.	49.80	....

According to L. Vogelstein & Co.'s report, dated August 1, it is difficult to draw conclusions concerning the probable future course of tin prices. Several facts, however, stand out distinctly. These are as concern supplies, that Straits' shipments to date are 2251 tons larger than for the corresponding period in 1912; that arrivals of Bolivian tin and tin ore in England and on the Continent are 2191 tons larger. On the other hand, Banca sales to end of July are 900 tons less than last year and Australian shipments 370 tons less; the net increased supplies from these sources being 3172 tons. Deliveries in the United States for seven months fell off 1800, and in London and Holland 550 tons; while other supplies in Europe seem to be holding their own; the net decreased deliveries being 2350 tons. The result is that, whereas the visible decreased 3168 tons, from January 1 to July 31, 1912, this year it has increased 1086 tons, a net

change for the worse of 4254 tons. Against this may be set the fact that the visible is still nearly 1300 tons less than at the corresponding time last year; while prices are £23 per ton lower in London, and 5¼c. per pound lower in New York. This fall in prices would seem to have discounted the relatively unfavorable showing of the metal except for this tendency of statistics to continually deteriorate, which will eventually result in an accumulation of stocks. Minor fluctuations will probably take place until the situation is more clearly defined.

The Stock Markets

SAN FRANCISCO STOCKS AND BONDS.

(San Francisco Stock and Bond Exchange.)

BONDS.

Listed.	August 7. Bid	Ask	Unlisted.	August 7. Bid	Ask
Associated Oil 5s	$ 97½	—	Natomas Dev. 6s	$ —	100
E. I. du Pont 4½s	83½	—	Pac. Port. Cement 6s	99	—
Natomas Con. 6s	—	80	Riverside Cement 6s	77	79
Unlisted.			Standard Cement 6s	91½	—
Ass. Oil 1st ref	76	80	Santa Cruz Cement 6s	—	81
General Petroleum 6s	55	56	So. Cal. Cement	—	85

STOCKS

Listed.	August 7. Bid	Ask	Unlisted.	August 7. Bid	Ask
Associated Oil	40½	—	Noble Electric Steel	—	3
Amalgamated Oil	85½	—	Natomas Consol	5	—
E. I. du Pont com	—	135	Pacific Port. Cement	59	—
Pac. Coast Borax, pfd.	—	—	Riverside Cement	45	—
do com	—	100	Standard Cement	—	11
Pacific Crude Oil	20c	—	Santa Cruz Cement	—	34½
Sterling O. & D.	70c	95c			

NEVADA STOCKS

(By courtesy of San Francisco Stock Exchange.)

San Francisco, August 7.

Atlanta	$ .15	Mizpah Extension	$ .40
Belcher	.24	Montana-Tonopah	1.02
Belmont	6.50	Nevada Hills	.87
Big Four	.39	North Star	.90
Con. Virginia	.10	Ophir	.19
Florence	.26	Pittsburg Silver Peak	.45
Goldfield Con.	1.60	Round Mountain	.52
Goldfield Oro	.07	Sierra Nevada	.07
Halifax	1.42	Tonopah Extension	2.25
Jim Butler	.66	Tonopah Merger	.72
Jumbo Extension	.13	Tonopah of Nevada	4.20
MacNamara	.12	Union	.09
Mexican	1.05	West End	1.22
Midway	.47	Yellow Jacket	.19

COPPER SHARES—BOSTON

(By courtesy of J. C. Wilson, Mills Building.)

	August 7. Bid	Ask		August 7. Bid	Ask
Adventure	$ 1½	1½	Mohawk	$ 43½	43½
Alloues	33½	34½	North Butte	28½	28½
Calumet & Arizona	64½	65	Old Dominion	48	49½
Calumet & Hecla	410	415	Osceola	78	80
Centennial	12	12½	Quincy	58	59
Copper Range	38½	39½	Shannon	6½	7
East Butte	12½	12½	Superior & Boston	2½	2¾
Franklin	4½	5½	Tamarack	27½	28
Granby	61	61½	U. S. Smelting	39	39½
Greene Cananea	6½	7	Utah Con.	8½	9
Hancock	17½	17½	Victoria	1	1½
Isle-Royale	19	19½	Winona	1½	1¾
Mass Copper	3½	4½	Wolverine	43½	46

NEW YORK QUOTATIONS

(By courtesy of E. F. Hutton & Co., Kohl Building.)

August 7.

	Bid.	Ask.		Bid.	Ask.
Alaska G. M.	19½	19¾	McKinley-Dar.	1¾	1⅞
Braden Copper	6¾	6⅞	Mines Co. Am.	2¼	2½
B. C. Copper	2	2¼	Nipissing	8½	8⅝
Davis-Daly	2	2⅛	Ohio Copper	½	⅝
Dolores	1	2	San Toy	20	22
El Rayo	2	4	Sioux Con.	2	4
Ely Con.	8	10	So. Utah	⅛	¼
First Nat.	2⅝	2⅝	S. O. Calif.	188	190
Giroux	1⅜	1½	Tri Bullion		⅛
Greene Can.	6	6½	Tuolumne	⅞	1
Hollinger	14½	15½	United Copper	½	1
Kerr Lake	3½	3⅝	Wettlaufer	10	12
La Rose	2¼	2⅜	Yukon Gold	2	2⅛
Mason Valley	6	8			

LONDON QUOTATIONS

(By cable, through the courtesy of Catlin & Powell Co., New York.)

	August 7. £	s.	d.		August 7. £	s.	d.
Alaska Mexican	1	17	6	Kern River Oilfields	0	5	0
Alaska Treadwell	7	17	6	Mexico Mines	5	5	0
Alaska United	3	15	0	Messina	1	10	0
Arizona	1	18	9	Oroville	0	5	0
California Amalg.	0	2	6	Pacific Oilfields	0	2	6
California Oilfields	4	0	0	Rio Tinto	73	5	0
Camp Bird	0	15	0	Santa Gertrudis	0	17	6
El Oro	0	13	9	Stratton's	0	2	6
Esperanza	0	16	9	Tanganyika	–	–	–
Granville	0	10	0	Tomboy	1	6	3

AUSTRALIAN

	August 7. £	s.	d.		August 7. £	s.	d.
British Broken Hill	2	0	0	Mount Boppy	0	15	0
Broken Hill Props.	1	15	0	Mount Elliott	5	5	0
Golden Horse-Shoe	2	12	6	Mount Lyell	1	10	9
Great Boulder Props.	0	12	6	Mount Morgan	3	10	0
Ivanhoe	2	16	9	Waihi	2	5	0
Kalgurli	1	17	6	Waihi Grand Junc.	1	1	3

Following the strike of the Lake Superior miners, copper prices took a sharp upward turn, reaching 15c. per lb. the last week in July, and continued upward to 15¼c., where it was firmly held on August 2, the American Smelting & Refining Co. asking the equivalent of 15⅜c. abroad. Since buying was resumed, over 150,000,000 lb. of copper has changed hands, mostly for the account of foreign consumers. The foreign buyers, indeed, are reported to be trying to buy for deliveries up to January 1 next, but have been unable to get beyond October copper. The London market showed a decline toward the end of the week, but this was entirely speculative and had no effect in New York. At this writing, the Lake Superior strike promises to be protracted, and it must be remembered that its effect on stocks will be almost immediate, for not much of the Lake copper needs refining. This takes 18,000,000 lb. of copper off the monthly output, and as it will be a month yet before the Nichols refinery is back to its normal output, next month's figures should show a marked effect. Exports of copper for July, as reported by the Custom House, were 65,000,000 lb. Speculations as to the Copper Producers' figures for this month incline toward a 15,000,000 lb. increase in the surplus. Shares in copper mines elsewhere than in the Lake district rose as a result of the better price of copper, and the temporary disqualification of the Lake mines. Speculators in Lake shares are wondering whether the lowered price of Lake issues is only temporary or whether it presages a permanent decline in the importance of the Lake district. Either in sympathy with copper, or because of the good demand and small stocks, lead has also advanced from 4.35 to 4½c., the American Smelting & Refining Co. having set the price of pig lead at the latter figure.

The half-yearly reports, to June 30, 1913, of several of the Lake Superior copper companies contain the following information:

	Ahmeek.	Centennial.	Superior.
'Rock' stamped, tons	322,551	62,323	76,572
Copper produced, pounds	7,893,340	1,135,000	1,705,000
Mining cost per lb., cents	6.03	10.50	10.72
Construction	2.71	....	0.68
Smelting, freight, etc.	1.27	1.65	2.15
Total cost per lb., cents.	10.01	12.15	13.55
Profit	$421,000	$32,000	$37,000
Dividends	350,000	.....	.....

JULY COPPER PRODUCTION

	Pounds.
Anaconda group	22,100,000
Chino	4,831,185
Miami	2,890,000

On August 4 the Bunker Hill & Sullivan Mining & Concentrating Co. paid dividend No. 191, of $65,400. This makes the total amount of dividends paid $14,434,950.

Company Reports

FEDERAL MINING AND SMELTING CO.

Earnings of the Federal Mining & Smelting Co for the six months, September 1, 1912, to March 1, 1913, were approximately $520,000. This averages $86,500 per month, or at an annual rate of 8½% on the preferred stock. The Company is now paying 6% on its preferred stock. The Company has entered into agreements to purchase several new properties, details and the arrangements of which are as follows:

The interests of Richard Wilson and Walter McKay in the Cleveland group of claims, situated near the town of Mace, and adjoining the Standard-Mammoth, were purchased on September 14, 1912, for the sum of $180,000 in cash. Negotiations for the purchase of these interests had been carried on for several years. The interest purchased by the Federal company was thereupon consolidated with the remaining interests in the Green Hill Cleveland claims and put into a company called the 'Green Hill Cleveland Mining Co.', which started operations toward the end of September. The Federal company has already received back its $180,000, and the property of the Green Hill Cleveland Mining Co. is now in position to earn and pay substantial dividends to its stockholders; the Federal company being the owner of one-half of the capital stock.

Negotiations for the purchase of the Helena-Frisco property at Frisco, which is adjacent to the Mace properties, have been carried on for several years and were completed on December 12, 1912, by the payment of $100,000 and an agreement to expend $150,000 for development purposes and in the rehabilitation of the mining plant. This property contains a large tonnage of zinc ore, value of which is in excess of the total of the above figures, according to the estimates of reliable engineers. Possibilities for exploration and development of the new vein, called the Cape Horn vein, recently discovered therein, together with the prospect of finding orebodies in a second known vein, called the Black Bear vein, should result in great benefit and advantage to the Federal company.

Between January 13 and March 14, 1913, negotiations were concluded with more than 96% of the stockholders of the Star Mining Co., a property near Mullan, and adjacent to the Morning and You Like mines of the Federal company, for an option to purchase their stock in the Star Mining Co., conditioned upon certain payments to be made and work to be done by the Federal company, over a period of about three years. The first payment was 1c. per share and did not exceed $10,000. Under the terms of the option, the Federal company has the right to enter into the property of the Star company and do what exploration and development work it considers necessary. By reason of the fact that the mining property of the Star company is contiguous to the Morning mines of the Federal company, the development work upon the property of the Star company can be advantageously and economically conducted by extending the work of the Federal company in its Morning mines into the property of the Star company.

The Federal company has obtained an option to purchase at least 51% of the capital stock of the Flynn Group Mining Co. Part of this stock has already been issued to the stockholders of that Company and part of it is treasury stock. Under the terms of the option, the Federal company has the right and privilege of expending all the money paid by it for the treasury stock in the development of the property owned by the Flynn company. This property is adjacent to the Frisco property, and will be developed by the extension of the underground workings of the Frisco. The orebodies of the Frisco and Flynn properties run very high in zinc. The Federal company has no contract for its zinc ores and sells them in the open market. The zinc product of the Morning mines goes at the present time to the plant of the Beer-Sondheimer Co. at Bartlesville, Oklahoma. It is expected that the Company's policy of extending its holdings without spending or risking any considerable amount of its surplus, will be continued.

BULLFINCH PROPRIETARY (W.A.), LTD.

This Company was formed in 1910 to acquire the Bullfinch gold mines, about 1381 acres, in the Yilgarn goldfield, Western Australia, on the railway line from Perth to Kalgoorlie. The report for 1912 gives development work for the year as 4123 ft., which with 1085 ft. of diamond drilling gives a total of 5208 ft. The gold content of the No. 1 series orebody was disappointing, but developments on the No. 3 series were satisfactory. The vein in the northwest drift, 447 ft. north at 310-ft. level, which has been driven on for 28 ft. and averages $15.60 per ton over a width of 68 in., with ore standing in the sides, seems to be a strong body of quartz with the appearance of persistence in depth. Ore reserves above the 210-ft. level total 158,313 tons averaging $12.42 per ton. Owing to the draining of the salt water supply in the mine, it was necessary to approach the Government for a permanent water supply. The laying of the government water pipeline is now completed. Development has been restricted

BEGINNINGS OF THE BULLFINCH.

owing to the concentration of labor upon the completion of the plant. The plant commenced crushing on February 15, and for the first period of six weeks to the end of March 1913 crushed 5178 tons, giving a profit of $49,000. The April crushing returned a profit of $39,000 from 4343 tons. Up to May 30, 1913, 15 stamps and one tube-mill have been running, and 5 more stamps and another tube-mill are now being installed. When these are completed a mill capacity of 6000 tons of ore monthly is expected. Diamond-drilling work to obtain a water supply was carried on during the year, nearly 1100 ft. of hole being drilled without results. The balance-sheet shows assets of property account $11,929,000; machinery and plant, $230,000; buildings, $29,000; shaft-sinking, $29,000; mine development and general expenditure account, $182,000; stores, etc., $31,000; a total of $2,430,000; and liabilities of issued capital, 476,150 shares at $4.80 each, fully paid, $2,285,520, and sundry creditors, $28,500.

KYSHTIM CORPORATION, LTD.

KYSHTIM MINING WORKS CO.

The Kyshtim Corporation, with a capital of £1,260,000 in £1 shares, was formed in 1908, to acquire the Kyshtim Mining Works Co. which was organized in Russia in 1900, and owns copper mines and smelters, iron mines and smelters, gold deposits, timber and forest land, and ranch lands, in the Government of Perm, in the Southern Ural mountains.

The report of the Kyshtim Mining Works gives the gross receipts for the year as £1,221,379, against total expenses of £752,978, resulting in a profit of £468,401 for the year. The most important branch of the Company's operations is now the copper department. Special attention has been devoted to the work of searching for and prospecting new ore deposits, and last year this work met with conspicuous success in the discovery of the Amerikansky mine, situated in the Soymanofsk valley near the present mines and smelter; preliminary prospecting and development work here have so far proved the existence of more than 500,000 tons of ore, probably of somewhat higher

value than the average of the ore from the other mines. The total reserves of copper ore now amount to more than 2,500,000 tons, averaging about 3% copper, 0.1 oz. of gold, and 1 oz. of silver per ton. With a view of proving the persistence in depth of the present known copper deposits, extensive drilling operations have been authorized, by which drill-holes to a depth of 1500 ft. will be put down on these deposits. Smelting is now concentrated at Karabash; at Upper Kyshtim works where, up to April of last year, blister copper was also being produced, only flue-dust and fine ore are now being treated in reverberatory furnaces, and the matte thus produced is shipped to Karabash for treatment in the blast-furnaces. Three McDougall roasters for fine ore have been installed at the Upper Kyshtim works. The capacity of the Karabash plant was increased in 1912 by the addition of a third water-jacketed furnace. During the current year the construction of a reverberatory plant at Karabash for the treatment of flue-dust and fine ore will be undertaken, and also the installation of six McDougall roasters to serve the reverberatory with hot calcine. The completion of this work will admit of a yearly production of about 10,000 tons of copper from the Kyshtim estates. All the copper produced is electrolytically refined at Lower Kyshtim works. In 1912 the Company produced 7547 tons of electrolytic copper; including slime recovered from the refining of copper, the profit amounted to £538,563. Mining costs show a small increase, as was to be expected with increasing depth; smelting, an increase of 8 pence, due chiefly to increased cost of fuel and flux at both smelters. The net cost, after deducting the precious metals, was £22 per ton in 1912. The total profit of the iron department was £26,274. For 1912 the trading profit realized by the forest department amounted to £8705, and also 19,577 tons of barren pyrite was sold in 1912, showing a net profit of £5811.

MONTGOMERY-SHOSHONE CONSOLIDATED MINING COMPANY

The stockholders present at the February 14, 1912, meeting of this Company unanimously voted to sell all the machinery and other perishable or removable property of the subsidiary companies in the state of Nevada and to pay the proceedings over to the Consolidated company on account of their existing indebtedness to it. This would render it possible to reduce expenses substantially; to leave in the treasury of the Company an amount sufficient to protect the interests of the stockholders of this Company for a period of years, pending any possible future developments which might give value to the mining or other properties of this Company, and to use the balance to wipe out the existing indebtedness of the Consolidated company by a composition or settlement, thus leaving the Consolidated company out of debt, and insuring the return to its treasury of the stock of the subsidiary companies now pledged as collateral.

The following is a consolidated statement of the cash transactions of this Company and its subsidiary companies during the calendar year 1912:

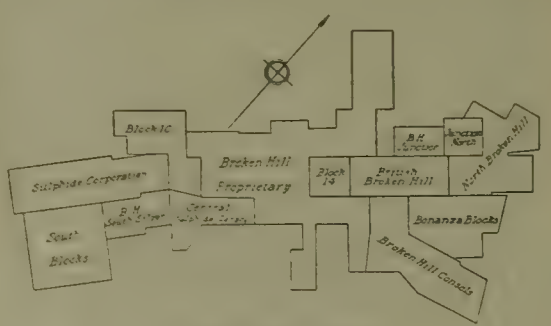
Aggregate of cash in treasuries on January 1, 1912		$25,364
Receipts from sales of machinery, equipment and supplies		9,489
Receipts from interest, rentals, and miscellaneous minor items		793
Total		$35,646
Western expenses	$5,426	
Eastern expenses	1,804	
Old accounts paid	506	
Payments on account of contract above referred to	$8,443	$16,179
Balance in treasuries		$19,467

Of the above balance $13,463 has been invested in U. S. Steel Corporation sinking fund 5% coupon bonds and the remainder consists of cash in bank and on hand.

BRITISH BROKEN HILL PROPRIETARY CO., LTD.

This Company operates a silver-lead-zinc property in New South Wales, and the report covers the half-year ended December 31, 1912. The general manager, C. J. Emery, reporting on the operations for the half-year, states that the greater part of the development work was carried out around Thompson's shaft, in the main orebodies. A later report is issued by G. C. Klug, the managing engineer for Bewick, Moreing & Co. The general testimony is to the satisfactory development of the mine, auguring well for the realization of anticipations regarding the continuity of ore lenses north of Thompson's shaft. The southern part of the western lens is merging into a large body of rhodonitic low-grade sulphide ore, but the lens itself is continuing with depth, on a fairly flat angle of pitch. The eastern lode-channel is proving itself consistent, and several lenses of milling ore are being developed. On No. 10 level, the lowest in the mine, the cross-cut had intersected the southern portion of the main western orebody. As in the upper levels, this orebody was of a rhodonitic nature. The cross-cut also passed through a lens of good ore in the east lode-channel. From the evidence revealed by this cross-cut, it is apparent that the western and eastern orebodies are approaching each other in depth.

The development of the northern portion of the mine is



BROKEN HILL DISTRICT.

of great importance, and a satisfactory arrangement has been made with the Junction company, whereby this work can be started from Browne's shaft at No. 6 level. The mine is opening well on No. 2, 3, and 5 levels, south of Thompson's shaft; and in the south end of No. 2 level ore has been opened in the eastern lode channel.

It is intended to remodel the lead mill, and install the Minerals Separation process in the zinc plant. Tube-mills will be installed and concentrating tables increased. The remodeled treatment plant should have a capacity of 20,000 tons of ore monthly. Operations resulted as follows:

Development, feet	1,955
Diamond-drilling, feet	4,288
Ore reserves, tons	2,000,000
Ore milled, tons	103,680
Average content:	
Lead, per cent	13.2
Zinc, per cent	11.7
Silver, ounces	7.3
Lead concentrate produced, tons	15,003
Recovery of lead, per cent	68.8
Zinc tailing treated, tons	49,238
Zinc concentrate produced by Elmore process, tons.	13,386
Average content:	
Zinc, per cent	40.2
Lead, per cent	11.7
Silver, ounces	11.4
Recovery of zinc, per cent	78.0
Metal production:	
Lead, tons	10,989
Zinc, tons	6,379
Silver, ounces	516,096
Revenue from concentrate sales, etc.	$912,000
Profit	293,000
Dividends (reserve account drawn on to make up).	518,000
Surplus of liquid assets	734,000

Concentrates

Most of these are in reply to questions received by mail. Our readers are invited to ask questions and give information dealing with the practice of mining, milling and smelting.

SLATE AND SHALE are used to a considerable extent in the manufacture of pigments and as fillers in the manufacture of oilcloth and linoleums.

CONCRETING the 5-compartment Junction shaft of the Calumet & Arizona company, which was commenced at the 1500-ft. point eight months ago, is now within 250 ft. of the collar, and should be finished in 30 days.

ELECTRIC POWER is supplied the Arizona Commercial mine by the Old Dominion company for hoisting at 2.5c. per kw. hour, and compressed air for pumping and drilling at $35 per 1,000,000 cu. ft. of free air. Pumping is to be done by electric power instead of air.

ORE TRANSPORT from the Hannan's Star mine and the Lake View mill, Kalgoorlie, a distance of one mile, is done by means of a 9.5-ton Koppel locomotive and side-tipping cars of 2.1-ton capacity. The costs are per ton of ore: labor, 1.80c.; repairs, 1.16c.; fuel, 0.74c.; and stores, 0.28c., a total of 3.98c. per ton. The quantity of ore carried averages 9615 tons per month.

FURTHER experiments with the volatilization process at the Gwalia Consolidated mine, Western Australia, are encouraging. Apparently the antimony in the ore aids volatilization of the gold, as tests hitherto have not been successful in roasting clean pyritic ore with salt. At Hillgrove, New South Wales, metallic antimony reduced from flue-dust (oxide of antimony) contained an appreciable quantity of gold.

EXTENSIVE experiments are being made for the purpose of securing a higher extraction from the manganese ores of El Favor mines, Jalisco, Mexico, and several promising methods are now being tried, the best of which seems to be from the work of the Massachusetts Institute of Technology where tests indicate that a much higher percentage can be saved through magnetic concentration. This process is now being thoroughly tried by Walter Neal.

CHINESE AND FOREIGN CURRENCY is to be excluded from Hongkong. The standard of currency since 1895 has been the British silver dollar, equal to about 48 cents United States currency. It weighs 416 gr. and is 900 fine. There are also the 50, 20, 10, and 5c. silver coins, and 1c. copper pieces, and were made by Indian mints. Of course, the British sovereign, $4.86, passes at Hongkong. On December 31, 1912, there was in circulation in the colony $36,992,370 in Hongkong currency.

STOPES in the Chief Consolidated mine, Utah, are large as a rule, being from 40 to 50 ft. in width, and they are carried from level to level as the ores make in vertical position. It is the plan to fill in all stopes to within one set of the backs, thereby eliminating any possibility of injury to the men and any loss of stopes and ore as might occur at any time under the old system. The lime walls are very unstable and full of irregular fissures, which makes plain timbering insufficient at times to properly hold the ground.

ANALYSIS of a carload of ore from the Tough Oakes mine, Kirkland Lake district, Ontario, made by Campbell and Deyell, shows the following composition: SiO_2, 78.45%; FeO, 2.90%; $Na_2O.K_2O$, 2.62%; Al_2O_3, 5.92%; $CaCO_3$, 2.75%; $MgCO_3$, 2.75%; $MnCO_3$, 0.26%; $FeCO_3$, 0.21%; $CuFeS_2$, 0.09%; FeS_2, 3.20%; Ag_2S, 0.14%; MoS_2, 0.68%; PbTe, 0.17%; and alloyed metals, gold, 0.008%, and silver, 0.077%; a total of 99.975%. The altaite is a lead telluride, and no trace of gold was obtained from it, and less than 0.5 oz. per ton of the mineral in silver. The dark mineral in the ore, supposed to be graphite, was molybdenite.

EXPERIMENTS were made by the Phthisis Prevention Committee of the Rand to find out the amount of dust at different times, before blasting, after blasting, during drilling, and so on. They show that the most serious dust is created by the blasting and then by drilling. Repeated microscopic examination of lungs of silicosis victims have been made, and comparisons have been instituted between the physical characteristics of extraneous mineral matter in these lungs and the dust arising from various mining operations. At the present time it may be provisionally stated that dust originated by blasting most closely resembles the dust incarcerated in silicosic lungs. Dump dust, dust from compounds and streets, are not characteristics present in silicosic lungs.

FREQUENT mistakes are made in examination of rocks, according to H. A. Buhler, state geologist of Missouri, and mining swindles are promoted thereby. Dark, fine-grained igneous rocks have been passed off as valuable tin ore; the yellow color of pyrite has been taken for gold; a yellow stain on rocks passed as gold; also small specks of yellow mica have caused much excitement; white marcasite, a sulphide of iron, is often mistaken for native silver; many green silicate minerals are often taken for copper ore; limestone and chert are mistaken for carbonate of zinc and lead sulphate; and many oil excitements are the result of finding a slight scum on the surface of stagnant pools, caused by iron. It may also be stated that tellurides of gold and silver are often suspected in rocks containing specular iron.

PLUMBAGO is a considerable source of revenue to the Ceylon government, as there is an export royalty on it of 0.25 rupee per hundredweight (about 8½c. per 112 lb.). It is Ceylon's most important mineral product. For the benefit of the industry, the Government arranges for the inspection of every working plumbago mine once in six months. The miners are advised generally as to their operations, and no mine is allowed to be worked which is considered unsafe. Information is afforded as to the mineralogy of plumbago districts. Skilled plumbago miners work for about 25c., laborers for about 17c., and cleaners for about 6c. per day. During 1912, exports of the mineral from Ceylon totaled 73,420,800 lb., valued at $2,782,262, of which the United States took about 40%, most of the balance being taken by Germany and England.

Selective mining has received attention on the Rand, and an attempt to justify its introduction was made as a reply to the criticisms advanced against it by Lord Harris at the last annual meeting of the shareholders of the Consolidated Gold Fields of South Africa. No one can reasonably object to the adoption of selective mining methods when the gold contents and mining conditions justify it, but even the mines controlled by the Rand Mines, Ltd., although comprising nearly all the higher-grade mines, do not in every instance lend themselves to its successful adoption. The pioneer of selective mining among the Rand Mines group was the Village Main Reef, where at the present time the average monthly working profits have been reduced to $144,000 from $240,000 six months ago, and it is doubtful whether the higher level of profits will ever be reached again. Another mine belonging to the same group, the Geldenhuis Deep, was attempted to be worked by selective mining with disastrous results, while the reversion to normal methods of mining has practically put the mine on its feet again. It is therefore evident that, even among the mines controlled by the Rand Mines, the adoption of strict selective mining will not always bring the anticipated success; and, as pointed out at the meetings of the Consolidated group, there are many low-grade mines on the Rand where the adoption of selective mining is quite out of the question. No one can, of course, dispute the fact that in numerous cases broad selective mining is unavoidable, but when it is adopted with the object of temporarily increasing the profits and to influence the market, it cannot be too strongly condemned.

Production Statistics

ANTIMONY

No antimony has been produced in the United States from domestic ore and no domestic antimony ores have been mined and marketed since 1907, so far as can be learned by the United States Geological Survey, though a little metallic antimony was at one time saved as a by-product in the electrolytic refining of lead ore. None was reported, however, as saved during 1912 or 1911, according to Frank L. Hess. Imports during the year were: metal and regulus, 13,936,873 lb.; crude antimony and ore, 1,562,066 lb.; and oxide and salts of antimony, 1,759,908 lb., with a total value of $940,994.

ARSENIC

In 1912, as in the four preceding years, the only white arsenic (arsenious oxide, As_2O_3) produced in the United States was that made by the Anaconda Copper Mining Co., the American Smelting & Refining Co., and the United States Smelting, Refining & Mining Co. as a by-product at their smelters. They made a total of 3141 short tons, valued at $190,757, an increase of about 9 tons in quantity and of $117,349 in value over the record production of 1911, during which year the output was 3132 tons, valued at $73,408. The prices given in the returns averaged 3.07c. per pound f.o.b. New York, but ranged from 2.43 to 3.28c. per pound. Imports of arsenic or arsenious acid were 6156 short tons, and 81 tons of paris green and london purple, valued at $435,691.

SELENIUM

Only one smelting company reported the production of a considerable quantity of selenium in 1912, though one other company made a few pounds, and on this account the quantity may not be given. The value was estimated at $2.50 per pound. No selenium is known to have been imported.

As heretofore, the selenium produced was obtained from the anode muds left in the electrolytic refining of copper. Although selenium minerals are rarely or never found in copper deposits, nearly all copper bullion made from sulphide ores carries a little of the element. At Ducktown, Tennessee, as at most places, selenium has not been detected in the copper ores, but some of the sulphuric acid made from the sulphurous gases is given a pink or reddish tint by selenium.

Selenium is used principally in making red glass, enamels, and glazes. Small quantities are also used in photometers and electric apparatus.

BISMUTH

No production of bismuth ore in the United States during 1912 was reported to the United States Geological Survey, but one lot which was taken from the Highland Mary mine at Leadville, Colorado, in 1911 was sold in 1912. The ore was rich in gold and carried 15.47% of bismuth in the form of carbonate.

The American Smelting & Refining Co. and the United States Metals Refining Co. both produced a considerable quantity of bismuth as a by-product during the year, and it seems possible that in time enough bismuth may be produced from the various smelters to supply the domestic market. Heretofore large buyers have claimed that they could not safely buy bismuth from American producers, for should they do so and should the American producers be unable to continue supplies, the agents of the foreign sellers would thereafter refuse to sell bismuth to them, and the lack of a constant supply has always been a possibility to be feared.

Bismuth occurs generally in small quantity, but in some lots in considerable percentages with gold and silver ores at various places in Colorado and other Western states, and with lead ores in Utah. When these ores are smelted the bismuth may be collected in the lead bullion. From this bullion the bismuth is obtained in the anode muds in electrolytic refining.

Bismuth also occurs with the copper ores of the Butte region and, as has been frequently noted, in the aggregate a large quantity passes out of the smelter stacks with the fumes. Some remains in the copper bullion and is found in the anode muds of the electrolytic refineries. Imports were 182,840 lb., valued at $316,440.

TALC AND SOAPSTONE

Talc and soapstone are closely related mineralogically. Talc is a definite mineral of which soapstone, as the term is generally used, is only an impure massive form, according to J. S. Diller of the United States Geological Survey.

Talc is a magnesium silicate, $H_2Mg_3(SiO_3)_4$, containing silica 63.5%, magnesia 31.7%, water 4.8%. It has a foliated structure, with pearly lustre on its cleavage face, greasy feel, and may be easily scratched by the thumb nail.

In talc-schist the folia of talc are arranged approximately parallel to the schistose structure and form rock masses that split readily into flat fragments. In other places the talc folia are not parallel, but lie in all directions, bind the mass more firmly, and give the rock a coarse to fine granular texture and a massive structure which characterizes soapstone (steatite), and enables it to be sawed into slabs for various manufacturing purposes.

Talc is generally mined in small fragments by underground methods, while soapstone is generally quarried in large blocks in open pits. The production of talc and soapstone was 133,289 tons, worth $1,097,483, and 25,981 tons, worth $609,480, respectively.

GYPSUM

Gypsum deposits are widespread in the United States. This mineral, in quantity sufficient to be useful, is reported as occurring in the following states: Alabama, Arizona, Arkansas, California, Colorado, Florida, Iowa, Kansas, Louisiana, Michigan, Mississippi, Montana, Nevada, New Mexico, New York, Ohio, Oklahoma, Oregon, South Dakota, Texas, Utah, Virginia, and Wyoming. The producing localities east of the Mississippi river are central and western New York, northern Ohio, two areas in the southern peninsula of Michigan, and southwestern Virginia. West of Mississippi river gypsum was mined in thirteen states in 1912. It is also mined in southeastern Alaska and shipped to a mill at Tacoma, Washington.

The production of crude gypsum reported for 1912 exceeds that of any previous year, according to the United States Geological Survey. The progress of the gypsum industry has been marked, although somewhat irregular. Increased production has not been recorded every year, but the gain made in good years more than offsets the decrease of less prosperous seasons. The number of short tons of raw gypsum mined in 1912 was 2,500,757, an increase of 176,787 tons over the 2,323,970 tons mined in 1911. The gypsum sold without calcining and used principally as land plaster and as an ingredient in portland cement and in paint, amounting to 441,608 short tons, valued at $623,522, showed an increase in quantity of 54,128 tons, and in value of $34,043, as compared with 387,480 short tons, valued at $589,410 in 1911; and the material calcined for plaster increased in quantity 133,256 short tons and in value $67,830. The total value of gypsum and gypsum products in 1912 was $6,563,908, as compared with $6,462,035 in 1911, an increase of $101,873.

Imports totaled 412,697 short tons of unground and 3702 tons of ground or calcined gypsum, together with $38,589 of manufactured plaster of paris, was valued at $488,481.

INFUSORIAL OR DIATOMACEOUS EARTH and tripoli produced in the United States in 1912 was valued at $125,446, compared with $147,462 in 1911. The earth is largely used as an absorbent of nitroglycerin in dynamite manufacture. It is composed largely of silica, is a variety of opal, and represents the remains of certain aquatic forms of plant life known as diatoms. Tripoli is a light, porous, silicious rock, supposed to have resulted from the leaching of calcareous material from the silicious limestones, and is used as an abrasive, in the manufacture of filters, and in the paint industry as a wood filler and for enameling.

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EDITORIAL

THAT the United States has no monopoly on the conservation movement is evident from a recent report from China to the effect that the new republic is adopting conservation measures for the protection of natural resources in the Hwai River basin.

AS a profitable field for legal exploitation, mining and the allied industries are at present supplying bonanza claims. Just why a small fee of $100,000 should be considered exorbitant and out of the ordinary for patching up a difference between two mining companies is a question which the courts of Utah will decide in the near future.

THE California State Mining Bureau is about to undertake the preliminary work involved in a thorough examination of the mineral resources of the state. As this work is the first of its kind to be undertaken since 1896, such a report will be a welcome addition to the literature and information now available on the subject. The program includes a detailed canvass of the mines, quarries, and mineral springs as to their present status and future possibilities.

THE last report of the Mount Morgan Gold Mining Company shows that this famous old Queensland property is far from that stage of existence which would warrant Oslerization. With a past record of £8,079,166 paid in dividends, and the present rate of 20 per cent on a capitalization of £1,000,000, together with 3,526,000 tons of auriferous copper ore in reserve at the beginning of the year, the property is far from being 'played out.' The grazier who sold this property to the Morgan brothers in the early eighties for £640 evidently did not realize that the lamb with the golden fleece was within his fold at that time.

IN the ordinary conduct of mining operations it is seldom that a prospect becomes a mine, and more seldom that a prospect becomes a dividend paying investment. The fact that there are, however, notable exceptions to the rule, has made possible the mining industry as we have it today, as well as resulting in financial gain to at least some portion of the investors. As a property belonging to the latter class, we take pleasure in recording the mining and milling operations of the Seoul Mining Company in the present issue, which in less than four years has paid the shareholders in dividends the total of the $400,000 of the stock issued. While Korea is not numbered among the important mineral producing countries of the world, the explora-

tion and development work which has been done in recent years in that country would indicate that it does present great possibilities for the future.

THAT the federal ownership of railways is not always an ideal solution of transportation problems is being demonstrated in Argentine, where the administration of the national transportation system has recently been acknowledged a failure. The Government is now contemplating the rental of the national lines to private companies under leases of 60 years duration in the hope that a change of administration will result in the efficiency of this system being raised to the standard of those controlled by private enterprise. As railroads are the all-important factor in the development of natural resources, a change such as proposed that will result in the extension of the lines and the development of new territory will be welcomed by those having interests in that part of the world.

THERE seems to be considerable misunderstanding and some dissatisfaction with the new Alaska mining laws as passed at Juneau and which went into effect on August 1 of the present year. The law as applied to placer mining is a combination of the old and new federal codes, together with the new territorial laws which went into effect the first of this month. The chief clauses in dispute are those in regard to the power of attorney and the question of assessment work. Under the new law it is permissible for a locator with a recognized power of attorney in his possession to locate two claims for each power of attorney which is held, he being limited to two such powers of attorney. It is thus possible under the new law for one person to locate six claims of 20 acres each during each calendar month. It is required under the present law that, before the end of the year in which the claims were located, the locator do $100 worth of assessment work on each individual claim which has been located. The law also provides that no placer claim can be patented which contains a larger area than that fixed by law nor which has a length that is more than three times its greatest width. This clause makes impossible the 'shoe-string' locations of former days.

Mexican Metal Production

As the mineral exported from Mexico presents a true index of production, it is interesting to note the figures as presented in a recent bulletin of the Department of Statistics of the federal government covering the first ten months of the fiscal year ended July 1, 1913. The gold exportation during this period amounted to ₱32,863,703, which is a decrease of ₱9,783,063, or about 22 per cent from the amount of gold exported during the same period of the preceding year. While silver exports show an increase of ₱5,920,780 for this period, the increase is due solely to the great increase in the exportation of silver coin, and as a result this figure has no relation to the production. The silver bullion and that exported as concentrate and alloyed with other metals amounted to ₱70,195,369, which is a decrease of ₱3,526,768. Copper production, however, has shown a notable gain, as is evidenced by an increase in the exports, for the period under review, of ₱5,027,698 over that of the corresponding months of the preceding year. Copper has, of course, suffered less than the precious metals, in that the bulk of the output is obtained from a comparatively few districts which have been in almost continuous operation during the period: Cananea, Boleo, Moctezuma, and the Mazapil companies being the chief producers. The last Company has been forced to suspend operations recently because of rebel activity in the district, which will have an important effect upon the copper production of the country. Lead and zinc have shown a decrease of ₱846,154 and ₱206,272, respectively, for the ten months under review. This is equivalent to a 16 per cent reduction in the lead exports and a 26 per cent reduction in zinc. Graphite mining, while in its infancy in Mexico, has the best record of any of the metals from the standpoint of increase in production. While this branch of mining has not reached that state of productiveness where it has become an important factor in the mineral wealth of the country, it is, however, making a beginning even under existing conditions. The exports of graphite during the period under review amounted to ₱222,346, as compared with ₱16,200 for the same period of the preceding year. The gold exportation for the past ten years varies from ₱23,857,612 in the fiscal year 1902-03 to ₱62,090,505 in the year 1910-11, and the silver exportation varies from ₱65,523,645 in 1904-05 to ₱125,400,083 in 1905-06, which was an exceptional year from standpoint of output. The average exportation of silver during the past ten years has been about ₱86,000,000 annually and that of gold has averaged about ₱35,700,000. Although the reduction in silver and gold export is significant and indicates a decided decline in the precious metal mining industry during the past year, it is not as serious as might be expected under the conditions which have prevailed in Mexico.

Sulphuric Acid Leaching

By one of the frequent vagaries of circumstance it is with sulphuric acid leaching, which has been tried times without number with at best but limited success and most commonly with no success at all, that much of the most promising experimental work on the extraction of copper from its ores by wet methods is being done. On the face of it, this method seems the simple, easy, and obvious means to employ. It is one of the classic theorems of economic geology that iron and copper sulphides oxidize on exposure to the air, yielding free sulphuric acid which takes the copper into solution as sulphate and carries it away to take part in other reactions, possibly the forming of a rich copper orebody. At Rio Tinto this natural reaction is utilized in a metallurgical process for the recovery of copper, and from time immemorial it has been customary to recover copper from underground waters by causing them to flow over scrap iron. Except under special circumstances the use of sulphuric acid to dissolve copper from its ores, subsequently precipitating the copper from the sulphate solution, has miserably failed to

meet that inflexible definition of metallurgy as the art of making money out of ores. In attempting to make sulphuric acid the basis of a general process such as the use of cyanide solution for the recovery of gold, a host of technical difficulties are met, many of which are apparently insuperable that have so far, except under special circumstances, combined to prevent the successful use of this method. So much buncombe regarding leaching processes for copper is to be heard or seen that it will be well worth while to review the facts.

The first difficulty with sulphuric acid as a solvent for copper ores is that it will not attack metallic copper, fresh unaltered sulphides, or chrysocolla. The last is somewhat in doubt, as apparently the acid will attack some varieties of chrysocolla, though it is maintained, with some show of reason, that these are not true chrysocolla, but an intimate mixture of a large quantity of malachite with a small quantity of chrysocolla. Cuprite also is not soluble in sulphuric acid, though the oxide of copper formed in roasting sulphides is soluble. Now as a matter of practical fact, in dealing with a copper orebody of profitable size it is usually necessary to deal with the whole range of copper minerals, oxides, carbonates, silicate, metallic copper, and sulphides ranging from chalcocite to lean chalcopyrite. To attempt to use sulphuric acid on such a melange as this is like trying to put salt on the collective tail of Noah's ark. Where nature has been especially kind the use of sulphuric acid is feasible. Thus at Chuquicamata the copper occurs as a basic sulphate which is easily soluble in acid; at other places considerable bodies of carbonate ore occur and the amount of insoluble copper mineral present may be small enough so that the copper recovered may be enough to yield a working profit. At times an ore may be concentrated in the ordinary way, and leaching applied to the tailing, which is largely composed of oxidized minerals, as at the Arizona Copper mill at Clifton. But as a general thing the presence of metallic copper or unaltered sulphides will make ordinary leaching with sulphuric acid unprofitable.

Assuming that it is practicable to dissolve with H_2SO_4 the copper present in the ore, a fresh crop of difficulties is encountered. The acid not only dissolves the copper, but a variety of ore substances present in the ore as well. Thus clayey minerals will be attacked yielding aluminum sulphate, and iron oxides will be in part converted into ferrous sulphate. These and other substances remain in solution when the copper is subsequently precipitated and accumulate to such an extent that the solution becomes so foul that it must, in part at least, be thrown away. Sulphuric acid is now worth about $7 per ton at the copper and zinc smelters where it is being produced; at more remote places its cost may considerably exceed this figure. It is easily seen that the cost per pound of copper for the sulphuric acid thus consumed is an important item of working cost. Various schemes have been tried to prevent this loss of acid, but no general remedy has yet been devised. The iron thus dissolved is a source of further trouble in case it is desired to precipitate the copper from the solution by means of electrolysis. When the current is passed through the solution, copper is precipitated and SO_4 ions are released which oxidize the ferrous sulphate present to the ferric state, and the ferric sulphate promptly redissolves the copper, reducing itself to the ferrous state again. The ultimate result is much like that of a puppy chasing its tail, and converts the electric energy into useless heat. Some promising work is being done on the use of porous diaphragms to prevent the ferric sulphate reaching the cathode; but while effective these increase the resistance of the cell and merely alter the difficulty without solving it, though it is possible that a satisfactory solution may be found. Another troublesome difficulty in electric precipitation is the securing of a satisfactory substance for an anode. The best that has been found is lead, but even when this is used it is slowly converted into the peroxide of lead by the oxidizing reaction mentioned above and is gradually destroyed. The peroxide can be collected and reduced to metallic lead, but this operation forms another item of working cost.

It is possible to reduce the copper from the solution by causing it to pass over metallic iron. Theoretically, 56 pounds of iron will thus reduce 63 pounds of copper, but in practice this is greatly exceeded, for a certain amount of free sulphuric acid is present and dissolves iron, thus at once consuming iron and sulphuric acid. Pig iron is not very satisfactory for precipitation, since it contains phosphorus, sulphur, silicon, and carbon, and is, in addition, in the form of pigs which present only a small active surface in proportion to their mass. Scrap iron and steel are used for this purpose in small way, but a large plant would quickly exhaust the scrap heaps of the world. It is usual to reckon that three pounds of iron is required to thus precipitate one pound of copper, though much better records are made in many cases, and on this basis the cost of precipitate alone would be 3 cents per pound of copper. Some interesting work has been done on the roasting of pyrite to yield H_2SO_4 and the reduction of the resulting porous iron oxide to metallic iron in a reverberatory furnace, but even by this method the cost is still heavy.

Collateral with these fundamental difficulties are a variety of mechanical and chemical problems which vary according to local conditions. If the ore is ground fine the action of the acid on the gangue minerals is greatly increased and in addition colloidal material is produced which renders difficult the separation of the dissolved copper from the residue. It is reported that in the leaching work at Butte only 80% of the copper is obtained in the solution, the rest, though apparently dissolved, remaining with the ore. A muddy solution is obtained which leads to the inclusion of floating particles in the precipitated copper. On the other hand, if the ore is coarsely crushed these difficulties are avoided, but the copper may not be dissolved by the acid. But enough has perhaps been said to clearly indicate that sulphuric acid leaching, while applicable where conditions favor its use, has not yet been sufficiently developed to play any such part in the metallurgy of copper as cyanide does in that of gold.

The Simplification of Gold Ore Treatment

By A. W. Allen

The successful application of the cyanide process in the extraction of gold from a great variety of ores has led to much theorizing on the question of the simplification of treatment; and attention has lately been drawn to the so-called advantages arising from the abolition of amalgamation in favor of direct cyanidation, whatever the coarseness of the gold in the ore. As the matter cannot be satisfactorily disposed of by a few expressions of opinion it may not be inopportune to draw attention to the various considerations involved, and the probable advantages and disadvantages arising from such a change of policy.

System of Nomenclature

The actual treatment of a gold ore is generally preceded by a series of experiments; and the results of these and the deductions therefrom are embodied in a metallurgical report. I would like to suggest the adoption of some definite system of nomenclature in such reports because at present the advantages of thorough amalgamation are apt to be overlooked. A report of experimental cyanide treatment generally gives a misleading estimate of probable recovery; and too often the fact is overlooked that an additional percentage must always be deducted from possible solution before it can be compared with, or used in conjunction with, possible recovery. The assaying of the ore before and after experimental amalgamation, or the actual recovery of gold during experimental amalgamation, denotes an actual possible recovery or extraction in practice. The assaying of the washed ore before and after experimental cyanidation indicates nothing more than a possible solution of gold, and must be distinctly differentiated from a possible recovery. When the percentage of possible recovery by amalgamation is added to the percentage of possible solution by cyanidation the total is by no means a possible extraction of gold; but is less in error than the result of a direct cyanidation test where the solution of gold is made to indicate a possible extraction.

Simple Amalgamation

As a preliminary I would like to consider the use of the term simplification when used in connection with the suggestion of the abandonment of amalgamation in favor of all-cyanidation in free-gold milling practice. Simple amalgamation is too well known to need further description. Suffice to say the gold is obtained in its original state of purity. The method of recovery is by far the most direct and the most economical; and the actual mechanical losses before realization are so small that they may be left out of consideration. There is an actual recovery of the total extraction of gold; and in the great majority of cases there are no refining fees to pay on bullion so recovered. The so-called 'simplification' consists in the following as an alternative. The amalgamable gold is ground and agitated in cyanide solution and a certain percentage is dissolved. The balance may be considered, so far as the treatment under review is concerned, as an unrecoverable loss; and is an actual addition to the residual loss which would have occurred had amalgamation been practised. The gold so dissolved is then, during the course of treatment, intimately mixed with the ore. Owing to the higher metal content in the pulp a higher cyanide strength is necessary, and this results in a higher chemical loss to the solvent. During treatment the stability of the solution is impaired by the increased metal content, and the premature precipitation rendered proportionately more probable. Filtration follows thickening and agitation, and the purpose of this step in the process is to remove as much as possible of the dissolved gold from the residue. The efficiency of this separation varies with the class of apparatus used and the condition of the pulp; but let it be noted that, given the same scheme of treatment and filtration, the loss in dissolved gold is strictly proportionate to the original value of the solution in the pulp. This dissolved gold loss may be as low as 1% of the dissolved gold in the cyanided product; or it may be as high as 10%. On a homogeneous pulp a high displacement efficiency may be obtained in various types of vacuum filters or in the frame filter-press. On a non-homogeneous pulp of too high a dilution, or in other types of filters or presses, the displacement efficiency may leave much to be desired.

Precipitation Losses

Zinc precipitation may be assumed to follow filtration. The increased gold content necessitates a higher free cyanide percentage in the solution entering the precipitation plant. This results in a higher zinc and cyanide consumption. A percentage of the gold is precipitated. Acid treatment of the zinc sludge may be assumed to follow, after which the precipitate is washed, generally dried, fluxed, and smelted. A certain mechanical loss during these operations is inevitable, and there is a further loss in slag and matte in which, even if time, trouble, and expense are unstinted, the whole gold content is unrecoverable by ordinary methods. A percentage is generally realized by direct sale.

When the elaborate method of cupellation, preceded by litharge smelting, is practised, the resultant bullion is high grade. Under ordinary conditions, however, cyanide bullion is lower in grade than the bullion obtained from the amalgamation process; and refining fees have often to be considered as an additional expense.

Enough has, I think, been said to show that the so-called 'simplification' cannot refer to other than to the elimination from the flow-sheet of fundamental units for the recovery of gold. In actual practice the solution of gold can never be more than partly successful; and unavoidable losses occur at every stage of a treatment process rendered more complicated by an unnecessary addition of gold to

the material being handled. The result is an eventual recovery of but a percentage of the gold which would have actually been obtained had amalgamation been practised.

Insistence on the theory that amalgamation is unnecessary is the natural sequence of milling in cyanide because, under such conditions, amalgamation must play a secondary part in the scheme of operations. The only direct argument which can be used against the practice of amalgamating a free-milling gold ore is that it is not up-to-date.

Treatment of Free-Milling Ore

For the purpose of comparison I append some theoretical estimates which will serve to illustrate my contentions as to the importance of amalgamation in the treatment of a free-milling gold ore. The ore is assumed to carry $20 in gold, 50% of which may be directly recoverable by amalgamation. It is further assumed that the tailing can be cyanided and a solution of the remaining gold, to the amount of 90%, can be obtained. Before the gold is ready for a mint, a loss of 2% of all the gold which passes into solution is assumed. A solution of 98% of the amalgamable gold is assumed in the case of direct cyanidation.

1. Amalgamation and Cyanidation

	Per ton.	Per cent.
Recovered by amalgamation	$10.00	50.0
Dissolved by cyanide, 90% of $10	....	...
Recovered by treatment, 98% of $9	8.82	44.1
Total recovery	$18.82	94.1
Loss:		
Dissolved and precipitated gold, 2% of $9	$0.18	
Undissolved gold	1.00	
	1.18	5.9
Value of ore	$20.00	100.0

2. All-Cyanidation

Amalgamable gold:	Per ton.	Per cent.
Dissolved by cyanide, 98% of $10	....	...
Recovered by treatment, 98% of $9.80	$ 9.60	48.0
Unamalgamable gold:		
Dissolved by cyanide, 90% of $10	....	...
Recovered by treatment, 98% of $9	8.82	44.1
Total recovery	$18.42	92.1
Loss:		
Dissolved and precipitated gold, 2% of $18.80	$0.38	
Undissolved gold	1.20	
	1.58	5.9
Value of ore	$20.00	100.0

These figures are, I think, as lenient as possible toward all-cyanidation, but by no logical rearrangement could they be made to show a result in favor of the abolition of amalgamation. An exceptionally high figure has been assumed for the solution of amalgamable gold; and the assumed loss (2%) of the dissolved gold is below the average.

It may be said that when the pulp is high in dissolved gold the filtration treatment might be preceded by a system of decantation, or decantation and replacement with barren solution, which would reduce the amount of dissolved gold in the pulp, and also the ultimate dissolved gold loss in the residue. Such a method might be followed but it would be equally applicable in the case of the treatment of the tailing from the amalgamated ore; so that given similar schemes of treatment, better results would always be obtained from the handling of material from which the greatest quantity of gold had been removed before cyanidation was commenced.

In most gold ores the abolition of amalgamation prohibits the application of leaching to the sandy portion of the product. In an ore carrying high or coarse gold content it is rarely possible to obtain a sample from the tube-mill circuit (or from the classifier discharge when the tonnage is being forced), which does not contain, in the absence of efficient amalgamation, sufficient free gold in a condition to make the leaching of the sandy portion impracticable. Unless the sand and the accompanying gold is pulverized and flaked to an exceptional fineness there is a possibility of the residue, after a complete agitation treatment, showing free gold in the pan. This is the more liable to happen when the viscosity of the mill pulp is high on account of the presence of clay in the ore.

Use of the Tube-Mill

As already mentioned, the abolition of amalgamation is closely associated with milling in cyanide; and much of the benefit said to accrue from the latter practice when used in treating amalgamable gold ores is due to the fact that, with the abolition of amalgamation, the tube-mill assumes importance as a prime factor for the solution of the excess gold. The effective action of the pebbles in bringing the solution in contact with the gold admits of no doubt; neither is there any question that a considerable percentage of amalgamable gold can be dissolved in a tube-mill circuit using cyanide solution as a diluent. But from this fact can be adduced no argument in favor of the solution of gold rather than amalgamation; it indicates no economic advantage in neglecting to recover the greater portion of the gold in the shortest time and by the most direct method.

One of the most interesting examples of metallurgical advance is indicated in descriptions of the Dome mill, Porcupine, where the efficiency of modern equipment is helped by a combination with previously proved practice. From a published account* it is to be noted that a recovery of 95% is being obtained, and 65% of this is the direct result of amalgamation treatment. After the removal of the bulk of the gold it has been found that cyanidation is so successful that only economic restrictions limit the ultimate recovery which may, from all accounts, be raised at will to an exceptionally high figure. The question of leaching the fine sand from the milling plant has been raised and the thoroughness of the amalgamation treatment will doubtless make this an economic possibility. On the other hand, and although such minor modification may be instituted, it would seem impossible to improve upon the general scheme of treatment both as regards economy of method and efficency of operation.

*H. A. Megraw, *Eng. & Min. Jour.*, Nov. 23, 1912.

Mining on the Suan Concession

The general report on the Suan concession by Hooper, Speak & Co., which is based upon an examination of the property made by A. H. Curtis, contains the following information on the present position of the Company.*

The concession is situated in the Suan district, Province of Hwang-Hai, Korea, the Suan mine, which is at present the only producing claim, is at Hol Kol, a village lying about due east of and 52 miles distant by road from Pyeng Yang, the second capital city of Korea. From Pyeng Yang (called by the Japanese 'Hei jo') there is railway communication northward with Europe, via Siberia, and southward with the Korean port of Fusan, whence there is daily steamship service across the Straits of Shimonoseki, Japan.

GENERAL VIEW OF THE SUAN HOLDINGS.

Topography

The concession is irregularly and ruggedly mountainous, with many valleys and detached groups of low mountains of peculiar forms, frequently conical, due to the erosion of easily crumbling rocks; and it is evident that eruptive action has played an important part in the formation of the region.

The ordinance for the concession, signed and sealed at the Foreign Office, Seoul, Korea, on November 4, 1905, gives full and exclusive rights and authority to examine, develop, and operate all mines and deposits contained within the district covered by the grant, with permission to cut timber and use all the water required for mining, milling, and other purposes from sources within or adjacent to the district.

A royalty of one per cent upon the gross value of the output of the mines is payable to the Korean government, also an annual mining land tax of 50 sen for each 1000 tsubo (say 25c. U. S. currency per 5/6 acre) of land actually selected for mining operations.

Korean Syndicate

The original concessionairy was the Korean Syndicate, which, however, leased its right to Collbran & Bostwick on November 12, 1907, at which time the prospects of success were not considered as encouraging by the syndicate. Under this leasing agreement it is provided that the Korean Syndicate shall receive 8% of the actual profits derived from the concession and all properties comprised within that area, these payments to be made clear of all deductions for depreciation of plant or property and for interest on capital.

All rights, title, and interest in the concession and property were transferred to the Seoul Mining Co. at its incorporation on April 27, 1908, in exchange for one-fifth of the capital shares of that undertaking, the authorized capitalization of which is 5000 shares of $100 (U. S.) each. Of this capitalization, the Company's balance sheet for the year ended December 31, 1911, showed 4000 shares to have been issued. The earning of revenue by the Company practically commenced in January 1910, although 827 tons of ore from the Suan mine was milled during December 1909.

For the same periods, the actual operating costs,

*For further information, see 'Work of the Seoul Mining Company, Korea,' *Mining and Scientific Press*, June 7, 1913.

revenue, and gross profits at the Suan mine per ton milled were as follows:

	Year ended December 31.		
	1910(a).	1911.	1912.
Ore milled, short tons	32,793	70,229	74,432
OPERATING COSTS			
Mining (including all development, but not outside prospecting)	$1.76	$1.25	$1.68
Ore transportation to mill	0.05	0.05	0.04
Milling	1.03½	0.62	0.74
Concentrate expense	0.20	0.24	0.31
Shipment of smelting ore	0.32(c)	(d)	0.02(e)
General expense (b)	1.30½	0.85	0.75
Total	$4.67	$3.01	$3.54
REVENUE			
From bullion	$8.03½	$6.21	$6.34
From concentrate shipped	1.18½	1.62	1.89
From ore shipped	1.37(c)	0.02(d)	0.08(e)
From bank interest	0.01½	...	0.02
Total	$11.23½	$7.85	$8.33
Profit (f)	$6.56½	$4.84	$4.79

(a) 20 stamps working until November 28, 1910, and 40 stamps subsequently.

(b) 'General expenses' include management and all office expenses; maintenance of agents at Pyeng Yang, Chemulpo, and elsewhere, and of president's and secretary's offices; bullion, surveying, hospital, legal, and traveling expenses, etc.

(c) 707 tons ore shipped to Tacoma, Washington, U. S. A.

(d) No ore shipped, but $1197.39 over and above its estimated value received in final settlement for shipment in year 1910.

(e) 57 tons ore shipped to Liverpool.

(f) This is gross profit, no deduction being made in respect of royalty and taxes, improvements and buildings, or administration expenses.

Capitalization

As already mentioned, the authorized capitalization of the Company is $500,000, of which the issued capital amounts to $400,000. The following table shows that 100% has already been returned to the holders of the issued shares:

No. of dividend.	Date of payment.	Rate, per cent.	Total amount distributed.
1	Oct. 1910	10	$40,000
2	Mar. 1911	15	60,000
3	Aug. 1911	30	120,000
4	Apr. 1912	20	80,000
5	Nov. 1912	25	100,000
Totals		100	$400,000

The Collbran Contact

Up to the present time, mining and prospecting work has been almost exclusively confined to the eastern half of the concession, in which portion a number of claims have been located along what is known as the Collbran Contact. The Collbran Contact may briefly be described as occurring between limestone of Paleozoic age and a deep seated instrusive boss, or batholith, of granitoid rock, which has tilted the limestone at varying angles and greatly altered it for a distance in general not much exceeding 200 ft. measured horizontally. As more or less defined by mining and prospecting work, the contact is roughly elliptical in surface contour, the major (east-west) axis being about 9 miles and the minor (north-south) axis about 7 miles in length.

OFFICERS' HOUSES AND LABOR QUARTERS.

The limestone rarely lies in immediate contact with the granite, being generally separated from it by a band of hard micaceous schistose rock, varying in width from a few inches up to several feet. This schistose rock is usually garnetiferous, and, on being reached when cross-cutting, no further attempt is made to find ore by an extension of the cross-cut. Masses of rock composed almost entirely of lime-garnets have recently been discovered in several parts of the Suan mine, actually in central

portions of orebodies. Seams containing garnetiferous matter have also been found at a distance from the schist lying next to the granite. Exposure, therefore, of the garnetiferous rock does not necessarily mean (as appears hitherto to have been assumed) close proximity to granite.

Contact Minerals

Among other contact minerals of more or less usual occurrence with deposits of this class are actinolite, biotite, chlorite, and talc, while fluorite in the rare octahedral form has recently been found.

Although the contact as defined by mining and prospecting work, has been referred to herein as being roughly elliptical in surface contour, it must not from this be assumed that its outline is regular; for observations show that the limestone is pierced in many places and directions by long tongues of granite protruded from the main mass, the eastern workings of the Suan mine being situated to the north of one such protrusion. Further, vertical cross-section around the contact would no doubt show that it has many variations of dip, the cross-sectional outline being in places nearly or quite horizontal—as evidenced by the flatness of dip characterizing lenses, more particularly in the western part of the Suan mine.

Speaking generally in reference to the orebodies occurring in the zone of mineralized limestone (extending, as already mentioned, for a distance of not much exceeding 200 ft. from the contact, measured horizontally) these may be described as a series of irregular masses in general parallel with the limestone granite contact in their respective vicinities, these lenses being in general connected by more or less well defined fissures or channels, in following which only occasional 'payable assays' may be obtained. There appear also to be certain transverse channels which may be assumed to have played an important part in the genesis of the ore-lenses.

In the case of the Suan mine, the rock constituting the gold and copper-bearing orebodies, is a highly silicious crystalline limestone, generally white in color, and containing a considerable amount of magnesia and alumina, also sulphides of iron—chiefly ordinary pyrite.

Valuable Content of Ore

The valuable constituents of the Suan ore are gold (fineness about 810 to 812), copper, and bismuth. Gold seldom occurs visibly and rarely in coarse condition. It is alloyed with an appreciable percentage of silver (not taken into account in mine estimates but paid for by purchasers of bullion) the ratio of weight of the former metal to the latter being about 4.6 to 1. The average fineness of Tul-Mi-Chung gold may prove to be considerably less than that occurring in the Suan ore, a test of 59 tons at the Sectarie mill in January 1913 having yielded bullion with a fineness of only 741.

Copper occurs chiefly as chalcopyrite, also as bornite and tetrahedrite. A high percentage of copper is usually associated with a high content of gold, although there is no fixed ratio between the amounts and, indeed, there are many exceptions to the usual rule. On certain other claims, large quantities of magnetite occur in close proximity to the contact, and this mineral appears to have been extensively mined and smelted in earlier days by Koreans, as an ore of iron.

The Suan mine is situated at the village of Hol Kol, at the head of a short, somewhat steep, poorly watered valley formed by hills forking northward from a branch of the main mountain chain of the district. It is in this branch chain that the Collbran Contact occurs at Suan. The Suan mine has been developed and exploited to a vertical depth of about 300 ft. below the outcrop by means of cross-cutting adits and of levels driven therefrom. Below the deepest of these adits development and exploitation have been continued by means of an inclined shaft to a further depth of nearly 500 ft. measured on the incline. The development of the mine has been seriously retarded by the inadequacy of the air-compressing and rock-drilling equipment, as well as by the incapacity of the main shaft hoist (also operated by air) to handle any larger tonnage of rock than that actually required to keep the mill supplied.

A large compressor has arrived and a new hoisting engine has been ordered, of appreciably larger size than the one now in use. It should, therefore, be practicable with this new equipment to push mine development ahead more rapidly, and it is recommended that the present inadequate equipment of machine drills should be supplemented by at least an equal if not a greater number.

Development

The annual development footage since the commencement of operations has been as follows:

	Feet.
Previous to 1909	5,199.0
1909	4,929.5
1910	2,971.0
1911	4,694.0
1912	5,264.5
Total	23,058.0

The average monthly footage accomplished at any face by hand labor is about 20; raising (with Waugh drill) about 50; driving (with Siskal drill) about 80. The cost per foot of this work (which is done by Chinese and native contractors), including supervision and all other charges, cannot be exactly stated; but an idea of the cost may be formed from an inspection of contract payrolls for 1912, from which it appears that prices paid to contractors were in general as follows: driving, Y8 to Y10 ($4.80 to $5); cross-cutting, Y8 to Y9 (usually Y8); raising, Y8.

Prices do not include the cost of explosives, drill-steel, and candles, which were supplied by the Company at an advance on actual cost delivered at the mine. Contractors on development work are supplied by the Company with air-drills and compressed air, when the work requires the use of machines and these happen to be available.

Stoping was formerly done with the assistance of square-set timbering, which is probably the safest and simplest method of exploiting the wide ore-

bodies of the Suan mine. Owing, however, to the cost of squared timber of the necessary size becoming prohibitively high, the 'shrinkage' system of stoping was introduced throughout the mine.

The average number of men working daily at the mine is about 425, the number being made up approximately as follows:

	No. of men.
Stoping	100
Development	100
Tramming	40
Miscellaneous, including bosses, shovelers, coolies, blacksmiths, engineers, oilers, etc.	185
	425

Labor is most plentiful between November and April; but the force appears to be reduced by about one-third during the summer months, when many Koreans go to the farms. Neither holidays nor labor shortage is a serious consideration at the Suan mine.

The Suan Orebodies

The orebodies that have principally contributed to the output of the Suan mine since milling was commenced are known respectively as:

(1) The 'Eastern' orebody which occurs eastward of the main shaft;

(2) The 'Central' orebody, lying to the west of that shaft; and

(3) The 'Western' orebody (sometimes called the 'Southern') which occurs to the southwest of the 'Central' orebody.

In addition to these orebodies, subsidiary lenses and pockets of ore have been found and worked, or are in the course of development, the most important of these being one occurring a few feet eastward of the main shaft.

For the year 1912, the value of the bismuth recovered in concentrate was $19,025 ($0.25 per ton of ore milled), the weight amounting to 2.24% of the total concentrate made, or 0.023% of the ore milled. During the current year, the ore delivered to the Suan mill will be obtained almost entirely from the Eastern orebody, and probably in largest proportion from the North branch or branches, the average bismuth content of which has yet to be determined. It will be safe, however, to assume an average bismuth content of not less than 0.15% (3 lb. per short ton) for the entire output sent to the mill.

The concentrate (averaging for the year 1912, 0.99% of the weight of ore milled) contains gold, silver, copper, and bismuth. After being dried on a heated cement floor it is sampled and then sacked for shipment to Liverpool.

During three or four winter months, shipment of concentrate is impossible owing to the freezing of the river. The 'canvas' and 'black' concentrates are shipped together as 'black concentrate,' the 'regular' concentrate being shipped separately.

The bismuth content of the concentrate is determined monthly prior to shipment, by averaging the assays of three composite samples (each representing 10 days run of the mill). This is the only determination of bismuth made, neither the heads nor the tailing of the ore milled being assayed for that metal. It is, therefore, impossible to state the average percentage of bismuth in the ore.

The sources of amalgam recovery in the mill are as follows:

	Approximate percentage of total recovery.
Mortars	5.0
Upper Pierce amalgamators	79.0
Plates	1.0
Lower Pierce amalgamators	4.4
Tube-mill and Pierce amalgamators	6.0
Miscellaneous, including launder	4.6
	100.0

No attempt has hitherto been made to store tailing for future treatment. Official records show that the average head and tailing assays and percentage extraction, by means of amalgamation and concentration, for the years 1910-1912, were as follows:

SUAN MILL.

Year.	Heads. Ore milled, tons (2000 lb.)	Assays. Gold, dwt.	Assays. Copper, per cent.	Actual tailing. Gold, dwt.	Actual tailing. Copper, per cent.	Actual extraction. Gold, per cent.	Actual extraction. Copper, per cent.
1910	32,793.3	11.88	1.43	2.10	0.96	78.03	18.32
1911	70,229.4	9.30	1.03	1.43	0.73	79.10	18.40
1912	74,432.0	8.53	0.89	1.30	0.65	86.20	20.34

Water Storage

At present the only water storages on the concession are that provided by the Morachi dam for supply of water to the two boilers at the Suan mine power-house, and that at the Tolkokai dam for the purposes of the 40-stamp mill at Soctario. The amount of water required at the mill for all purposes, including boiler-feed, probably does not exceed 450 gal. per minute; nevertheless even this small supply is not always fully available during the winter months, owing to the freezing of the streams, none of which is of any considerable volume except when swollen by exceptionally heavy rainfall. The consequence is that from 5 to 20 stamps are liable to be out of operation during the coldest part of the winter, as actually happened recently.

After considering the power problem in all its aspects, the only conclusion at which it is possible to arrive is that electrical transmission from outside

the concession is the best solution, the point remaining to be decided, being whether such power could be more economically purchased than generated by a plant installed by the Company, having due regard to the prospective life of the mines. The maximum amount of electrical power likely at any time to be actually required to be delivered at the Suan and Tul-Mi-Chung mines and mills is about as follows:

	Kw.
Suan mine	190
Suan mill	225
Tul-Mi-Chung mine	225
Tul-Mi-Chung mill	225
Total	865

It has been estimated by the general manager that the total cost of the power plant and a single transmission line, including the sub-stations, transformers, instruments, etc., also construction and erection, but not including the motors and compressors, would not exceed $250,000. There should, however, be no difficulty in obtaining a close estimate when a site for the power generating station has been definitely selected and the length of the transmission line is known.

Additional Equipment

It appears by no means unlikely that an increase in the size of the suggested ore treatment plant will be warranted by developments during the remainder of the current year, and the mill should be so designed and erected that additional stamps and concentrating plant can be placed to the best advantage.

For the deeper development of the Tul-Mi-Chung mine, it will be necessary to provide pumping machinery and plant of larger capacity than required at the Suan mine, the amount of 'backs' of ore obtainable above water level at Tul-Mi-Chung being comparatively small, although there is sufficient to furnish ore to 20 stamps for a considerable time.

The other claims located along the Collbran Contact have not yet been sufficiently explored to warrant the expression of a firm opinion with regard to their prospective palue.

The Suan concession is a property of great potentialities. Already one mine developed thereon (namely, the Suan) has been successfully exploited for more than three years, and at the present rate of crushing, and without counting on future discoveries, there is enough ore (including probable ore) to supply the mill for 3½ years and longer. Another claim (Tul-Mi-Chung) has been already sufficiently prospected and developed to prove it to be of great value, and will become productive as soon as a mill can be installed.

The western half of the concession is not so encouraging, and may not prove valuable, at all events before the end of June 1916, when the Company must surrender such areas as it has not by that date deliminated for mining purposes subject to the annual land tax. Therefore an active prospecting policy is strongly recommended and certainly no part of the concession in the immediate vicinity of the Collbran limestone-granite contact, perhaps 20 miles in length (which occurs in the eastern half of the concession), should be surrendered, since valuable ore deposits may be found in many localities around that contact.

Copper Production

The world's production of copper for 1913 is not likely to show any large increase over last year, and in a market letter on this subject Thompson, Towle & Co. predict that it will not exceed the 1912 production by 5%. Despite the fact that a large amount of new copper has come upon the market this year from the newer 'porphyry' mines, the total production thus far for 1913 of the United States, including two large Mexican properties, Greene Cananea and Moctezuma, is practically the same as that of the corresponding period of last year.

Outside of the United States labor troubles are playing an important part in the curtailment of copper, and the indications point to a still further reduction in the near future. In Australia some of the most important copper mines are now shut down. These include Mt. Lyell, Mt. Morgan, and many other large producers. An estimate of the copper curtailment now taking place at these properties aggregates approximately 5,000,000 lb. per month. This copper goes direct to Europe and while the figures will not be reflected in the refinery output of the United States, nevertheless their influence will be felt in Europe reducing its supply of the refined metal to that extent.

In the western hemisphere copper producers have been beset with many difficulties. In Mexico the political troubles have done much to curtail production. At the present time but one smelter of the A. S. & R. Co. is operating, that at Aguascalientes, and while this Company is working on supplies at hand and is still producing, a large number of the Company's mines have been closed and the copper output may be seriously affected unless operations are soon resumed. In addition to the A. S. & R. plants, Teziutlan and Mazapil, two of the largest copper properties, are shut down. These are the largest Mexican producers outside of those mentioned near the American border. In addition to these, probably many smaller properties are affected. Production from Greene Cananea at present is far below normal, and it is doubtful when this will be brought up to the rate predicted by the management for this year.

In the United States, labor troubles have brought about a still further reduction. A general strike has been called at the Lake Superior mines and the properties have all been shut down. This is one of the largest copper producing districts in the United States, and the closing of the mines will result in a curtailment of approximately 18,000,000 lb. per month. It will be seen from the above that the world's copper production for 1913 is not likely to be much in excess of 1912. When it is remembered that an increase in production of around 7% per annum is needed to provide for a normal consumption, it will be noted that production is not keeping pace with consumption and that from a statistical standpoint, the position of the metal for 1913 is an extremely strong one.

Mine Cost Keeping

By C. M. Eye

The importance of keeping a cost-system which will show clearly at any time just how the work is going, is now generally conceded by those in charge of mining enterprises. Just what the system may be, and how it is applied, varies with different enterprises, owing to local conditions and variations in methods. In order to get good results, however, the system must conform to certain principles. The figures must be reported daily from every department and promptly entered on the books. They must come from men in charge of departments and be vouched for by them. The system must be designed to give full data on every department without being too cumbersome and without requiring too much time for its preparation. The information should be as condensed as possible, and require as few forms as possible. There should be a check on the system to insure its accuracy; and, above all, the system of reports must correspond closely with the system of cost accounts adopted, which should be designed to show just what is required.

I recently had occasion to install a cost-keeping system where the operations were naturally divided into three distinct departments: mining, haulage, and milling, which are, of course, the most common divisions. Therefore, the three main operating accounts were carried under these heads as No. 1, 2, and 3.

No. 1 was subdivided into four sub-accounts, as follows:

Account A—Exploration.
" B—Development.
" C—Exploitation.
" D—General charges.

No. 2 was subdivided into three sub-accounts, as follows:

Account E—Train operation.
" F—Maintenance of way.
" G—General charges.

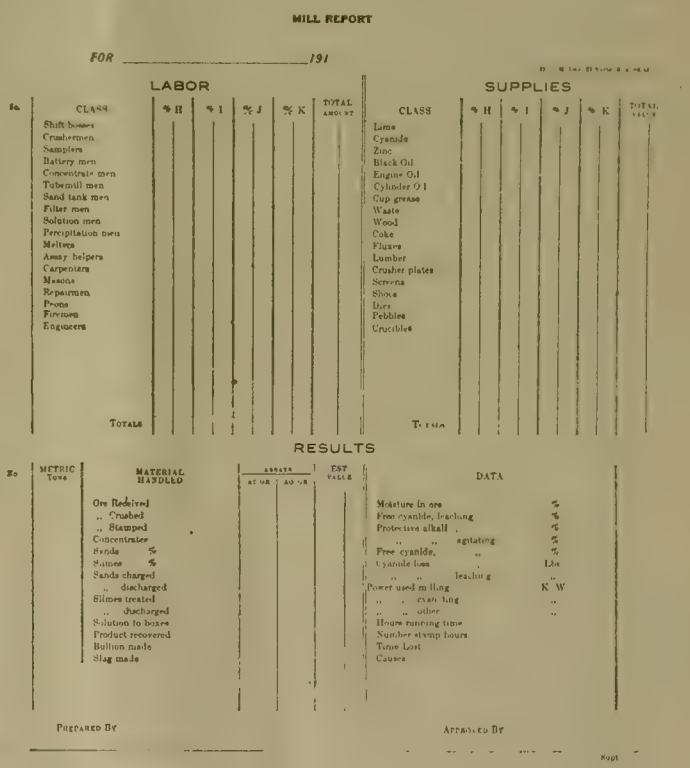
No. 3 was subdivided into four sub-accounts, as follows:

Account H—Crushing and sampling.
" I—Reduction.
" J—Concentration.
" K—Cyanidation.

The following divisions of operation were made under No. 1: Breaking and handling; tramming; hoisting; timbering; pumping; track and pipe-laying; repairs and renewals; assaying; engineering: mine sampling; supervision. With following division of items of cost: salaries; labor; power and light; timber and lumber; explosives; candles; oil and waste; fuel; tools; steel and iron; miscellaneous supplies.

Under No. 2 were made the following divisions: Loading; hauling; unloading; repairs and renewals; engineering; supervision. With following items of cost: salaries; labor; power and light; timber and lumber; explosives; oil and waste; fuel; tools; steel and iron; miscellaneous supplies.

The following divisions were made under No. 3: Receiving, weighing, and sampling; crushing; stamping; concentrating; fine grinding; elevating and dewatering; leaching (sand); discharging (sand); agitation (slime); filtration and discharging (slime); precipitating; recovery (clean-up and melting); marketing; assaying; engineering; repairs and renewals; supervision. With following cost items: salaries; labor; power and light; timber and lumber; explosives; oil and waste; fuel; steel and iron; zinc; cyanide; lime; screens; mill repair parts; fluxes; crucibles; assay supplies; belting; pipe and fittings; miscellaneous supplies.



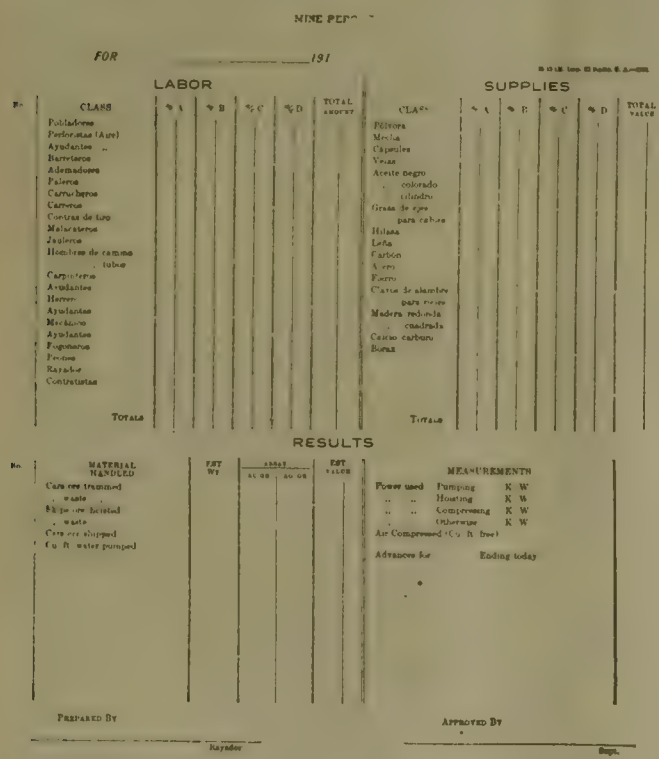
Daily Report Forms

In order to collect the figures daily for these accounts, and to furnish the manager with the information promptly and in a clear and comprehensive form, the above daily report form was designed. The arrangement and ruling is exactly the same for all of the operative reports. It is, therefore, possible to have a large number of forms ruled at one time, and then by the use of a small printing press at the works the forms can be printed in as needed, and the matter varied as changes are found advisable. Another advantage of the uniformly

ruled form is that the same class of information always appears on a given part of the form, so no time is lost in looking for the desired item of information. All of the desired information regarding a given department for a given day is on one report, and the various reports are easily compared and checked against each other as to results accomplished.

Various Uses of Report Form

The same form can be used with different printing for any other operation, such as the power-plant, or can be used for construction accounts equally as well. Of course, perfection is not claimed for this system. No doubt many changes can and will be made to advantage where it is being used, but one of the merits claimed for it is that the forms are easily and readily adapted to such changes as well as to desired extensions. Of course, certain of the cost items need not appear daily in the reports, but come to the proper main accounts by monthly distribution, such as salaries, power, and light. It is important to have a daily report from each department as to cost of labor and of supplies used, and as to what has been accomplished. I believe that these forms, properly used, will secure good results, and am therefore glad to place them before my fellow-workers with the hope that they may call forth comments and suggestions which will be of use to the profession.



The Great Cobar mine, New South Wales, produced the following during the first quarter of the current year: ore, 88,419 tons; blister copper, 1477 tons; gold, 6429 oz.; and silver, 25,000 oz. The revenue amounted to £147,000, mining expenses, £54,750, smelting, £30,670, and construction £15,000.

Safety Electric Switches for Mines

By H. H. Clark

*As a part of its investigation into the causes of mine accidents and the safeguarding of the use of electricity underground, the Bureau of Mines has recently completed a preliminary study of electric switches designed to prevent the ignition of gas by the spark that is drawn when such a switch is operated under a load.

Two general methods have been proposed to prevent switching flashes from coming in contact with gas that surrounds the switch. One method is to enclose the switch in a casing provided with openings that are covered with gauze or are otherwise designed and equipped, so that if a gas explosion occurs inside the casing the flames will be extinguished before they can reach the gas outside. Switches so protected are called explosion-proof switches. The other method is to immerse the switch contacts in oil to such a depth that the flash cannot reach the explosive mixture. Switches so protected are called oil-type switches.

The success of the first-mentioned method of protection depends on the proper design and construction of the switch casing. The merit of such design and construction can be determined by test. The successful operation of the second-mentioned method is dependent on the switch contacts being surrounded by the proper kind of oil in good condition. Switches of the explosion-proof type can be so designed that the condition of their protective features may be readily examined each time that the switches are operated.

The tests conducted by the Bureau seem to indicate that the oil switches will not ignite explosive mixtures of gas under the conditions described as long as the switch contacts are covered with oil to a depth of ¼ inch or more. This is best shown by the tests of the automatic oil switch in which the maximum instantaneous current was not far from 1000 amperes. The tests also show that the oil is not lost rapidly by evaporation nor by many operations of the switches under rated current load and at a voltage as high as the probable underground voltage in places where explosive gas is likely to be present. The tests show that the switch contacts deteriorated more rapidly than the oil. Even in the case of the automatic switch that finally ignited gas, several sets of contacts were burned off before the oil-level was so lowered that the gas was ignited.

It therefore seems reasonable to believe that oil switches will not ignite inflammable gas if they are designed with attention to the service that they are to perform and are inspected at reasonably frequent intervals. The tests demonstrate the possibility of constructing an explosion-proof type of switch that will not ignite gas.

*Abstract from Technical Paper 44, Bureau of Mines.

Under-Estimating the Cost of Milling Plants—III

By A. Sydney Addton

But little has been written, and no discussion carried on, in the technical journals upon the subject of underestimating the cost of mill construction, mainly for two reasons, those who have experienced heavy 'jolts' of cost have nothing to write about; those who have not had such experiences are too busy making installations to write about the other fellow's troubles.

Reasons for Excess Cost

Having, during seventeen years' experience as a metallurgical and constructing engineer, been called upon to examine many sets of specifications, plans, and estimates made by others, and the subject of cost always having been of special interest to me, I have gathered a large amount of data bearing upon this subject which may be of as much interest and possibly of more value, than any account of my visits to plants for the purpose of ascertaining the reasons for costs which exceeded the estimates. The reasons for excess cost are so many and varied that it will be necessary to take them up under the groups into which the work of making an installation might be divided.

1. Preparatory talk and discussion.
2. Arranging for finances.
3. Selection of engineer.
4. Examination of ore for treatment.
5. Additional talk and discussion.
6. Deciding on site.
7. Preparation of plans and estimates.
8. Securing of bids and buying material.
9. Clearing site and surveying.
10. Excavations.
11. Organization for installation.
12. Material yards, stock, and supply department.
13. Utilities during construction.
14. Crushing and concrete plant.
15. Foundations and retaining walls.
16. Equipment: (*a*) breaker plant; (*b*) sampling plant; (*c*) milling plant; (*d*) cyanide plant; (*e*) refining plant; (*f*) power plant; (*g*) heating plant; (*h*) lighting plant; (*i*) machine shop.
17. Buildings: (*a*) lumber (doors and windows); (*b*) iron and hardware; (*c*) structural steel (in case of steel frame).
18. Permanent utilities; water and air systems; fire system; assay plant; office; superintendence; supplies; labor; miscellaneous; freight and hauling.

Preparatory Talk and Discussion

Preparatory talk and discussion usually extends over quite a period of time and consists in taking up an unnecessary amount of the time of the manager or superintendent of the property in trips between the mine and city office, talking with machinery men, and securing prices of supposed requirements. All this costs money for no useful result and could be reduced by nine-tenths.

Arranging for finances is usually an expensive item involving trips to the East, commission allowances for assistance, and so on. When done at this time it is largely a waste of money, as it is not known what amount is necessary, and the work will undoubtedly have to be done over again later on, when additional funds are needed. The second 'raise' usually costs more than the first, as money is wanted at once. The cost for this work can be greatly reduced by waiting until complete plans and estimates of cost are ready. A little delay at this point costs nothing beyond the engineer's salary, which he can generally be made to earn during this period to excellent advantage.

This item in itself incurs but little expense, but upon its careful carrying out depends the avoiding of great ultimate expense, and it is really the greatest factor in preventing an excess cost. The engineer must have both technical and practical experience, successful experience, business and executive ability, and enjoy the complete confidence of his principals. If the owner has not absolute confidence in the engineer and conversely, another should be secured, or excess cost may be expected. The engineer should be selected immediately on deciding to build a plant, or before.

Examination of the Ore

In the examination of the ore for treatment, the expense of sampling by the superintendent, foreman, sampler, or examining engineer, and the shipment of large samples to a metallurgical works for exhaustive testing, is entirely or largely wasted. The engineer employed to design and erect the plant must do it all over again, as he is not going to risk his reputation upon the results of work done by others. Therefore leave this work to be done by or under the supervision of the engineer who is expected to build an efficient plant. No attempt should be made to rush this work. This is most important and thoroughness is most essential, even at what may seem to be a high cost. Nothing can be saved here, except what is spent or wasted beyond payment for the conscientious service of competent men, who are expected to build the plant and be responsible for its efficiency. Much is often otherwise spent, and constitutes an excess cost.

Additional talk and discussion generally involves considerable delay and is more or less expensive and unnecessary. Visiting in the city by the manager, superintendent, or engineer, at company expense, discussing the proposed plant, and lunching with machinery dealers is a source of expense which could be eliminated.

Deciding upon millsite is not an expensive item, nor one that is apt to cause any excess cost, as the best site is usually evident. Special trips of the engineer from the city to the mine is about the only added cost that creeps in here. The engineer should be provided with facilities at the mine for preparing his plans, specifications, and estimates, since as the plans develop, an occasional reference to the site is quite necessary.

After the treatment of the ore has been determined upon, the preparation of plans, specifications, and estimates is most vital. Right here is where the excess costs should be avoided, but too often it is right here that excess cost is born. To enumerate the points wherein most estimates are deficient would be but to anticipate what is to follow: for all added costs, as taken up below, are due to lack of attention to this point. There is no reason why a plant should cost more than the estimate, if sufficient intelligent work is done upon plans, specifications, and estimates, barring accidents, strikes, or acts of God, which no one can foresee. The usual set of plans, specifications, and estimates consist of submitted prices of equipment, quoted freight rates, and roughly estimated labor costs, and are entirely lacking in detail (detail being worked out, if at all, as construction progresses). Such estimates are actually only preliminary, and the real work for which a high-priced man has been engaged is not done at all. No man can make a close estimate of cost in this way. Often it is an engineer's first construction work, and he cannot therefore be expected to 'guess' at a thousand and one items of cost with which he has never actually dealt. And even after he has designed and constructed many plants, his guessing is likely to be in error, as no two plants are alike or built for same duty or under same conditions. The reasons for so many incomplete sets of plans, specifications, and estimates are: attempt to rush, over-confidence on part of engineer, failure to see necessity for proper plans and estimates, and desire to save cost of preliminary work. All of these are also very good reasons for either failure or excess cost.

Purchase of Material

Securing bids and buying material is an important part of plant construction, where many dollars may be saved or wasted. To secure the best results the engineer who has made plans, specifications, and estimates, and is to supervise construction, must select his own equipment and material, and arrange for delivery, including routing of freight. Too often this is left to the president of the company, a director, or purchasing agent, with some of the following results: Articles are bought on account of some friendly or personal reason, others are substituted on account of a strong talk by a salesman or an attempt to save a few dollars; supplies are bought on account of best 'brokerage' paid; deliveries are made inconveniently; freight is shipped by a route different from that upon which the estimate is based, on account of the strong talk or friendliness of some railroad soliciting agent; goods are shipped in less than carload lots, when they could have gone in carloads; higher prices are paid than the goods could be bought for. An engineer can buy at lower prices than an owner, owing to the dealer's desire to gain the engineer's favor, in view of the future plants he will build, while the owner's buying is probably limited to the one plant. Besides all this, incidental expenses may be incurred in buying of which the engineer knows nothing, and for which he has made no allowance in his estimate. Not a dollar should be spent and charged to cost of installation which is not either spent by the engineer or with his knowledge and sanction.

Excavations

Clearing site and surveying is usually left out of estimate entirely, and while it is not large, it is one of the many small items that swell the excess cost.

It is customary to estimate the cost of excavation by a price per cubic yard. So many yards of picking ground at so much per yard, and so many yards of rock at so much per yard. One common error in such figures occurs in cost per yard of rock; this cost being based on breaking solid rock of character known to exist on the site, overlooking the fact that rock found near the surface commonly breaks badly, being either short or blocky, and straightway driving can seldom be counted on. There is also much breaking up of pieces too large to handle, either by hammer or by 'bulldozing,' and much gathering up of rock blown into completed excavations; all of which is seldom counted on. Such figures are based upon the customary costs per cubic yard without going into the details of costs under the conditions actually prevailing, such as inconvenient dump-hand drilling or machine drilling (if latter, where is power to be derived from?); must temporary plant be installed for this, what portion of the plant can be utilized afterward, and what portion of its cost must be credited back to excavation, transmission of power (material, installing, wrecking, and loss of material); where will tools be dressed, must shop be maintained for purpose, and if the mine shop is to be used, how much must be paid to mine, water supply, how many cars, barrows, feet of track, barrow runways will be needed to suit conditions, cost of temporarily holding dangerous banks, finishing of grade and setting plugs, including surveyor's time. This common method of estimating may be found to be correct, where usual conditions exist, but it is dangerous, and if it is desired to insure against excessive cost, the details of the work in hand must be gone into thoroughly.

Organization

For economy and to insure the expected results the constructing engineer must necessarily be the one head to such an organization. The connecting link between himself and the company is the bank account. He must depend upon advices from the company as to when funds are to be available in order to be able to arrange contracts and payments to the best advantage. Other than this dependence, he should be free from company direction, except at such times as contingencies arise which may cause him to consult with officers of the company. The following organization of the work under the direction of the engineer is necessary to insure best results: assistant engineer, who should be the man expected to take charge of the plant as its superintendent later; general foreman of construction; master mechanic; boss machinist; boss carpenter; boss of erection (if steel frame construction); boss mason; boss pipe-fitter; boss tank builder; boss electrician or engineer; boss of common labor; boss yardman; storekeeper; tool and appliance man; surveyor; timekeeper; clerk in charge of orders and sup-

plies, clerk in charge of freight and hauling; clerk in charge of utilities, bookkeeper; draughtsman; stenographer; roustabout; boy or messenger.

It depends, of course, upon the size of the plant whether or not an individual is needed for each of these divisions of work, but if the plant is so small that a half dozen men can perform all of the above duties, each of them must know just what, of the above, he is required to take care of, and must do that, and not a little of everything. Lack of organization is responsible for costly errors and delays and has been a large factor in causing excess cost in more instances than would be supposed. Too often one man attempts to do all of these things, or nearly all, or is compelled to do so by not being allowed sufficient help. There are thousands of things to be thought of which need intelligent attention, in building a large plant, and even the most clever men have a limit of capacity. When this is crowded, then come those most dangerous causes of failure: "I forgot that," or "I did not have time to attend to that." To save costs this sort of thing must be eliminated.

Essentials of Construction

A plant is built of three things; material, labor, and brains. If material runs short, buy more; if there are not enough men to do the work, employ more. If there are not enough brains to attend to everything in detail, or if the brains are not organized, do not fail to observe the fact and correct it, for here lies the cause of excess cost. A plant can go ahead regularly, as planned, smoothly, without loss of time, one step after another, no blunders, nothing done over, and no alterations, but this is only possible under a perfect system of organization for efficient work. Too much cannot be said in favor of organization, as a factor in the prevention of excess cost.

Estimates seldom include any cost of preparing a yard or yards for material, or for housing and caring for stock and supplies, and any money spent for this is, therefore, an added cost. Too often, however, nothing is spent for this purpose and the result is a greatly increased cost of handling material, waste of supplies, and costly delays. The time to prepare for yards is when the site is selected. If a hillside site, the yard should be laid out during excavation, and the material moved so deposited as to form ample room for storing and handling all material with least possible amount of labor. It is quite customary for material to be delivered at the site, dumped off at the top or bottom, or scattered about over adjoining ground, at any place convenient for unloading, later necessitating high labor cost to move to place or handle. One of the best times to judge whether or not a plant is being built with intelligence and economy is just after material has been delivered; a glance is then sufficient.

When building upon a hillside, no plant is too small for it to be economical, to provide means for hoisting or lowering everything to the level at which it is to be used. This may consists of a well ballasted track for cars with hoisting engine, or only a skidway with a 'boat' and hand-winch. In making excavations a yard can easily be leveled at each grade at one side of the site with a minimum expense of possibly a little dry-wall building, and heavy labor costs saved later during construction. (These yards should, of course, be all on the same side of the plant.) As material is delivered, all the equipment and much of the building material can be placed at once in the yard at the grade wanted. All that cannot be easily sorted at this time should be yarded at the top or bottom of the incline, according to where delivery must be made. From the time material leaves the wagon or car it should not stop moving until it is so placed that it need be moved only horizontally to its final position, or perhaps lowered a little. The boss yard man must be advised by the general foreman, or clerk of supplies, just where everything is to go. At the top or bottom yards and at important intermediate grade-level yards, provision should be made for housing or caring for all supplies in such a manner that when any piece is wanted it may be obtained with the least possible amount of labor and loss of time, and absolutely without a hunt. It costs money for a high-priced mechanic to wait for another man or to go himself to the top of the mountain or down into the cañon and hunt through a mixed mass of freight for an ingot of babbit. This certainly increases the estimated cost of babbit per pound, or the estimate of the cost of labor for the piece of work the mechanic is doing. On certain construction work where $50,000 was the total labor cost, the records show that $3800 was spent for moving and handling material and supplies from the point where they were delivered to where the construction gang could get at them.

Cost of Yards

Here, then, are two items of excess cost. First, failure to include the cost of yards in the estimate, afterward realizing the necessity for them and incurring additional expense. Second, failure to include this cost in the estimate and afterward incurring the expense, but spending many times that amount in handling material. The effect of an efficient organization bears very strongly on this point; more will be said about this later, when discussing the various items of equipment and material.

Most estimates will include provisions for power, air, water, shop, bunk-houses, and boarding-houses. In cases where the plant is being built close to the mine, but little allowance is made even for these items; they are checked off by noting that "such accommodations and service are already provided for at the mine." Sometimes this is true, but often the accommodations and service are entirely inadequate. For instance, it is not often that the mine bunk-house can accommodate the large number of men employed on constructive work, and in most instances the boarding-house and equipment is far too limited. Blacksmith shop built for mine work can seldom care for work of construction in addition, and besides it is not always near enough to be used with economy. The power, air, and water available at the mine are usually only just sufficient for mine requirements. All of these things must be considered carefully and after discounting exist-

ing accommodations liberally, an allowance must be made in the estimate.

Besides these there are a number of utilities that are seldom, if ever, included in estimates, such as; ways and means of distributing power, air, water, and light to points of use during construction; provision for care, repair, and maintenance of tools and appliances; tramway or skidway equipment, maintenance and operation; cabins, mess-house, or other accommodations for the general foreman and office men who do not use the bunk-house; sanitary arrangements, fire protection, water, heat, and light service for men; watchmen, attending to men's personal wants, such as mail, etc.; saddle animals or light conveyance for use to and from railroad or town; telephone connections, when possible, with main lines, railroad, or town; caring for accumulated rubbish, its removal to points out of the way of the work, and reclaiming as much as possible for use. Many other things may be necessary, according to circumstances and conditions.

Permanent Installations

Many of these utilities may be installed permanently at the start, to serve for use later during operation of plant, but at no time are they of more use than during the construction. I recall a good illustration of the short-sighted policy of failing to provide utilities until after construction is finished. At this property the mine was two miles from the plant, and at about 2000 ft. greater elevation. The power-plant was 1½ miles from the plant, and in the opposite direction from the mine. From the mine to the plant there was an aerial tramway and from the power-plant to plant was a large air-pipe line. During construction no telephone service was provided between these points. A record was kept of the time of men who were sent back and forth with messages, the cost of which amounted to $425. After the plant was installed and running smoothly a complete telephone system was put in at an expense of $240. The supplying of utilities and accommodations can easily be overdone, but necessities of this kind must be provided, and an allowance made in the original estimate to prevent any excess cost.

The including of a rock-crushing and concrete plant in an estimate is dependent upon the size of the mill. Just how large the plant must be to justify such equipment is largely due to conditions. Often a large plant is undertaken without such equipment, and in this case excess cost generally results. When such equipment is included in the estimate, the following are usually not included: good foundations for machines, "being only a temporary plant, good enough will do," with the result that the efficiency is greatly reduced and the cost of the broken rock and the concrete is correspondingly increased. Grading for buggy-ways on car tracks to site, with sufficient equipment for delivery of material to site; also for delivery of materials to concrete mixer. Care of cement, renewal and wear and tear of screens and tools, too high an allowance for subsequent use of equipment and building, etc., transmission of power, water, and light, cost of wrecking the plant when its work is finished. The cost of all these becomes another item in excess cost.

Foundations and Retaining Walls

Usually foundations and retaining walls are figured at a certain price per cubic yard, the price varying with the class of foundation according to duty. Under certain favorable conditions, and if the estimator has had considerable experience, this should be all right, but there are many items of expense connected with this work that are usually overlooked. (The excess cost of the concrete is not to be included here.) These items are such as follow:

1. Taking out foundations and establishing centre-lines.
2. Lumber and labor necessary for making the form is always greatly under-estimated. The waste of lumber alone is an item. Also too great an allowance is generally made for lumber being used more than once.
3. Material for, and erection of buggy-runs, platforms, chutes, and staging.
4. Water service.
5. Preparing of templates.
6. Setting of hold-down bolts.
7. Leveling and finishing to grade, including surveyor's time.
8. Tearing away of buggy-runs, form, and staging.
9. Cleaning up of grade ready for the setting of the machinery and building.
10. Caring for the concrete work in inclement weather.
11. Often the base of the retaining wall is omitted in computing contents, the height being taken only to the grade-line on the drawing.
12. Failure to save and return cement bags.

In estimating in the usual way these items are supposed to be included in the cost per cubic yard, but it is not possible for this to be exact under all conditions, and the only safe way to avoid an excess cost is to consider the case, in detail.

Importance of Minor Items

The portion of the usual estimate covering equipment, is, as a rule, correct, as the figures include actual bids or prices secured from machinery dealers and manufacturers. The main chance for excess cost is in the leaving out of minor but necessary items. The most common omission in the various departments is as follows: Breaker plant; usually not much is left out here unless it is scales or weighing devices, either above the breaker, on the conveyor, above the sampler, or above the mill bins. Smaller items, such as steel for the breaker floor, lining of chutes (sometimes the chutes themselves) and an outfit. Sampling plant; this is often entirely omitted from original estimate and added later at an excess cost, owing to the necessity for rearranging the top of the plant, and installing elevators. When it is included in the estimate, the usual omissions are the frames or supports for samplers, chutes or chute linings, feeders, steel floor for sample room, fan for grinding machines, and an outfit of tools and hand appliances. Milling plant; it is difficult

to specify omissions in this part of the equipment, as no two plants are alike; hence only general items can be mentioned. Amalgamator's and batteryman's kit of tools, hose for use at batteries, sufficient valves and fittings for desired control of water at battery, especially if both clear and returned water are to be used, overhead crawl and amalgam cage (if a large mill); screws for putting down apron plates, material for apron plate stands, material for launders and launder distributors, material for gangways, platforms, and walks; clutch pulleys and belt-shifters; necessary tools and appliances; sufficient classifying capacity; sufficient fall for launders; accommodations for millmen; conveniences for making out reports, etc.; tunnels or cuts in retaining walls for belt drivers, if any.

Cyanide Plant

In the cyanide plant only general items can be mentioned, such as tools for the use of each man in this department, material for launders and launder distributors, material for gangways, platforms, walks, and steps; shifters for belts, sufficient power transmission to the many points of use, gauges, indicators, automatic registers, and solution and pulp sampling devises, report room and equipment for testing and standardizing solutions, sufficient pulp storage and settling capacity, sufficient solution storage, especially sump and gold-solution, sufficient clarifying capacity, adequate solution-circulating system to admit of universal handling of solutions, including pipe, fittings, and pumps, pipe clamps for supporting pipe-lines, sufficient grade for launders and discharges, adequate filtering capacity, accommodations for men, are some of these, also an estimate often covers the cost of cars and tracks for removing tailing from filters or vats when it is later found necessary to install conveyors for this purpose. Refinery; specifications for a refinery are nearly always complete except for such items as, scales for fluxes, vessels for fluxing, suitable arrangements for storing fluxes, acids, and gasoline, sampling devices, asbestos goods, spare burners if gasoline is used, and hose, tools, and small appliances. Power-plant; estimates for this are usually based upon the bids of dealers and are generally all right except when the specifications are at fault as regards the capacity required, which is often the case. If electric power is to be used and generated at the plant, the power-plant is generally turned over to an electrical contracting company, in which case it is usually completed according to specifications and is satisfactory. The excess cost then arises in the plant itself. Under-estimated motor capacity due to incorrect rating of machines to be driven, due to 'guessing' or 'bunching' instead of going carefully over the building and its requirements. No cost included for providing proper, clean, and ventilated places for motors. Full complement of tools, oilers, etc. Insufficinet transmission; in these cases where power is purchased from a power company, in addition to these five items there is usually another larger one, resulting from insufficient transformer capacity. It often happens also that the power company will insist on placing the transformer house so far from the motors that additional capacity is required on account of the excessive loss in transmission.

Steam Engine Capacity

In cases where steam is used to drive the mill direct, the engine capacity is usually under-estimated on account of incorrect rating of machines driven, or low efficiency of engines, and too little allowance of power necessary to drive shafting, and for starting loads. Besides this, boiler capacity is commonly not provided in sufficient excess of engine capacity. In some climates this item can be entirely neglected, but where it is necessary it is safe to calculate the amount required as exactly as possible and then double or triple it, as there is no way of estimating heat losses in a mill building. The principal oversight in estimating the cost of a heating plant is not in the cost of the heating plant itself, but in the cost of construction of the buildings to be heated. Very little heat is required for this purpose if buildings are designed and built in such a manner as to conserve the supply. The cost of material and appliances for the distribution of the heat is usually omitted from estimates. Lighting; where lighting is done by electricity, the most common cause for excess cost is the failure to actually determine the position of light needed, so that the wiring can be exactly computed for the entire building or buildings. Dynamo and power capacity can be exactly calculated if this is done carefully. In cases where the lighting is done by oil, lamps or lanterns are usually omitted from the estimate, or, if included, are insufficient in number. When acetylene gas is used, too little attention is paid to placing each light wanted, resulting in the tearing up of piping in order to add additional lights, and generally requiring an additional generator. Machine shop; this item of cost depends upon the size of the plant constructed and upon the position of the plant with relation to any available shop. No plant is so small but what if not near a good machine shop, some kind of a shop is needed, other than the smithy, in order to avoid an excess cost on this account. The cost of any equipment of this kind is rarely included in an estimate for the installation of plant. No general specifications can be drawn for this item, as it must be determined by the style and size of the plant being built. The usual excess cost arises from leaving it out of the estimate entirely, or from failure to install the equipment at beginning of the construction.

Capacity of Machinery

In concluding these remarks upon equipment, it is necessary to emphasize that but little has been said above regarding the over-estimated capacity of appliances, which, in many cases, is one of the greatest reasons for excess cost. Nor has anything been said about the installation of unsuitable equipment or untried designs of apparatus. These are obvious to anyone, and while these notes are intended to cover only the points usually overlooked or not thought of in estimating, deal only with general cases.

Black tin output of the Aramayo Francke mines, Bolivia, in June was 248 tons.

Transportation in the Orient

The best and cheapest method of transportation in the Orient, and especially in China, is by water, and an infinite variety of boats are employed, according to the conditions to be met. They range from the sea-going junks, such as is shown in the illustration at the top of this page, which skirt the coast from port to port, down to small flat-bottomed boats rowed by a man who stands facing forward and pushes on his oars, instead of pulling on them in American fashion. Especially useful for river traffic are shallow-draft boats which use sails, float with the current, or are poled along downstream and are hauled up by tow-lines attached to the tops of tall masts. Men are universally employed to pull on the tow-line, sometimes over a dozen in tandem pulling on one boat. For travel along canals, narrow boats are used, so as to pass each other, and in order that locks can be negotiated they are frequently made in two sections which can be detached in the middle, taken through separately, and joined on the other side.

In the interior, quite other means must be employed, and in crossing the waterless deserts which separate China from Russia, camel-trains are employed. The top illustration shows a camel-cart. This is covered with felt and painted canvas, and is provided with glass windows. They make a comfortable sleeping place, but when awake the slow speed, monotony of the outlook, and cramped quarters make them rather tiresome. The camels travel twelve hours per day at the rate of 2¾ miles per hour. The next illustration below shows a tea caravan. This method of transporting tea to Russia is still in use, although railway connections across Siberia are now available. Most of the caravans now go by way of Urga to Irkutsk, where the cargo is transferred to the Trans-Siberian railway. The camel is commonly thought of as at home on the hot deserts, but in Mongolia they are chiefly used during the dry cold winter, being turned out to grass during the summer. They are much used in parts of northern China that are not desert, as they are able to carry heavier loads than mules or ponies.

A common method of transport in towns and cities is the wheelbarrow, which is of many patterns, one of the best being shown in the illustration. Heavy loads are moved on these, the centre of gravity of the load coinciding with the axle of the wheel, so that the load balances itself, and the man has only to push. To aid

him in keeping the load from tilting, the handles are made with a wide flare, and what little weight he carries is borne by the strap across the shoulders. In this way heavy loads are transported for distances of several miles. The wheels are rarely greased, and the squeak of the native wheelbarrow is a sound few 'old China hands' can forget. For moving material shorter distances, though often used for over a mile or two, the carrying pole is in universal use. This is of springy wood and is fitted with ropes at each end by which loads may be tied, or baskets attached, in which the objects are placed.

The first of the group of illustrations on this page shows a Korean and his pack-pony. These hardy little beasts easily carry a 200-lb. load over a bad trail at a fast walk. Each pony has its own attendant, and as only stallions are used, they are kept muzzled. According to Korean practice, ponies are not allowed to lie down at night, but are tied with ropes to the roof of the stall. They are only watered at feeding time, and when working are given cooked food three times per day. Their food is chiefly beans and chopped straw or other forage placed in a trough with plenty of water. In order to enable the pony to eat the beans on the bottom of the trough and breathe at the same time, his nostrils are slit for some distance up. In slinging a pack on a Korean saddle, a lash-rope is put over the outside of the pack, but the balancing of the side loads and the contact of the sling-ropes with the outside ends of the saddle keeps the load in place. The Chinese pack-saddle is differently constructed, consisting of a wooden frame heavily padded beneath, and which may or may not be cinched to the animal. The pack is tied on a wooden frame which fits over the saddle, and can be easily put on or taken off without loosening the pack. This arrangement is hard to beat, except on very brushy or narrow rocky trails. The balancing of pack on the frame and the close fit of the frame to the saddle makes the use of lash-ropes unnecessary.

The illustration at the right shows a Siberian post conveyance or *tarantass*. This is a sort of bathtub slung on poles between the two axles. It is usually covered with tin on the bottom to keep out water when fording streams or when negotiating mud-holes. The occupant sits flat upon straw in the bottom and wedges himself in with his luggage. The driver has nothing much but force of habit to keep him on the vehicle, and if he is in the humor, he can generally give the passenger at least an exciting ride. There are no buckles to a Russian harness, and there are always frequent stops to tie something. No brakes are used.

The lower illustration at the left shows the method of traveling with the fast post in Mongolia. The post route between Kiaokta and Peking was established by treaty between China and Russia, some years ago, for the use of officials of either Government when on business, and for mails. The cart is pulled by Mongols on horseback who tie a pole to the cart shafts at right angles to the shafts and take the ends of the pole on their saddles. A full complement consists of eight ponies, two on each end of the pole, two in front with ropes attached to guide, and two, also with ropes, in the rear of the pole and slightly at the sides to pull back. Needless to say that with frequent changes of animals considerable speed is developed. At each stage of the journey a clean tent is erected for the traveler, and his luggage is taken ahead in a light cart and awaits at the end of each stage. Money in this part of the world consists of lump silver, and each person carries his own particular kind of scales, and pieces are chopped to fit the amount needed. The Siberian post stations are Government institutions, placed along the post-roads at distances from ten to twenty miles apart. Each station has several changes of horses, and the rate for hire is nominal. One room in each station is reserved for the use of travelers, and contains two wooden benches for beds, a table, lamp, mirror, *ikon*, wash-basin, rules and regulations, and complaint book. Prices for food and hire of horses and conveyances are fixed by schedule. On a busy road, or at times when the mail is going through, the traveler has considerable waiting to do to obtain fresh horses, but if he has a special permit, such as Government officials have, he can keep going constantly.

The illustration at the lower right shows a Chinese *shan-tze* or mule-litter. The traveler reclines on a bed of straw or felt, and the driver walks or rides behind, constantly requesting the occupant to move to the right or left to 'trim ship.'

A new slime collector, devised by R. V. Smith, is being tried at the Daly-Judge mill, Utah. It consists of a belt conveyor which allows slime to come to rest, and which is dewatered to enrich the valuable portion of the slime. After this, the product will undergo further treatment to recover the lead-silver and zinc concentrates. Only the crystalline minerals will be caught, and no attempt will be made to recover all the metal content of the slime. The overflow from the last Callow tanks and from the 'slime' ends of those Wilfley tables treating what is termed 'slimes,' is the product to be treated by the new machine.

Gold production of West African mines in June was as follows:

	Tons.	Value.	Profit.
Abosso	8049	$ 70,000	$15 000
Ashanti	9798	165,000	55,000
Broomassie	2800	50,000	10,000

Iron-ore shipments at Lake Superior points in June were 7,974,444 tons, making a total of 16,125,042 tons for the season, against 13,690,671 tons for the same period of 1912.

Minerals Separation, Ltd., v. James M. Hyde

*Complainants are owner and its license of United States patent No. 835120 for improvements in a process of ore concentration, issued on an application filed May 29, 1905, by said owner's grantors, Messrs. Sulman, Picard, and Ballot, of London, England, joint inventors and patentees, and this suit is for infringement of certain claims of said patent by defendant, a former employee of said owner, and by it trained in the process. The defenses are various grounds of invalidity hereinafter noted so far as of merit and seriously urged and non-infringement.

The Invention

The invention claimed, in general terms, may be said to be the discovery in March 1905, that if a very small and appropriate quantity of an oily substance, ranging around 0.02 to 0.5% of the weight of the ore be added to a pulp of water and finely pulverized ore (the slime being helpful and most easily recovered) and the whole vigorously agitated and thereby thoroughly aerated by great and excess quantities of air, the metalliferous particles are oiled and adhere in a complete envelope to or of bubbles of the air and rise to the surface of the mixture on occasion of agitation, forming a strong coherent and stable froth easily removed. The process may be aided by heat to more quickly and effectively disseminate the oily substance through the pulp and bring it into contact with the metalliferous particles, and may also be aided by a mineral acid or salt up to 1% thereof of the weight of the ore to increase the preferential affinity of the oil for metal over gangue, but not sufficient acid to cause chemical action on the metal, nor is it intended to generate gas for flotation. The patent specification is full, complete, and clear to those skilled in the art, and describes one well known apparatus of mixing vessels, spitzkasten, etc., and the operation of the process therewith.

Prior Processes

The claims are general and particular, all calling for oil and agitation to produce a froth, some defining a range or quantities of oily substance, some likewise of acid, some specifying oily substance alone, some oily substances in various combinations with heat or acid and with both. The main defense of invalidity is lack of novelty and anticipation. In reference thereto it appears from the evidence that the use of oil, air, and agitation in ore concentration, separately and in various combinations, and with other ingredients, was well known to the art prior to the discovery of the process in suit. To fully summarize the prior processes, some of them were bulk oil processes, using oil in such large quantities that in taking up the metalliferous particles in the pulp the mass thereof was yet sufficiently buoyant to float to the surface of water, the gangue sinking. Concentration being more essential for lean ores, economy is the foundation of success, so other of

*Abstract from Judge Bourquin's decision.

these processes reduced the amount of oil to a degree where it was not sufficient of itself to float the metal, and to aid therein, air, steam, or gas was injected to render the mass spongy. Another process further reduced the oil and to and around 4 to 6% in weight of the weight of the metalliferous content of the ore, the somewhat novel result being that the metalliferous particles were by the oil agglomerated into granules which sank in the water and were retained in the mixing vessel, while the gangue rose and was carried off by upcast. Some dispensed with oil and employed surface tension or skin flotation by floating off the powdered metalliferous particles on the surface of quietly flowing waters, or by injecting air, steam, or gas into the mixture of ore and water, or by generating gas therein, where bubbles attached to said particles and carried them to the surface of the water, in all the gangue sinking. Another process sought the same end by spraying the oiled metalliferous particles through air and on to water, where they remained, the gangue sinking. In some processes acid was used to generate gas *in situ* for flotation, while in others it was used soley to render more pronounced the selective attribute of oil for metal over gangue. This last feature was the discovery, so far as ore concentration is concerned, of Carrie J. Everson, of Chicago, to whom a domestic patent, embodying it, was issued in 1886. In some, heat was used to hasten the action of the oil, and some resorted to agitation.

Froment's Patents

For anticipation, defendant relies most upon Froment's patents and working description. They date from 1902 to 1903. The process thereof is one wherein the ore is carefully crushed in two operations so as to minimize slime, and is first deslimed, for that the slime is "too fine to be treated," quoting Froment. Thereupon, to a mixture of deslimed ore and water, oil and carbonate of lime (which may be limestone) are added proportionate to the weight and richness of the ore, from 1% of oil in weight of the ore, for one containing up to 5% of metal, to 3½% of oil for ore containing 50% of metal, and from about 1% of carbonate of lime in weight of the ore, 2½% in difficult cases, or more, and in like proportions to the oil for richer ore, it requiring more gas. Agitation in mixture containing two stirrers revolving in opposite directions and for a few minutes, or about 10 minutes, at about 300 revolutions per minute, the "chief point" being that all metallic particles are brought "into thorough contact with the oil," is described by Froment. The mixture is then discharged into a vat containing a perforated coil through which sulphuric acid is introduced in quantity about 10% of the carbonate of lime, and a vat therein turns slowly and about 10 to 12 revolutions per minute to prevent the ore collecting at the bottom in too compact a mass.

Steam may also be injected through said coil to assist the reaction, but it is necessary in only cold countries. The reaction of the acid generates gas, which in bubbles carry the sulphides to the surface, here skimmed or pushed into a hopper. Such thereof as fall back and sink are otherwise recovered. A large proportion of the oil may be recovered from the concentrate in a press. Froment's patents refer to the use of gas of any kind, that the bubbles will become covered with an envelope of sulphides and rising to the surface form a kind of metallic magma, and the formation of these metallic spherules is singularly active if the gas is in a nascent state. There is little evidence of practical use of any prior processes, and no substantial evidence that any substantial commercial success has accrued to any of them, or that any of them has had any considerable continuous successful operation. Froment's process has not been in practical operation.

Comparisons of the Process

Complainants' process has, in substance, displaced some of the prior, and has firmly established itself as evidence shows many and large plants thereof, built or building, in widely separated parts of the world. Its successful operations, practically from discovery, have recovered, and largely from waste and tailing, value aggregating nearly $9,000,000, and at a profit of nearly $4,000,000, to the patent owner and its licensees. Looking to the evidence, and therefrom contrasting the process with complainants', Froment's requires several times the quantity of oil than does this in suit, both by examination of the patents and working description and by tests in evidence. Froment crushes the ore in two operations and deslimes it before treatment, because the slime is too fine to be treated by his process, while the process in suit needs but one crushing operation and finds slime advantageous and most easily recovered. Froment employs carbonate of lime, the process in suit does not. Froment requires acid and in greater quantity and for a different function, than does the process in suit, which latter may or may not use acid. Both may use heat, and both require agitation, Froment, agitation only to disseminate the oil, the process in suit for that purpose and also to aerate. Froment's result is by flotation by gas generated *in situ*, this in suit is by flotation by air introduced by vigorous agitation. Froment's product is like unto a magma, a spongy, pasty mass of oil and metallic particles, and more or less gas bubbles, while this in suit is a froth of oil and metallic particles and air bubbles. Froment's requires oil in such quantity that he deems it worthy of recovery from the concentrate, so far as it can be, this in suit so little oil, it disappears, is not sensible to sight or touch upon the concentrate, but only to analysis. In Froment's, it would seem that the metallic particles are floated like the basket of balloon, while in this, like the very envelope of a balloon. Froment's is costly, while this is cheap. And from the evidence, it would seem that Froment's process would fail in practical operation, while this in suit has succeeded. In Froment's, he oils the metallic particles by agitation, then, when the mixture is quiescent, generates gas therein by quick reaction, followed by immediate and direct rising of the gas bubbles to the surface in which they may come in contact with but few metallic particles. In this in suit, vigorous agitation of the mixture beats great and excess volumes of air therein, likely bringing the ultimate air bubbles into repeated contact with many metallic particles. The action of the

gas in Froment's is almost explosive in nature. He speaks of proportion of carbonate of lime to be sought as in his test tube example, the reaction may be so sudden and violent as to project the metallic particles out of the tube. Froment's gas bubbles, quick formed and quick rising, it may be, arrive at the surface with expansion still in progress. These or analogous reasons may account for Froment's magma breaking gas bubbles and fragile evanescent froth in so far as his result is like unto froth, and also may account for the process in suit's strong and lasting froth.

Definition of a Patentable Process

The differences hereinbefore set out between Froment's process and this in suit, are so obvious, numerous, radical, and, in many respects, vital, it is clear they constitute different processes. They are different in ingredients, function of some thereof, combination, manipulation, principle, and result. Their points of resemblance only serve to accentuate their difference. Broadly speaking, a process is a definite combination of new or old elements, ingredients, operations, ways, or means to produce a new, improved, or old result. Any substantial change therein, by omission to the same or better results, or by modification or substitution with different function to the same or better result, is a new and patentable process. New or substantially changed methods whereby the product is bettered, increased, cheapened, may be a new and patentable process.

In this suit the doctrine of equivalents has no application. The process in suit is so clearly new that no exhaustive discussion of facts, cases, or law is necessary to distinguish it from other processes or to demonstrate its novelty. The patentees herein discover a new, cheap, simple, practical, and useful way or process to combine oil and air and, by agitation, to float and secure the metallic contents in ore concentration.

Present v. Prior Patents

To whatever extent they drew from the prior art, as they rightfully could, they took the last and successful step. It is urged, however, that as the patent in suit does not specify exact quantities of oil and acid, but a range thereof, it describes merely an experiment not patentable. It is true, every ore presents its own problem of reduction. So while all may lend themselves to a general method, each may require some modification of the method. All skilled in the art understand this, and know that in addition to the best scientific theory they must add the light given by trial and practice. To the contention that, as in Froment's process, the agitation must entrain some air like unto that of complainants' and so the latter lacks novelty, it may be observed that if so, it was unintentional and unrecognized in that Froment had in mind only flotation by quick acting gas generated *in situ*, it aided the art none and is unimportant.

To the argument that in operating, Froment, in rightful economy and decrease of oil, and in rightful omission of carbonate of lime in treating ore containing it in sufficient quantity, his process would approximate this in suit and arrive at a like froth and hence lack of novelty in the latter, the response is that the fact that infringement may be easy does not impeach an otherwise valid invention, and that if Froment's methods are modified until they approximate complainants' and so produce a like product, the process is no longer Froment's, but is complainants'. Upon all the evidence the Court is of the opinion the defense of lack of novelty and anticipation is not established. Another defense is that the invention was not joint. It seems the patentees were experimenting with the Cattermole granulation process. An experimenter in their employ, in obedience to their instructions, determined on by consultation between all said patentees, and to which each contributed suggestions, gradually reduced the amount of oil until the result was the peculiar froth of the process in suit. The experimenter was but the instrument through which the genius of these patentees found expression.

Conclusion and Verdict

The circumstances are sufficient to constitute these patentees joint discoverers. At any rate, it is not proven they are not. Although some of the claims in issue include elements not absolutely essential, namely, heat and acid, and in respect to which they may afford no protection, they are not invalidated by undeceiving superfluous features, if heat and acid are such. The patent is valid in respect to all claims in issue. Enough appears in the evidence to compel the conclusion defendant was using complainants' process and was infringing the claims in issue as charged.

Mining Costs at the West End, Tonopah

The following figures are from the last annual report of the West End Consolidated Mining Co., and show a direct decrease of $1.28 per ton on the previous year:

	Cost per Ton		
Superintendent and foreman	$0.135	Excavating	0.027
Breaking	0.802	Assessment	0.011
Timbering	0.090	Total direct	$3.608
Tramming	0.372		
Hoist, etc.	0.200	Salaries	$0.145
Ore loading	0.233	Office	0.046
Ore sorting	0.366	Legal, etc.	0.031
Ore sampling	0.004	Taxes	0.012
Surveying	0.047	Insurance	0.020
Surface	0.135	Depreciation	0.067
Assaying	0.040	Automobile	0.044
Drayage	0.015	Bullion tax	0.131
Ore dump	0.045	Liability insurance	0.058
Development	0.862		
Electric wiring	0.012	Total indirect	$0.554
Shaft-sinking	0.212		
		Total operating	$4.162

The canning industry of the United States produces goods valued at over $160,000,000 per year, California leading with about $40,000,000. This will give an idea of where the great output of tin-plate is consumed.

Coal-mine fatalities in the United States during May were 195, making 1078 for the first five months of the year

Discussion

Readers of the MINING AND SCIENTIFIC PRESS are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment. Insertion of any contribution is determined by its probable interest to the readers of this journal.

The Psychology of Zinc

The Editor:

Sir—F. L. Clerc's letter of June 9 in the *Mining and Scientific Press* of July 12 has been read with interest. Among some sage remarks on the technology of zinc smelting, remarks which show your correspondent to be a close and accurate observer, are some observations of a character quite unworthy of a writer of the standing of Mr. Clerc.

Mr. Clerc is, I think, quite unintentionally misleading where he states that "a rich concentrate containing between 50 and 60% of zinc must be made before the smelters will look at it." It is true that for the most part in the middle western fields such a grade is produced, but this is purely a matter of metallurgical and financial balance on the part of the mines and not from the demands of the smelters. That such is the case is shown by the fact that the ores from the Rocky Mountain districts shipped to smelting works will average considerably less than 40%. During the year 1912, ores were shipped from Colorado to Oklahoma, with a zinc content as low as 18%, and apparently both parties to the transaction were satisfied. As an evidence that the process of mining, milling, and smelting taken together are efficient, it may be mentioned that zinc ores of less than 2% zinc are being mined, milled, and smelted, at a cost of considerably less than 6c. per pound, and this without any help from silver and gold, which compares favorably with the porphyry coppers.

I can remember a time not many years ago when the lead smelters in Colorado were receiving ores containing 20 to 25% zinc, and the slag contained 8 to 10% of this hated metal. Today that condition no longer obtains, and I cannot help remembering also that it was a zinc metallurgist who contributed most to that desirable end. Let Mr. Clerc cheer up, perhaps another Wetherell may arise to point a way to utilization of his 20% zinc ores of which he has such "enormous" deposits. In passing, let me remark that so far as concerns "enormous" deposits of 20% zinc, "opened by shafts and drifts," you might glance at the locality whence this communication is sent.

Notwithstanding the benighted state of the zinc metallurgists who will not follow the lead of their brethren in other branches of metallurgy, and discard furnaces and apparatus known (by Mr. Clerc) to be obsolete, I may mention that during recent years many hundreds of thousands of dollars have been spent in Europe in experimentation and much valuable work is being carried on there today both on electrothermal and hydrometallurgy of zinc; and in the United States from Hartford, Connecticut, to San Francisco, California, there are, at points too numerous to mention, many experiments being carried out along the same lines.

Let not Mr. Clerc despair, few of the zinc smelters maintain fences around their works, and I don't recollect ever seeing a single watch-dog in connection therewith.

The family physicians of whom we are told, are perhaps somewhat inclined toward homeopathy, for such has been their training, and I know they look with great suspicion on patent medicines and nostrums, for their experiences with the gentlemen who dispense these from the various metallurgical carttails have not been happy ones.

R. G. HALL.

Kansas City, Missouri, July 19.

One Reason Why Mining Languishes

The Editor:

Sir—Much has been written during the past few years in the attempt to explain the difficulty experienced by owners of mining property in interesting capital in the development of prospects or in buying their partly developed mines. The apex law; governmental bureaucratic interference with the divine right of the free American to do as he pleases, even on property he does not own; too many automobiles; unwillingness of the experienced investor to pay cash for the privilege of developing the other fellow's property—all of these, and still other reasons, are complained of by the owners of future bonanzas and their agents.

Contemporaneous with these complaints on the part of the owners, comes an equally emphatic complaint from the representatives of experienced mining capital that they can find no properties worth taking up on the terms demanded. As a matter of fact, some of the larger companies have become so discouraged that they have reduced their staffs of examining engineers within the past year or two.

Thus we find the party of the first part and the party of the second part complaining of diametrically opposite conditions; which fact seems to indicate that something is wrong with the methods used in presenting properties and propositions for consideration. In my experience, this difficulty lies in the fact that only a small percentage of the propositions presented are accompanied by an adequate convincing description of the mine itself and what it shows. It is so rare to receive a well written description by a competent engineer that is a pleasure, rather than a duty, to review such a report. The one important thing in a mine report is description of the mine. Describe the vein outcrop; then take the reader down the shaft and out through the first level, describing the vein in exact detail; describe each assay sample and tell where it was taken; then down through the stope and along the next level, etc. This sort of report is convincing to the reader and allows him to form his own opinion as to whether the mine would interest his clients. The majority of reports submitted do not contain such description, but compel the reader either to accept the opinion of some stranger to him, who wrote the report, or drop the proposition. Many badly written reports leave a lingering suspicion in the mind of the reader that, if the owner had employed a competent person to write the report and

describe the mine, the proposition might be of interest.

Here are two concrete examples to illustrate this. Recently I received a brief description of a mere prospect in northern California from a person who makes no claim of being a mining engineer. That person had visited the property, secured a tentative proposition from the owner, and had ascertained that the owner's rights to the unpatented claims were legally correct. He then described the entire proposition concisely and convincingly, quoted the owner's price to him—the option allowed ample time for development before any payments were demanded—and he stated what commission he expected in case the option should be exercised. I had a client who wanted something of this kind, so I examined it, and within five weeks the property was under bond, and development work was started. And this is merely a prospect, no ore whatever in sight.

In the other case, I have recently had occasion to struggle through thirty-odd typewritten pages of mangled and tortured English constituting an alleged report on a future bonanza, which describes everything in the neighborhood except the underground work, and is accompanied by a map which shows everything except the mines. The majority of the few samples taken are openly stated to have been taken from the high-grade streaks, and they assay well. As an example of how not to do it, this report is a gem; and yet there lingers a suspicion that if the property were properly described, and appropriate terms were offered, this might be an interesting proposition. Doubtless the owners paid a good round sum for this effusion, perhaps so much per page! The description of the geology and the lucid explanation of the ore deposition really warrants publication for the enlightenment of those of us who are obliged to struggle valiantly for a little ray of light on these profound secrets of the Great Architect.

Isn't this interesting:

"The apparent rocks are massive acid granites carrying the normal four constituents of quartz, mica, feldspar, and hornblende, with accessory minerals of value imbedded in the paste of the mass originally. This is now changed in places from segregation of the several ingredients into dikes of one or more only of the minerals, through like attracting like, from a certain intensity of magnetism being [illegible] for a period, this being said to be to the degree of conductivity of one of the materials in the magma. Then the magnetic current weakens, and another constituent more susceptible is effected. [illegible] seem to account for spar dikes, hornblende dikes, and micaceous dikes, and the helping by lateral secretion to assemble the economic metals, iron, copper, etc. into the fissures. These granites are the latest volcanic molten magna that came up as plutonic or deep-seated rocks during the Upper Jurassic period in geology. Their dynamic force was violent and stupendous, and they forced their way up through all previous rocks, probably the Triassic and Paleozoic indicated by —— and other peaks."

In speaking of the icefields which covered the region during the Glacial period, we get this gem:

"When icefields five thousand feet thick or more, covered the face of the land till the world tilted with its weight and shifted the equator, bringing the ice nearer the heat of the sun."

The entire report shows about the same grade of ability. Comment is superfluous, except, perhaps, to say that the report has visited the offices of various mining companies without commanding much attention.

Since starting this letter, the *Mining and Scientific Press* for June 21 has reached me. In it is W. F. Disbrow's letter on 'Vendor's Valuation of Mining Property,' which is very much to the point. By all means, Mr. Owner, read what he says and think it over. Scattered through all the important mining regions are enterprising newspapers, devoted heart and soul to boosting their region. This is right and proper, but the biggest part of their boosting consists in exaggerating the facts, and if a real investor visits the region he, too, often becomes disgusted and never wants to hear of that region again. But mostly he is used to the exaggeration and does not come. Now if the editors of those papers would take Mr. Disbrow's letter as a text and preach a few sound commercial sermons to their readers, they would be doing some boosting along new lines which would probably have a beneficial effect on the local mining industry.

Mr. Disbrow advises Mr. Owner to try and believe that the prospective purchaser is sincere, and says this, which is worth repeating: "You will find it easier to do this if you will consider *the indefinite manner in which you have arrived at the valuation of your mine*, and compare it with the systematic investigation of your purchaser." The italics are mine, and the phrase is emphasized because it seems to contain the vital point of all the discord between buyer and seller. The prospective buyer decides only after a most careful examination of the property and the operating conditions surrounding it. Even after this careful study the result is very often a failure. These failures have taught the buyer caution, and this caution is apt to be considered by the seller as a foul conspiracy to obtain his wonderful bonanza for a pittance. On the other hand, the seller's price and terms are usually based on what he would like to get for the mine, rather than on any real appraisal of the value of the property. If these premises are sound, then the solution seems to be that the cheapest and quickest way for the seller to present his proposition to the buyer is to employ a competent and disinterested engineer to report on (which means describe) his property and to advise with the owner in regard to terms and price. The expense of this is actually less than the cost and loss of time spent in peddling the proposition from office to office. The buyer must have convincing evidence, and more and more are the various mining companies demanding from sellers the reports of disinterested engineers on properties offered for sale.

J. Nelson Nevius.

Pasadena, California, June 22.

Special Correspondence

BOSTON

THE FIRM OF HORNBLOWER & WEEKS CELEBRATES TWENTY-FIFTH ANNIVERSARY—DEVELOPMENTS AT THE IRON CAP AND SUPERIOR & BOSTON MINES, ARIZONA—CONDITIONS OF MINERS AT BUTTE AND LAKE SUPERIOR COMPARED.

The Stock Exchange house of Hornblower & Weeks is [illegible] observed its twenty-fifth anniversary. The senior member, Henry Hornblower, is president of the Boston Stock Exchange, and the junior member, John W. Weeks, is now a United States Senator from Massachusetts. One of the strong members of the firm is James J. Phelan, who rose from a clerkship to an interest in the business. Mr. Phelan has a large political following, and through Mr. Weeks' activity in politics, first as Republican leader for several years and now as Senator in Congress, the house gained the name of "political headquarters." Hornblower & Weeks do not specialize in mining as much as they did a number of years ago, having encountered bad weather

in their sponsorship of Bingham Consolidated. Still later there has been some tendency to criticize them a little in connection with the mining failures of the convicted broker, Stephen R. Dow, and the Sealship Oyster Co. The house maintains a mining statistical department, and offices in Chicago, Detroit, Hartford, Newport, Providence, and New York.

The Iron Cap Copper Co., of Globe, shipped fourteen carloads of ore last month to the smelter at El Paso. On account of some additional exploratory work outside of the vein on the 650-ft. level, the average grade of the ore fell somewhat below the usual shipments. Driving east on the 650-ft. level, the face of the orebody is somewhat narrower than a fortnight ago, but the ore continues to be of high grade. At present five of the six faces of the mine are in ore. The Boston management of the Iron Cap is trying hard to rehabilitate the company, which suffered so much under former management and name. The stock is occasionally traded in on the Curb here, but has not been active, and this is not looked for until the mine has been better opened.

Superior & Boston, another Globe property, is also making encouraging headway and is shipping ore found in development work to the El Paso smelter. The mine in the lower workings has suffered from extreme dampness and bad ventilation. On account of this, the management paid miners $4 per day, 25 cents more than the other Globe mines. Conditions now have been made so much better that the normal union scale of $3.75 per day was adopted on the first of the month.

The continuance of the Lake Superior strike has brought into comparison and controversy the difference in wage and living conditions as between the Lake and Butte districts. By some it is claimed that the living standard at the Lake is fully 50% below that of Butte. It is said that the mining companies at the Lake exploit their workmen by renting them, at an extraordinary return upon the investment, old and cheaply built houses without any modern conveniences. It is claimed that a married man at the Lake, by denying himself and his family comforts, may save perhaps $5 per month in the summer, but these savings are used up during the winter. Anaconda has never had a strike, and it is claimed by its friends that it uses its miners a great deal better than Calumet & Hecla. On the Lake side the contention is made that the Butte miners have to pay rents of at least $25 per month, have to contribute an average of $5 per month in dues to the organization and strike assessment, have to pay for their water, and submit in many ways to higher living costs than those of Lake Superior. Underground workings, on account of the cool temperature in the Lake mines, are compared favorably with the heat at depth of the Butte mines. It is pointed out that the Michigan copper miner gets his home for $4 or $5 per month, has no union assessments, has his water free, and the end of the month has more money saved than the Butte miner. It is also pointed out that there is no Sunday work at the Lake, while at Butte operations go on every day in the year.

Engineers and surveyors have begun operations laying out the route of the Butte, Wisdom & Pacific railway, the subsidiary of the Boston & Montana Development Co., headed by W. R. Allen, of Butte, which will build a 100-mile road through the Big Hole basin and connect the two mining towns of French Gulch and Elkhorn.

NEW YORK

OPERATIONS OF THE INTERNATIONAL SMELTING & REFINING CO., GRANBY CONSOLIDATED, AMERICAN SMELTING & REFINING CO., AND THE GUGGENHEIM INTERESTS.—AFFAIRS OF OHIO COPPER CO.—GOLD AND SILVER SALES AND PRICES.

The International Smelting & Refining Co. is doing a big business and expects soon to blow in a fifth lead blast-furnace at Tooele, Utah. Its plants at Perth Amboy and near Chicago are running at full capacity, and when it builds a new copper smelter near Globe, Arizona, as is confidently expected, it will be an even larger factor in the smelting field. Since it has been paying 8% on its capital, and making earnings at an even greater rate, it is a profitable venture as well. The Granby Consolidated is a property which has not done so well, but which seems to have a bright outlook in its new property at Hidden Creek, British Columbia. Construction work is well advanced, and it is expected that production will begin by January next, when about $3,600,000 will have been spent on the new property. A pleasant feature of the situation is that

costs so far have been kept well within the estimates. The dividends of the American Smelting & Refining Co. should be kept at the usual rate, even though earnings have been decreased lately, due to the shutting down of its Mexican plants by the revolution. The smelter at Aguascalientes has been steadily at work, almost without interruption, but the rest are practically all shut down, the Chihuahua plant, however, being in shape to start whenever fuel in sufficient quantity can be shipped in. With its Mexican plants operating in ragtime, the United States Department of Justice threatening to investigate it as a 'smelting trust,' the minority shareholders in the Federal Mining & Smelting Co. creating all sorts of a rumpus over smelter contracts, A. C. Beatty suing the Exploration company, and Louis Ross suing A. C. Burrage in connection with the promotion of the Chile Copper Co., this has not been an entirely happy year for the Guggenheim interests. The Cananea Consolidated has also had its troubles incident to the Mexican revolution, and is now operating at about 60% of its full capacity. This Company some time ago joined the Amalgamated family at 42 Broadway. The stock in the Greene Cananea has been reduced to less than 500,000 shares, most of the old certificates having already been exchanged.

Ohio Copper is apparently in for a thorough overhauling, M. W. Atwater having been engaged for the task. The president of the Company has given out the statement that though over 70,000 tons is being handled monthly, at a cost for mining, milling, and transportation of about 85c. per ton, the earnings are not satisfactory. The average copper content of the ore for the first five months of this year was 1.015%, so it is evident that the chief trouble must be with the recovery. It will be remembered that not long ago Col. Wall's ideas of milling practice were incorporated into the Ohio mill, but had only a brief existence. Well informed people have expressed the opinion that the property is of a good deal of value, but has suffered from too much tinkering. The balance sheet of the Company for the year ended May 31 shows assets of $5,535,014, made up of the following items: mine and mill properties, $4,745,789; treasury stock, $250,000; furniture and fixtures, $2335; unexpired fire insurance, $792; cash, $192,404; and accounts receivable, $278,604. Liabilities include $4,150,000 shares, accounts payable $130,632. Surplus account includes profit on operations from August 1, 1912, to May 31, 1913, $93,177 less sundry and other expenses and interest on bonds, leaving a surplus of $8382.

Sales of gold bars by the New York Assay Office during July amounted to $2,183,140. This does not include exports, $5,240,882 having been sent to Europe and $23,311 to Canada. The domestic sales indicate that gold consumption by the jewelry trade, and in other industries, is larger this year than during the past two years. While this had no direct bearing on currency and financial relations, it forms an interesting sidelight on the general state of trade. The silver market continues steady, the average for July in London having been 27 1/16d., about the same as for June, and 1d. less than the average price last year. Conditions in Mexico and China have been so uncertain that both supply and demand have been restricted. Exports from London are falling behind last year somewhat. For the period up to July 24, £4,628,500 was exported to the East this year, compared with £5,001,700 a year ago. While India has taken slightly more this year, China has taken a good deal less. It is doubtful whether in the five months remaining the movement will be liberal enough to equal that of 1912 when for the full calendar year £13,872,500 was taken.

LONDON

AFFAIRS OF ORSK GOLDFIELDS, LTD.—LEAD AND ZINC DEPOSITS IN RHODESIA.—REPORT ON THE BWANA M'KUBWA COPPER MINE.

The Orsk Goldfields company provides an excellent example of 'phantom profits.' In fact, its case may be called the 'limit.' The yield of gold during 1912 was worth £36,662, and the so-called operating cost is given at £10,509. The directors subtract the latter from the former, and announce that a 'gross working profit' of £26,153 is shown. In the first flush of excitement, the shareholders naturally congratulated themselves on the low proportion of cost to output, and looked forward with pleasurable anticipation to handling some of that surplus. But on turning to the accounts, the real result of the year's work was seen to be a loss of £3144. The directors do not tell the worst all at once, but let their clients down gently by interposing a phantom 'net' profit between the 'gross' profit and the actual 'loss.' They deduct from the gross profit the items of £3044 for winter upkeep, £10,583 for administration charges, and £5921 as royalty to the Russian government, and make a 'net' profit of £6604. They then proceed to the next step and deduct £6772 for depreciation, and £2689 for London expenses. After allowing for one or two small items in the accounts not worth specifying here, the final result is obtained, namely, the loss of £3144 on the year's operations. It is hardly necessary to make any comment on this way of presenting accounts. Your readers can make the comment themselves. The Company has a distinguished board of directors and is advised by a leading firm of mining engineers. Besides, are not the lawyers and auditors whose names appear on the front page of the report the very leaders of their respective professions?

However, let me get back to the mining operations of the Orsk Goldfields. The Company was originally formed to acquire a quartz property in the Orenburg province, South Russia, but the results were disastrous. So subsequently a tract of alluvial ground, containing gold, was acquired near Nicolaievsk in Eastern Siberia. A number of distinguished American specialists on dredging have been connected with the enterprise, namely, D'Arcy Weatherbe, C. H. Munro, and C. W. Purington. None of these gentlemen stayed long.

From time to time, during the last half-dozen years, much has been heard of the copper and lead-zinc mines in Northern Rhodesia, belonging respectively to the Bwana M'Kubwa and Rhodesia Broken Hill companies. These two Companies are subsidiaries of the Northern Copper and Rhodesia Copper companies, of which Edmund Davis is chairman, and are affiliated to the Bechuanaland Exploration company. Reports have been made persistently of the great mineral resources at Bwana M'Kubwa and Rhodesia Broken Hill, and it has been supposed that the only obstacle in the way of their commercial exploitation has been cost of transport and unamenability of the ores to simple methods of treatment. Two documents have come to hand this week that tend to knock the bottom out of all these vague stories of wealth. One is a paper read by A. E. V. Zealley, recently published in the *South African Journal of Science* describing the Rhodesia Broken Hill deposit. Mr. Zealley is an able geologist and mineralogist connected with the Geological Survey of Rhodesia. His account of the deposit is cold-blooded scientific discussion, in sharp contrast to the more comforting reports liberally distributed by those in financial control. The deposits are found in small *kopjes* or hillocks, 30 to 50 ft. high. The water-level is less than 20 ft. below the level of the plain, and the unaltered zone consists of hard crystalline limestone containing scattered patches and small veins of blende and galena. The *kopjes* consist of weathered rock containing many cavities in which are found carbonate and silicate of zinc and carbonate of lead. In the lowest part of the oxidized zone are found phosphates and vanadates of lead and zinc, the phosphorus being apparently derived from the animal remains with which many of the caves are filled.

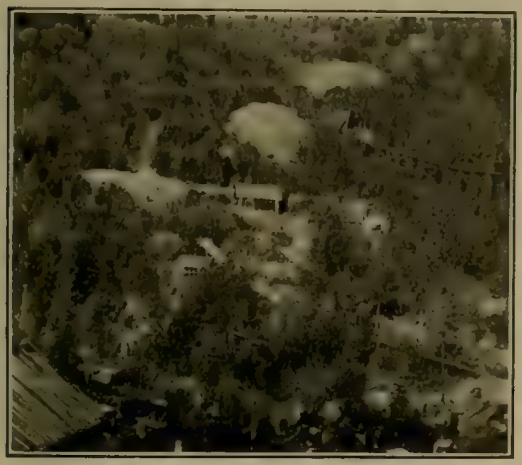
The other document referred to is the preliminary report issued by Hooper, Speak & Co., based on S. J. Speak's recent visit of inspection to the Bwana M'Kubwa copper mine. This mine was supposed to contain 120,000 tons of oxidized ore assaying 14% copper, together with 750,000 tons of low-grade oxidized ore. It was stated also that there were indications of at least 2,500,000 tons of sulphide ore. Mr. Speak has liberally applied the 'cold douche' by reducing the high-grade figures to 50,000 tons and 12% copper. He deprecates the continuance of the water-concentration plant that was erected for the purpose of producing a concentrate rich enough to ship, for the recovery is too low, if a rich concentrate is made, and the costs of treatment and of freight are too high. The direct smelting

of the high-grade oxidized ore could not be done in a blast furnace owing to its finely divided state. Mr. Speak recommends that development should be pushed in the low grade orebodies below the zone of oxidation, with the object of proving some of the 'indicated' sulphide ore. Hooper, Speak & Co. are engaged at present in preparing a plan of operations for treating the sulphide and oxidized ore.

LILLOOET, BRITISH COLUMBIA

REVIVAL OF THIS OLD DISTRICT - ORGANIZATION OF CORONATION MINES, LTD.—DEVELOPMENT OF THE LITTLE JOE.—TRANSPORT FACILITIES.

This is one of the oldest mining districts in the province, the first discovery being of placer gold on the bars of the Fraser river about 1856. Placer mining, both by sluicing and hydraulicking, was carried on until 1899, not only on the Fraser river, but also on the tributaries of the Bridge river, which empties into the Fraser a short distance above the town of Lillooet. Until 1897 the chief producers were Tyachien, Sucker, and Cadwalder creeks, and the South Fork of Bridge river, situated about 70 miles from the



SURFACE VIEW OF LITTLE JOE PROPERTY.

town of Lillooet. In 1897, prospecting for gold-bearing quartz was commenced, resulting in the discoveries of several outcrops of free-milling quartz veins on Cadwalder creek, from near its mouth, where a group of claims known as the Forty Thieves was located, to the Countless group of claims, about seven miles easterly and on the same creek.

During a visit made by W. M. Brewer to the district in 1898, he found the ground between these points all staked, and the outcrops of oxidized ore not only yielded some high-grade specimens, but so far as could be judged at that time, indicated that these outcrops were filled fissure veins possessing characteristics of permanence and continuity along the line of strike, which is, generally speaking, northeast and southwest. The district at that time, though, was quite inaccessible, the cost for freighting in supplies being about 9c. per pound, from Ashcroft on the Canadian Pacific railroad, the town of Lillooet itself being about 50 miles from that railroad. In 1901, operations were practically abandoned in the district, and from that time until 1911 there was no work done except assessment by a few 'old-timers' at Lillooet, who had faith in the country and believed that some time the town would be resurrected.

The revival was brought about early in 1911 by Arthur Noel, who may be called the father of quartz mining in northern British Columbia. He succeeded in interesting James Dunsmuir, H. B. Thompson, and B. J. Perry, of Victoria, who later purchased the Ben d'Or group, on which the first discoveries of high-grade gold-bearing quartz had been made in 1897 by Mr. Noel. These gentlemen organized the Coronation Mines, Ltd., with H. B. Thompson, president of the Company, and C. L. Copp, manager, and about July 15 the first clean-up from 188 tons of ore, yielding $9000, was brought to Victoria. This naturally attracted considerable attention because, although the Ben d'Or mines had not been heard of as a producer since March 1901, previous to that it had produced $64,808 from 5520 tons of ore. The ore from which the recent clean-up was made came from the Little Joe claim and from a stope about 200 ft. lower elevation than the old workings on that claim.

From a report made by Mr. Brewer on the property in April 1901, the following is extracted, confirming the conclusions drawn then, and such have been proved to be correct by the work done during the past two years:

"The Little Joe vein has the following characteristics: a true fissure, strike north 75° east magnetic, which is the general trend of the vein where exposed across the Little Joe and Countless claims. With slight variations this vein apparently maintains continuity a distance of about seven miles, and dips 65° to the north, with a width varying from 12 in. to 3 ft., in the underground workings. The outcrop of oxidized quartz is traceable on the surface by cross-cuts at variable distances apart for a distance of 4500 ft. The hanging wall is a highly silicious rock, probably an altered gneiss, extremely well defined and unbroken the entire length of the underground workings. Foot-wall is the same as hanging wall, with similar conditions. Vein filling consists of riband quartz, talcose gouge, and some schistose rock. Oxidized ore probably extends down to a great depth."

When the present owners acquired this property, all the old workings that the above examination in 1901 described, had caved in, consequently new working openings were started, both on the Little Joe and Countless claims, which today aggregate as follows: on the Little Joe, drift No. 3, 251 ft. below the outcrop is 361 ft. in length; cross-cut No. 4, 89 ft. below No. 3 drift is 505 ft. in length, with a drift from this 500 ft. in length and carrying ore for 375 ft. This ore-shoot has been connected with the shoot which was stoped in the old workings, and the ore from it yielded in the mill about $40 per ton in free gold. On the Countless, a cross-cut adit 545 ft. long, 275 ft. below the surface, has been driven to ore. The most easterly group of claims situated on this belt is the Countless. Traveling westerly from that, are the Ben d'Or (now known as the Coronation), Blackbird, Ida May, Lorne, Woodchuck, and Forty Thieves. Each group comprises several mineral claims and some fractions, each full claim being 1500 ft. square, and fractions of variable size.

The present means of transportation into the district are very different from those available either in 1898 or 1901, because it is possible at present to drive a wagon or even an automobile from Lytton station on the Canadian Pacific railroad to Lillooet, a distance of 48 miles, and from Lillooet to the mine, a distance of 70 miles, and owing to these improved transportation facilities, renewed interest has been taken by prospectors who this year are exploring the adjacent country. A 10-stamp mill was hauled to the Little Joe during the winter of 1898-9, at a cost approaching 18c. per pound for freight. This mill is today reported to be in excellent condition, and the ore recently treated was crushed in it by water-power furnished from Cadwalder creek, which was developed at the time the mill was erected in the summer of 1899, and is amply sufficient to drive heavier machinery than the present equipment.

PLATTEVILLE, WISCONSIN

PRODUCTION AND PRICES OF ZINC ORE IN JULY.—DEVELOPMENT AND NEW EQUIPMENT IN THE DISTRICT.

Low prices for zinc ore militated against a normal production for July, and the output for the field was 5,000,000 lb. of zinc concentrate lower than for the published reports covering the month of June. High-grade ore sold well in July on a basis ranging from $42 to $45 per ton for 60% ore. The bulk of the mine production, however, ranges from 30 to 55% for this field, and it is on the lower grades that the most serious inroads have been made. Thirty per cent ore brought $16 per ton, at which figure no profit can be made, as the average Wisconsin concentrate costs this much to produce, figuring fuel and cartage; 35% sold at $17.50 to $18; 40% ore brought $21.50

per ton; 45%, $24 to $25; and 50%, $28 to $30; all grades carrying the usual penalties for iron.

Car deliveries for the month were made as follows: To Mineral Point Zinc Co., 94 cars, 3490 tons; Grasselli Chemical Co., 34 cars, 1285 tons; National Separating Co., 27 cars, 1063 tons; Illinois Zinc Co., 22 cars, all high-grade separator ore, 892 tons; Empire Roaster Works, 15 cars, 558 tons; Matthiesen & Hegeler Zinc Co., 11 cars, 398 tons; Linden Zinc Co., 13 cars, 390 tons; Joplin Separating Works, 3 cars, 126 tons; a total of 219 cars, equal to 8202 tons. Shipments of lead ore were light, although prices were better maintained through the month than on zinc. The Federal Lead Co. secured four cars, 238,000 lb.; St. Louis direct, 239,160 lb.; a total of 477,160 pounds.

Heavy deliveries of iron pyrite came from the Wilkinson mine at Benton to the Grasselli Chemical Co., 3,089,240 lb.; National Separating Co., Cuba, 864,790 lb.; Linden Separating Co., 276,140 lb.; a total of 4,230,170 lb., about 2,000,000 lb. under the production for June.

The gross production of concentrate from mines during the month aggregated 13,872,390 lb., and net to smelters 10,386,800 lb. The Mineral Point Zinc Co. delivered to the smelter at De Pue, Illinois, 26 cars of roasted ores, equal to 1,884,300 lb., about half of the usual monthly deliveries.

Work in the various districts may be summarized as follows: The New Jersey Zinc Co. is planning extensive operations in the Highland district and is rigging up five power and concentrating plants. Linden reported four good ore developments on the Ross, Glanville, Gribble, and Optimo. More men are being taken on at the operating mines. Mineral Point shows activity about the works of the New Jersey Zinc Co., and the acid works will be remodeled. The Mineral Point Public Service Co., supplying electric power to mines and the industry generally, installed new machinery. Platteville witnessed a tremendous slump in local production, only two mines now producing and shipping. Benton holds up best of any 'camp' in the field, and reports almost normal production. The Fields Mining Co. reported the opening of zinc ore on new land. The orebody is 32 ft. thick. Hazel Green made its usual showing in deliveries, the ore coming from the Kennedy and Cleveland mines. A new development is being 'stripped' at the Scrabble Creek mine, owned by the Cleveland company. The Lawrence mine is producing, and a new 125-ton power and concentrating plant is now almost complete. Shullsburg shows the output of the Rodhams, Winskill, and Milwaukee-Shullsburg mines only. Galena is producing very little ore. A new paint factory is being established at this point by Edward T. Goldthorpe, formerly superintendent of the Skene mine at Elizabeth. Four new shafts requiring equipment are complete and in ore in the Mifflin district. Montfort has one live producer in the O. P. David, while Dodgeville has one in the Lucky Five.

SPOKANE, WASHINGTON

[illegible]

NORTHPORT, AND ORIENT DISTRICTS.

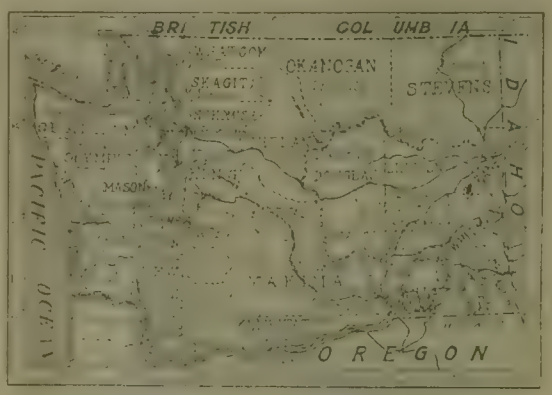
The Mountain Lion mine and mill, in the Republic district, was examined by J. Lorn McDougall, in the interest of the McLaren Bros., or estate, of Ottawa, Canada. The mill has since been examined by local engineers for the purpose of ascertaining the cost of remodeling it for treatment of the Mountain Lion ore by the latest method of cyanidation practised in the 'camp.' A large tonnage of $7 to $8 ore has been blocked out in the mine.

Milling practice at Republic is apparently still in the experimental stage, judging from the absolute inactivity of the North Washington Power & Reduction Co.'s mill and recent break-downs, and substitution of new machinery in that of the San Poil Consolidated. Here a Williams hammer-mill of heavier construction, and a new 350-hp. engine have replaced lighter machinery, and the rated capacity of 125 tons per day has not yet been attained. The present weekly output of bullion is reported at $4000 to $6000, from about 735 tons of ore treated.

The Knob Hill company has declared a dividend for July of $5000, being ½c. per share on its capital stock. This Company may open its lower levels.

The Republic Mines Corporation is employing 30 men on the 400, 500, and 700-ft. levels of the Surprise mine, stoping south of the shaft from the 500 to the 400 and north on the 500-ft. level. The present production is from 125 to 150 tons per month, and the ore assays from $15 to $20 per ton. This Company, during July, shipped 1358 tons of ore to the smelters. In the northern part of Ferry county the Shawnee company is contemplating a resumption of work, and the British Columbia Copper Co. is about to resume work on the Lone Star and Washington mines. J. L. Harper has taken a bond on the Faithful-Surprise mine, the consideration being given at $60,000. At Meteor, the most southerly mining town in the county, the Gwinn Mining Co. is installing a concentrator and erecting a dam on Hall creek to generate electric power for its mine and mill. The Gwinn ore has a value of about $16 per ton in gold, silver, copper, and lead.

The Chewelah district of Stevens county is at present the most active. The Copper King company has received from the Granby smelter at Grand Forks, British Columbia,



MAP OF WASHINGTON.

returns from two cars of ore amounting to 41.6 oz. silver per ton and 8.65% copper, with a net value of about $40 per ton.

The United Copper Co. has driven its lower adit about 2500 ft. and has gained about 1000 ft. depth. The shaft is down 600 ft. and has cut some stringers of high-grade ore unexpectedly. On the 500-ft. level, a drift on the vein has exposed the best grade of ore ever cut in the mine. The present shipments average 26 tons of crude ore and five to six tons of concentrate per day. The stockholders of the Company are holding the value of the stock [illegible]

the Aurora mine is in about 1000 ft., and has attained a depth of 547 ft. at the face. It has cut two veins; the first, near the portal, is 40 ft. wide, with ore assaying up to $20 per ton. The other was cut at 470 ft. from the portal and is about 30 ft. wide, of which 10 ft. assays about $20 per ton. The adit is intended to be driven about 5100 ft. in all, and may cut a third vein soon, if indications are to be relied upon. The Standard Chewelah company has installed an engine and a 5-drill air-compressor in addition to a hoist, boiler, and other equipment.

In the Northport district, G. H. Safford, of Spokane, has leased the ore dump of the Paragon mine and is concentrating the ore by first passing it over a grizzly, separating the coarse and washing the fine through riffled sluice-boxes and finally jigging. The principal metal content is copper.

In the Orient district the White Elephant company is erecting a concentrating plant, has installed a sawmill, and is cutting lumber on the ground. The Galena Hill company has finished sinking to the 200 and will sink to the 400-ft. level. The vein will be cross-cut on the 200, 300, and 400-ft. levels. The vein is four to seven feet wide and has a dip of 35 to 40 degrees.

General Mining News

ALASKA

Nome

Reports from every district on Seward Peninsula complain of want of water for placer mining. The total rainfall so far this summer is only one inch, the lowest in 14 years. The snowfall last winter was also light, and as a result all producing operations except a few dredging projects have been suspended.

Valdez

Later reports from Iditarod back in Alaska all tend to confirm the previous reports of the new mineral discovery at Separation, as detailed in our several correspondence last week.

ARIZONA

Gila County

(Special Correspondence.)—At the Inspiration Consolidated concentrator in Miami the first ore was passed into the crusher on August 11. The grinding and flotation units started on August 15. The concrete mixers at the millsite are set upon platforms and the sand, cement, and crushed rock carried to them, already mixed, by conveyor belts, the machines merely mixing the material with the water and discharging it into long wooden troughs or launders, which will convey the concrete downward to the successive walls as they are built one below the other. The concrete now being poured at the ore-bin foundations near the hoisting shafts in Webster gulch is being supplied from a flat-car, upon which the mixer is mounted. Launders leading out from each side of the car make it possible to fill forms on each side of the car as it moves along the track. The quarry, west of the millsite, is supplying about 80 cu. yd. of rock per day for the ore-bin construction and about an equal amount for the beginning of the mill building. As work at the latter progresses, the quarry will be opened and its output increased. Cement is arriving at the rate of a carload per day.

Ore will be removed from the Kingdon shaft of the Old Dominion, while 'A' shaft is being prepared for skip hoisting. Work on the concentrating plant is progressing rapidly. At the Copper Hill shaft of the Arizona Commercial, development work is being increased. The raise recently finished between the No. 8 and 6 levels revealed considerable sulphide, and that section of the mine will be thoroughly explored to ascertain the extent of the ore.

Development in the Miami mine covered 5600 ft., exclusive of reopening the ground in the northwest section of the orebody. R. B. Canby is erecting an experimental leaching plant for New Keystone ores at the Miami mill. The Iron Cap mine is being worked at six faces, of which five are in good copper ore. Fourteen carloads of ore were shipped to the El Paso smelter during July, although the average was not much above 8% because of the semi-exploratory nature of the work on the 650-ft. level, where the widening of the vein occurred. During the present month the ore shipped will be of higher grade.

Miami, August 6.

Definite information has been received at Globe that the International Smelting & Refining Co. will build a large smelting plant at that place. It will consist of reverberatory furnaces and converters.

A smelter is to be built in the vicinity of Christmas with sufficient capacity to handle the ore immediately in the neighborhood, and it is also stated that the London & Arizona Mining Co. will have its ore treated at this smelter.

Greenlee County

It was expected that the first roasting furnace of the new plant of the Arizona Copper Co., at Clifton, would be started on August 15, and a week later a blast-furnace will be blown in. Ore has already been hauled to the smelter site. L. D. Ricketts will take personal charge of the plant for about three months. At the old smelter, one furnace will continue work while the new one is getting into its stride. At the mine the Coronado tunnel will be finished in a week or so a total length of 6200 ft. Its purpose is to facilitate the transfer of ore from the Coronado and other workings of the Coronado Copper Co.'s mines to No. 6 concentrator at Morenci. A large addition to this plant will be completed by September 1. A sulphuric acid plant is to be added to the new smelter with 50-ton daily capacity.

Mohave County

The Vulture mine, near Wickenburg, is now producing between $30,000 and $40,000 in gold per month, and has several years' ore supply blocked out. The 40-stamp mill and cyanide plant treats 100 tons of ore per day, mostly from the 1000-ft. level.

Mohave County

It is reported that the Gold Reed Mining Co. has cut the vein at a depth of 250 ft. and at that point it is large, in fact one of the big veins of the Tom Reed district. The ore is said to have a high average value. The company has been in charge of H. H. Shuck since the commencement of work on the company account.

The first drill-hole of the Kingman Copper Mining & Milling Co. was finished last week at about 500 ft. depth. Assays gave satisfactory copper content. The Copper Giant shaft is down 250 ft., and drifts have opened 9 and 7 ft. of ore, respectively, carrying 8% copper and some gold.

Yavapai County

(Special Correspondence.)—The Block Mines Co. has taken over the Billy Boy and Christmas group of mines and claims, situated on the Hassayampa river northwest of Wickenburg. This is the result of the reorganization of the Company which was recently perfected. Among the officers chosen was Ed. Block, who will be secretary-treasurer, and as soon as the official proceedings are satisfied by the New York directors, active development will be begun, which should be within the next thirty days. Mr. Block, the new secretary-treasurer, has been the owner of these two groups of claims for a number of years, and on the splendid developments the operation of the properties was determined upon on a recent trip east by Mr. Block. The Binghampton mine, at Stoddard, has recently exposed large bodies of copper sulphide ores, and production is being made as fast as possible. At the Queen mine, in this district, driving is being done on the lower levels and gold ore is in sight in all the workings.

Prescott, August 7.

A Humphrey revolving-hammer type mill, built by the Arizona Mine Supply Co., is being installed at the Hopper mine. Good lead and zinc ore is being opened in the Ruth mine, six miles south of Prescott. The Arkansas & Arizona Copper Co., whose property is near Jerome, will connect the main shaft with the Verde Tunnel & Smelter railroad. The shaft is being 'raised' from the 1400-ft. level. The Monte Cristo, Nelson, Copper Queen, Bluebell, and Swastika mines are all developing in a promising way.

CALIFORNIA

Butte County

The total returns from Oroville for the current financial year to May 31 show 3,461,375 cu. yd. dredged, yielding estimated gross returns of $1,570,000. There are now three dredges in operation.

A nugget weighing 9 oz. was discovered in the Mineral Slide mine, near Magalia, on August 2, besides $80 of coarse gold. A cross-cut is being driven through the property, and is in 400 ft. Rich ore has been opened.

Inyo County

Work was stopped at the Bishop Creek mine and mill on August 4, on account of the financial condition of the company, but Gaylord Wilshire hopes to resume within 60 days. The mine and equipment are in good order. A good deal of development was done and a modern stamp-mill was completed this year.

Kern County

No. 10 well of the Standard Oil Co. is keeping up a production of 20,000 to 25,000 bbl. of oil per day. The oil tests 26 gravity, and none of the yield is being lost.

No. 2 well of the Pacific Crude Oil Co. is yielding 1100 bbl. per day. No. 4 of the California Counties Co. is down nearly 3000 ft. and cable tools are being used to finish the well. The Lakeview Oil Co. reports that the No. 12 well on section 25, 12-24, which was started on August 7 after the new Union rotary had been completed and the disk bits had been received, is down 300 ft. This new well will be rushed to completion and finished at the earliest possible date. All of the latest appliances for drilling are included in the rig. The new Molidor rotary disk bits are being substituted for the regular fishtail bits more commonly used. Other time-saving devices are also being used wherever it is possible.

FILLING AN OIL RESERVOIR, M'KITTRICK FIELD.

An interesting bulletin has been published by the United States Bureau of Mines, on 'The Prevention of Waste of Oil and Gas from Flowing Wells in California,' by J. M. Pollard, Ralph Arnold, and V. R. Garfias. This is Technical Paper 42.

PLACER COUNTY

The Iowa Hill district asbestos and magnesite properties have been inspected by S. M. Sprague, of the Placer County Properties Co., and Sacramento people. The Progressive Mining Co., composed of Ohio people, is to treat the tailing of the old hydraulic claims here. A new machine of 500-cu. yd. capacity is being used which operates as follows: The gravel is passed through a revolving cylinder of ½-in. steel with a screen which separates the cobbles and coarse from the finer gravel, and the latter drops through a hopper onto a series of riffles 14 ft. long with an 18% fall, and the gold is washed free with the water passing over the riffles. The water, after leaving the riffles, is caught by a rapidly revolving wheel and forced back through a tank to the head of the riffles, where it is used again. The washed dirt and sand is caught in buckets attached to an endless chain and carried to the waste dump. The process of cleaning up is the same as was used by the placer miners on river bars. The machine was started on the tailing of the old Bumpus hydraulic mine in Indian cañon, and the gravel showed a value of 25c. per cubic yard, which is considered margin enough to return a good profit.

SHASTA COUNTY

(Special Correspondence.)—A. W. Field and associates are converting the municipal rock-crushing plant into a temporary smelter, and expect to make the first fume-control test at an early date. Ore running 30 to 50% sulphur will be used in the experiments. The process is based on refrigeration, and several laboratory experiments are said to have been successful. The Shasta Dredging Co. is negotiating for options on the Saeltzer, Peterson, Jones, Gibson, and other ranches below Redding, and will examine them for dredging purposes. The tracts were recently tested by the Oro Water, Light & Power Co., but the option of this Company was not exercised. The Shasta Dredging Co. has been operating a 7-cu. ft. bucket-elevator dredge in the Clear Creek district for several years and recently acquired extensive placer holdings at Gas Point. Operations have been resumed at the Kimberly mines of the Balaklala Copper Co. with a small force of men. James Doyle, formerly in charge of underground work at the Midas mine, has been placed in charge of the Kimberly properties. The Mammoth Copper Co. is installing a new Ingersoll-Rand compressor at the Stowell copper mine. The long adit is reported to have cut a promising copper-bearing deposit. A tube-mill and Merrill precipitating press are being installed in the cyanide plant of the Midas Mining Co. at Harrison Gulch. Approximately 60,000 tons of tailing assaying $7 per ton is said to be available. Repairs to the plant of the Gambrinus mine have been completed and driving for the main vein has been resumed. The Mt. Bally Gold Mining Co. is reopening the old shaft workings and a depth of 60 ft. has been gained, but work is proceeding slowly because of a heavy inflow of water.

Redding, August 4.

SIERRA COUNTY

At the Alaska mine, at Pike City, 65 men are employed, and the 40-stamp mill is working full time on ore from No. 4 and 5 levels. The letting of blocks to lessees is gradually being discontinued. George St. John has retired from the management, and his place is temporarily filled by W. S. Schuyler, of the Sierra Alaska Gold Mining & Milling Co. R. C. Turner has been appointed consulting engineer.

COLORADO

EAGLE COUNTY

Reports from Eagle are to the effect that the Lady Belle remains the only claim in the Brush Creek district which is shipping ore, or that has ore in place. Several fair-looking prospects have been opened on Horse mountain, but the extension of the Lady Belle has not yet been found. During the latter part of the week ore was found in the North Dakota claim, Brush creek, which gives assays of 95 oz. silver, 12.8% copper, and 7 oz. silver and 1% copper per ton. The claim is situated about 1000 ft. south of the Lady Belle, higher up the mountain and toward the Salt Creek side, and the formation is the same, Dakota sandstone. The vein is 4 ft. wide and the adit is in about 40 ft. It is claimed by the lessees that this is the extension of the Lady Belle vein.

LAKE COUNTY (LEADVILLE)

The Arkansas Valley smelter is now running five furnaces in full blast and treating a large tonnage of ore, indicating that the district is in a healthy condition.

The Colorado Power Co. is installing two hoists at the New Monarch mine, and has completed the transmission-line to the Mt. Champion, Lackawanna gulch. Old producers at the head of Iowa gulch are to be worked again. Interest in Lackawanna and Half-Moon gulches continues to be the leading topic of conversation at Leadville, and both districts are active. The usual amount of work is being done by lessees in the district.

TELLER COUNTY (CRIPPLE CREEK)

During July 58 cars, equal to 1500 tons, of ore was shipped from the Isabella mine. E. J. Fackerell, a lessee, is at present developing a new ore-shoot, opened by him on No. 4 vein. The drift driven north and south has already proved the shoot for the distance of 30 ft., and the ore broken fully 3½ ft. wide, as exposed in both headings, is worth from $40 to $80 per ton. Great activity is evident on the properties of the Stratton estate, and there

are at present 32 leases in operation and 10 prospecting permits. One hundred cars of ore, equal to 2000 tons, were shipped from the main shaft and leased properties of the Vindicator Consolidated Gold Mining Co. during July.

THE SAN JUAN

Ore shipments from Ouray in July totaled 1538 tons, of which the Camp Bird supplied 565, Wanakah 556, Atlas 177, and Revenue 65 tons. Martin J. Heller is at Silverton looking after his interest in the Buffalo Boy property of the Continental Mining Co., and to assist in the pending litigation as outlined in the *Mining and Scientific Press* of July 19.

IDAHO

BONNER COUNTY

According to Robert N. Bell, inspector of mines, this county's mines are developing satisfactorily, the lead-silver orebodies being opened sufficiently to predict that the county will soon rank in output with some of the older mineral districts. The Idaho-Continental, which has been mentioned in these columns several times, is the most important property.

SHOSHONE COUNTY

Instead of constructing an aërial tramway between its mine and mill, the National Copper Mining Co. will install an electric railroad system. This line will be about two miles long. Between 50 and 60 men are employed on mill foundation and flumes for water and power purposes. Charles McKinnis is general manager.

MICHIGAN

HOUGHTON COUNTY

(Special Correspondence.)—The Quincy company is installing a new hoist at the Mesnard shaft, No. 8. This work will occupy several weeks. When the work is completed, the Mesnard will then be in position to contribute more largely to the daily 'rock' output of the Quincy mine. At the lower openings of the Mesnard shaft the Pewabic lode assumes physical characteristics which are quite unusual and quite different from any other local showings. The lode, instead of being wide and badly broken, is actually split into as many as two or three and sometimes four different lodes, each with distinct foot and hanging walls. These little lodes average four or five feet wide, but between the walls they are rich in copper. A different system of mining must necessarily be used to obtain good results, because it is necessary to minè the lode rock with as little waste as possible.

Tne Franklin company is prospecting to open the Allouez conglomerate at a depth of 3200 ft. A cross-cut from the Pewabic lode is being run a distance of some 500 ft. to cut the Allouez. This formation formerly was operated to good advantage on the Franklin property, but at a depth of 2300 ft. it 'petered out' and became so thin and poor that it was considered worthless. The development of the Grand Portage lode at the Isyle Royale property continues to be quite the most encouraging bit of news at this mine. This formation first was cut by long laterals from No. 2 shaft. The character of the ground, from the first, was good, and as it has developed, the improvement has been noticeable. During the past few months the Grand Portage formation has been furnishing the Isle Royale with a fair tonnage regularly.

Houghton, July 30.

MISSOURI

ST. FRANCOIS COUNTY

By a large majority, the lead miners of this county, numbering more than 4000, on August 5 voted to go out on strike, enforcing their demands for a raise in wages of 50c. per day. The executive committee of the Western Federation of Miners met on the following day to decide when the strike order shall become effective, which will probably be within a week. The companies have prepared to shut down.

MONTANA

FLATHEAD COUNTY

The South Fork & Kalispell Copper Co., capitalized at 1,000,000 shares at $1 each, was incorporated last week at Kalispell, to develop a group of four claims in Silver basin, eight miles from Essex, a station on the Great Northern railway.

MADISON COUNTY

An interesting suit involving extralateral rights on veins was decided at Virginia City last week. The case was that of Charles F. Simon, owner of the Missouri lode claim, and John D. Hatfield and others, owners of the Tucker lode claim. Both properties are in the Washington mining district, 15 miles from Virginia City, at an altitude of 9500 ft. Eminent counsel was employed by both parties, and elaborate maps and models were used as evidence. The plaintiff claimed the older location and alleged a side-line crossing of the Tucker apex, and consequent extralateral right to the east beneath the area between the plane of its north end-line, and a parallel plane through the point of crossing. Considerable high-grade ore was found here by the Hatfield adits. The latter people denied that the vein crossed the north end-line of the Missouri claim.

The ore-shoot is a remarkable one, lying in the bands of a granitic gneiss and almost against its contact with a sill of andesitic porphyry which conforms to the gneiss bedding, dipping to the north and east. The ore is in some places 8 ft. wide and carries gold to the extent of $100 per ton. Testimony was introduced by the plaintiff's witness to the effect that the apex was established in several cross-cuts and adits lying to the north and west of the Tucker workings, and that it crossed the end-line of the Missouri claim in cross-cut No. 4 near its intersection with the west end-line of the Tucker claim. The result of the trial was its settlement out of court by the purchase of both claims by Mr. Ellings of Virginia City.

SILVERBOW COUNTY

The Davis-Daly made a profit of $6000 in July from shipments of about 250 tons per day. One hundred and eighty men are employed. The Company is diamond-drilling at the Colorado section. In the old Fisher stopes the orebody is 7 ft. wide, averaging 4% copper. Generally the position is encouraging.

NEVADA

ESMERALDA COUNTY

The 10-stamp mill of the Pioneer Consolidated Mines Co. was to be started on August 14. There is a two years' ore supply in the mine above the 265-ft. level, with an average of $11 per ton. Rich ore has been shipped amounting to $420,000. It is estimated that 60% of the gold in the ore will be recovered by amalgamation, and 30% by the cyanide process. The ore is trammed a distance of 100 ft. from the collar of the shaft to the storage bin and from the bin gates it passes over a grizzly to the 7 by 10-in. crusher, thence dropping into a storage bin. From this bin the ore is fed into the 10-stamp battery by suspended feeders. The stamps are 1050 lb. weight and drop 5 in., 100 drops per minute. The crushed ore then passes through a 20-mesh screen and flows over silver-plated amalgamating plates, going thence to the Pearce amalgamators, where the float gold is saved. The pulp then goes to the spitzkasten, from which the sand flows directly into the vats, the first being 21 ft. diam. and 5 ft. deep. There are three of these leaching vats and 14 vats in all, of different sizes. The slime flows to settling vats that are directly over the leaching vats, three in number, and these are connected to a vacuum pump, the cyanide solution flowing through a water seal. Precipitation is by means of zinc shaving. The Nevada-California Power Co. will supply the necessary electric power.

MINERAL COUNTY

Reports from Coaldale, 22 miles south of Mina on the Tonopah & Goldfield railroad, state that the properties there will be able to soon supply plenty of coal of first-class grade. A diamond-drill has been operating for some time under H. A. Danus and associates, and down to 400 ft., three seams of coal, two being 4 and 6 ft. thick, respectively, were cut. A shaft will now be sunk.

Nye County

During the week ended August 9, eleven mines at Tonopah produced 12,560 tons of ore worth $290,810, and during the first half of the year the total was 279,491 tons valued at $5,608,580. This is an increase of 57,991 tons and $977,780 in value over the same period last year. There are five more producers on the list this term. During the past week the east drift on No. 14 level of the Belmont was in good ore; the West End started sinking on the vein to the 700-ft. level; the Tonopah Extension started sinking a winze on the Murray vein; at the Halifax-Tonopah, the 1000-ft. south drift cut a new east and west vein in trachyte formation; and the MacNamara opened good ore on the 700-ft. level.

Storey County

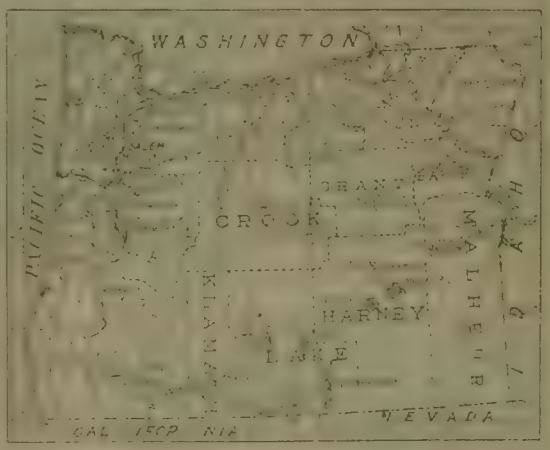
At the Comstock, the Ophir company reports a satisfactory week. In a raise above the 2500-ft. level, 136 tons of $31 ore was mined, and 253 tons of second-class ore was sent to the Kinkead mill. The Mexican mill treated 597 tons of ore from the Monte Cristo claim, averaging $8.14 per ton, with 90% extraction. The usual work was done at the Sierra Nevada 2500-ft. level, Crown Point, 1300-ft. level of the Belcher, Yellow Jacket, and the C. & C. pumping shaft, where all pumps worked satisfactorily.

White Pine County

On August 3, the 10-stamp mill of the Amalgamated Nevada Mines & Power Co., at San Pedro, near Black Horse, was destroyed by fire. Damages total $45,000, of which $9000 or $10,000 is covered by insurance. The plant has been idle for some time pending adjustment of finances, but at the time of the fire was running on custom ore. The directors of the Copper Mines Co. are expected to make an inspection of the property in the near future. It is stated that churn-drills and steam-shovels will be employed in development.

OREGON

Oregon, according to Fred R. Mellis, in the *Eastern Oregon Mining Journal*, and the following notes deal with the more important properties. At the Rainbow in Baker county, 18 miles from the railroad at Durkee, the country rock is a contact deposit of limestone. The mine is opened to 500 ft. by four levels from a two-compartment shaft. The vein is of a good width and averages $10 to $15 per ton. The stamp-mill treats from 75 to 90 tons per day, the monthly output being about $30,000. A. P. Anderson is general manager. The Columbia is six miles from Sumpter, and consists of six claims with water and timber rights. There is 100,000 tons of ore opened, and the ore is treated by the 20-stamp mill and cyanide plant. The annual yield is about $250,000, and since 1896 the total is $3,500,000. Frank S. Baillie is in charge. At the Cornucopia there are 60 men employed, and ore reserves amount to 60,000 tons of $16 ore. Recent improvements to the property cost $100,000. The monthly yield is $23,000. Robert M. Betts is manager. The Powder River Dredging Co. is busy, and its dredge is producing between $30,000 and $50,000 per month. Everything is driven by electric power. R. W. Derby is general manager. In Grant county, the Ben Harrison group consists of 10 claims, the principal ones being developed to 600 ft. depth. The vein is 75 in. wide, assaying $17 per ton on the 500-ft. level. Rich antimonial silver ore has also been developed. Reserves total 100,000 tons. The property is well equipped with an air-compressor and machine-drills, 20-stamp mill, tube-mill, 16 concentrating and 4 roughing tables, revolving screen, Dorr classifiers, Callow tanks, and cyanide plant. The present output is $30,000 per month. W. C. Fellows is in charge. The Humboldt is in Malheur county, 20 miles southwest of Durkee, in the Morman basin. At one time this was a large placer district. The Humboldt is developed to 400 ft. depth. The quartz ore occurs as lenses in a contact between trachyte and diorite, and averages $7 to $30 per ton. The 10-stamp mill and tables produce about $10,000 per month. John Arthur is general manager. At the Highland, 14 miles from Haines, 50 men are employed, and the output is from $10,000 to $15,000 per month. The property can be worked by adits to a depth of 2000 ft., and 60,000 tons of $10 to $18 sulphide ore is blocked out. The mill consists of rolls, jigs, Hardinge mill, Callow screens, and Deister tables, all driven by motors. Ten tons of concentrate is produced daily. Robert R. McGaughey is superintendent. The Pacific Lime & Gypsum Co., five miles from Huntington, in Baker county, has its new plant in operation, employing 75 men and producing three to four cars of lime and plaster per day. Power used totals 450 hp., supplied by the Idaho-Oregon Light & Power Co. The Ibex, in Baker county, 10 miles from Sumpter, has an adit in 3249 ft., with veins averaging 6 ft. wide. Over 100,000 tons of ore has been opened, and the mine is well equipped. The ore will probably be treated by the cyanide process. David Ross is manager. The Boulder Creek placers, near Cornucopia, are being equipped for a larger yield, while the North Fork placers, in Grant county, have 300 acres, with an 80-ft. face,



MAP OF OREGON.

which is being sluiced under 130-lb. pressure. Results are satisfactory. Other interesting properties in Baker county are the Mammoth, Mayflower, Virtue, Gem, Bonanza, North Pole, Red, White & Blue, Red Boy, Golconda, Baisley Elkhorn, Maxwell, Blue Mud, Inter-Mountain, Magnolia, and Morris.

UTAH

Juab County

On the 1000-ft. level of the Tintic Standard, the drift is following the east and west break, with some good ore in the face. At the Grand Central, the daily output is 100 tons, and a good percentage of ore is being mined on the 2300-ft. level. A large orebody is being opened on the 700-ft. level of the Gold Chain. It carries copper, silver, and gold.

Salt Lake County

A strike for higher wages at the Midvale concentrator of the United States Smelting, Refining & Mining Co. was started in the charge department on August 12. The men demand an increase in pay of 25 cents per day. G. W. Meintz, the general manager, stated only about 20 men had actually quit work. The strikers, however, claim a larger number have quit and say that practically all of the 500 employees will walk out unless their demands are granted.

MEXICO

Sonora

The Cananea smelter will continue to smelt Miami concentrate under a new contract.

Tepic

The Mexican Searchers, Ltd., of London, which took over an option on the Pinavete mines in the Jora district of Tepic late in 1911, has surrendered the option and is withdrawing from the field. The general situation in Mexico is responsible for the action. Chicago people control these properties, and the English company has done over 1000 metres of development.

Schools and Societies

The Lake Superior Mining Institute is holding its eighteenth annual meeting at Houghton, Michigan, from August 26 to 29. There will be several excursions and inspections.

With a new laboratory, the building of which has cost over $30,000 and the equipment of which will cost $10,000 additional, Stanford University is now able to offer to engineering students as complete and practical a course in hydraulics and testing of materials as any technical school west of Chicago.

The Illuminating Engineering Society will hold its seventh annual convention at Pittsburgh on September 22 to 26. The Papers Committee announces that ten additional papers will be read and discussed, seven others will be presented besides a lecture on 'The Development of Alternating Current Luminous Arc Lamp,' by Charles Proteus Steinmetz.

The Kalgoorlie School of Mines, Western Australia, Syllabus for 1913 contains much interesting information in its 91 pages of illustrated matter. There are 14 on the teaching staff, including five laboratory assistants. The third term begins on August 25. The school includes chemical, assaying, physics, and engineering laboratories; also the usual class rooms for mining, geology, and other subjects; while the engineering department is equipped with a gas engine, steam engine, fitting shops etc. Mining and geology students are given field work. Certificates, diplomas, and scholarships are offered, and there are openings at Western Australian mines for certain students. A full course of lectures may be taken for £5 5s. per term.

The University of Nevada, at Reno, Register states that the first semester of 1913-14 will start on September 2. Affiliated organizations are the State Mining Laboratory, a laboratory at the Mackay School of Mines, Reno, for examination of material suspected to contain potash, State Hygienic Laboratory, Laboratory for Pure Food and Drugs, Laboratory for Weights and Measures, and the Agricultural Experiment Station. Entrance to University Schools is by examination, but a graduate of an accredited school need not sit for this examination. Reduced railroad rates are allowed to students traveling to and from the University. Board and room is obtainable at reasonable rates. A liberal estimate of necessary expenses, exclusive of clothing and traveling, is $397. The University consists of many well equipped buildings and good scholarships are offered.

The twenty-fourth general meeting of the American Electrochemical Society will be held at Denver, on September 9, 10, and 11. The first day will be devoted to reading and discussion of papers, various trips, and a smoker. On the next day a car will be taken for Boulder, and a session for papers will be held at the University of Colorado. After lunch automobiles will be taken up Boulder canon to the power-plant of the Central Colorado Power Co., at the entrance to the Boulder tungsten district. On September 11, a session will be held in the evening for the reading and discussion of papers at the School of Mines at Golden. For the afternoon various visits are being arranged. An informal picnic dinner will also be held on Lookout mountain, just west of Denver, behind Golden. Various visits are being arranged to places of great natural beauty, as well as to chemical and metallurgical works. J. W. Richards, Lehigh University, South Bethlehem, Pennsylvania, is the secretary of the society.

The United States Civil Service Commission announces an open competitive examination for assistant curator in the Division of Mineralogy and Petrology in the National Museum, Washington, D. C. The salary will be $1800 per annum. The subjects of examination are crystallographic mineralogy, descriptive mineralogy, petrology, chemistry, education, training, experience, and fitness.

Personal

Professional men are invited to send news of their engagements and travels. Such news is interesting to friends.

D. L. Rogers is visiting Hayden, Virginia.

Henry L. Hollis was in New York last week.

F. G. Janney has returned from Juneau, Alaska.

David T. Day is at the Palace hotel, San Francisco.

J. C. Branner has returned to Stanford from Brazil.

L. K. Fletcher, of El Chico, Mexico, is in San Francisco.

F. Lynwood Garrison is on a vacation in Massachusetts.

Arthur Flint is returning to New York from Nevada.

D. W. Brunton is spending a holiday at South Poland, Maine.

L. S. Austin has returned to New York from British Guiana.

W. H. Storms is in Calaveras county, engaged in professional work.

Charles A. Chase has been at Ouray, Colorado, on examination work.

F. J. Dennis is in North Carolina, engaged in mine examination work.

Rex R. Seeber is now manager for the Winona Copper Co., succeeding L. L. Hubbard.

Robert H. Richards has been spending a few days at Ishpeming on professional business.

A. L. Dean has resigned from the Mount Lyell M. & R. Co., Ltd., at Queenstown, Tasmania.

F. M. Simonds is in Cuba on professional business. He expects to return to New York in November.

T. B. Greenfield has left Mexico and gone to the Ibutil mine, at Morriston, Madras Presidency, India.

Desaix B. Myers is in British Columbia for two or three weeks, and will return to Los Angeles on August 25.

R. A. F. Penrose, Jr., and E. A. D'Invilliers are attending the International Geological Congress at Toronto.

L. D. Ricketts is at Clifton, Arizona, to superintend the blowing in of the new smelter for the Arizona Copper Company.

H. Ries is in British Columbia, finishing an examination of the clays of western Canada for the Canadian Geological Survey.

Frederick G. Clapp and Alten S. Miller are examining the gasfields of Hungary in company with Hugo Bockh of that country.

Martin J. Heller is at Silverton looking after his interest in the Buffalo Boy property of the Continental Mining Company.

Robert Scott is at Ione, Nevada, installing one of his improved quicksilver furnaces, a 50-ton plant, for the Nevada Cinnabar Company.

F. L. Sizer, general superintendent of the Mascot Copper Co., Dos Cabezas, Arizona, has been examining mines in the Santa Catalina mountains, north of Tucson.

J. Malcolm Maclaren has recently been examining the Great Fingall and Fenian mines, and will later inspect the Sons of Gwalia and the Kalgoorlie group, in Western Australia.

C. R. Wilfley, manager of the Barstow mine, Ouray, Colorado, is now residing at Denver, where he will continue as manager of the mine, and also take up private interests as well as consulting work.

Ludwig H. Diehl was in San Francisco on August 9. He has been to Western Australia in connection with the bromo-cyanide patent suit, and is now returning to London, stopping over at Cripple Creek, Colorado, on his journey across the United States.

The following members of the staff of the California State Mining Bureau are now doing field work: Walter W. Bradley is examining conditions in Colusa, Glenn, Lake, Marin, Napa, Solano, Sonoma, and Yolo counties; S. L. Lowell in Del Norte, Mendocino, Humboldt, and the west side of Trinity counties; Errol MacBoyle in Plumas, Sierra, Nevada, Placer, and Eldorado counties; R. T. McLoughlin in Mono, Inyo, and Madera counties; and J. Chester Brown in Siskiyou, Trinity, and Shasta counties. They will be out from 6 to 20 weeks.

The Metal Markets

LOCAL METAL PRICES

San Francisco, August 14.

Antimony	12—12½c	Quicksilver (flask)	$41
Electrolytic Copper	16—16½c	Tin	46—47½c
Pig Lead	4.75—5.70c	Spelter	7—7½c

Zinc dust, 1400 lb. casks, per 100 lb., small lots $9.50—9.75; large $7.50—8.50

EASTERN METAL MARKETS.

(By wire from New York.)

NEW YORK, August 14.—Copper market is strong with electrolytic at nominally 15⅞c. Early deliveries are becoming scarce and spot delivery copper is unobtainable from the largest sellers for less than 16c. Cable from London reports all producers quoting 15⅞c. for October delivery. Spot is quoted at £69 17s. 6d. and futures £69 17s. 6d. A large decrease in August stocks is predicted, probably amounting to 20,000,000 lb. Lead is quiet with little trading reported. Spelter remains firm.

SILVER

Below are given the average New York quotations, in cents per ounce, of fine silver.

Date.		Average week ending	
Aug.	7	July 2	58.20
"	8	" 9	58.29
"	9	" 16	58.43
"	10 Sunday	" 23	58.79
"	11	" 30	59.28
"	12	Aug. 7	59.29
"	13	" 14	59.12

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	56.25	63.01	July	60.67	58.70
Feb.	59.06	61.25	Aug.	61.32	....
Mch.	58.37	57.87	Sept.	62.95	....
Apr.	59.20	59.26	Oct.	63.16	....
May	60.88	60.21	Nov.	62.73	....
June	61.29	59.03	Dec.	63.38	....

Writing on July 24, Samuel Montagu & Co. state that the upward tendency of silver prices has arisen from considerable buying, orders coming on a dull and inactive market. A certain amount of nervousness as to the effect of politics in China is undoubtedly responsible for these purchases, which introduce an element of uncertainty into a market scantily supplied from normal sources. The stock at Bombay has increased from £320,000 to £670,000, and the offtake is about 80 bars per day. Shanghai reports a stock of £5,825,000 compared with £5,750,000 last week. A shipment of £130,000 has been made from San Francisco to Hongkong. The quotations today for cash and two months delivery are 3s. 16d. above those fixed a week ago.

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.		Average week ending	
Aug.	7	July 2	4.33
"	8	" 9	4.33
"	9	" 16	4.33
"	10 Sunday	" 23	4.34
"	11	" 30	4.40
"	12	Aug. 6	4.50
"	13	" 13	4.48

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	4.43	4.28	July	4.71	4.35
Feb.	4.03	4.33	Aug.	4.54	....
Mch.	4.07	4.32	Sept.	5.00	....
Apr.	4.20	4.36	Oct.	5.08	....
May	4.20	4.34	Nov.	4.91	....
June	4.40	4.33	Dec.	4.20	....

ZINC

Zinc is quoted as spelter, standard Western brands, St. Louis delivery, in cents per pound.

Date.		Average week ending	
Aug.	7	July 9	5.10
"	8	" 16	5.08
"	9	" 23	5.10
"	10 Sunday	" 30	5.20
"	11	Aug. 6	5.40
"	12	" 13	5.45
"	13		

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	6.42	6.88	July	7.12	5.11
Feb.	6.50	6.13	Aug.	6.96	....
Mch.	6.57	5.94	Sept.	7.45	....
Apr.	6.63	5.52	Oct.	7.36	....
May	6.68	5.23	Nov.	7.23	....
June	6.88	5.00	Dec.	7.09	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California, being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending			
July	17	July	31
"	24	Aug.	7
		"	14

All 41

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	43.75	39.37	July	43.00	41.00
Feb.	46.00	41.00	Aug.	42.50	....
Mch.	46.00	40.20	Sept.	42.12	....
Apr.	42.25	41.00	Oct.	41.50	....
May	41.75	40.25	Nov.	41.50	....
June	41.30	41.00	Dec.	39.75	....

COPPER

Quotations on copper as published in this column represent average wholesale transactions on the New York market and refer to electrolytic copper. Lake copper commands normally from 1-5 to 1-4c. per lb. more. Prices are in cents per pound.

Date.		Average week ending	
Aug.	7	July 2	14.43
"	8	" 9	14.25
"	9	" 16	13.81
"	10 Sunday	" 23	13.97
"	11	" 30	14.58
"	12	Aug. 6	14.92
"	13	" 13	15.53

15.15	
15.25	
15.35	
15.45	
14.45	
15.45	

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	14.09	16.54	July	17.19	14.21
Feb.	14.08	14.93	Aug.	17.49	....
Mch.	14.68	14.72	Sept.	17.56	....
Apr.	15.74	15.22	Oct.	17.32	....
May	16.03	15.42	Nov.	17.31	....
June	17.23	14.71	Dec.	17.37	....

TIN

New York prices control in the American market for tin, since the metal is almost entirely imported. San Francisco quotations average about 5c. per lb. higher. Below are given average monthly New York quotations, in cents per pound:

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	42.53	50.45	July	44.25	40.70
Feb.	42.96	49.07	Aug.	45.80	....
Mch.	42.58	46.95	Sept.	48.64	....
Apr.	43.92	49.00	Oct.	50.01	....
May	46.05	49.10	Nov.	49.92	....
June	45.76	45.10	Dec.	49.80	....

COPPER PRODUCERS' ASSOCIATION REPORT

The Copper Producers' Association statement, August 8, shows a decreased surplus. The details are as follows:

	Pounds.
Stock of marketable copper of all kinds on hand at all points in the United States, July 1, 1913	52,904,606
Production of marketable copper in the United States from all domestic and foreign sources during July	138,074,602
Deliveries for consumption, July	58,904,192
Deliveries for export, July	78,480,071
Stock of marketable copper of all kinds on hand and at all points in the U. S., August 1	53,594,945

Recent changes in surplus have been as follows, in pounds:

	Increase.	Decrease.
July 1912	5,945,416	.....
August	.....	3,579,046
September	16,364,213	.....
October	13,679,380	.....
November	9,419,095	.....
December	19,148,523	.....
January 1913	17,885,770	.....
February	.....	896,134
March	.....	18,032,928
April	.....	28,720,162
May	.....	8,074,883
June	.....	14,569,619
July	690,339	.....

The Stock Markets

SAN FRANCISCO STOCKS AND BONDS

(San Francisco Stock and Bond Exchange)

BONDS

Listed.	August 13. Bid	Ask	Unlisted.	August 13. Bid	Ask
Associated Oil 6s	$ 97½	–	Natomas Dev. 6s	$ --	100
E. I. du Pont 4½s	85½	--	Pac. Port. Cement 6s	90	—
Natomas Con. 6s	78½	80	Riverside Cement 6s	77	79
Unlisted.			Standard Cement 6s	91½	—
Ass. Oil 1st ref	77	—	Santa Cruz Cement 6s	--	81
General Petroleum 6s	54½	--	So. Cal. Cement	--	85

STOCKS

Listed.	August 13. Bid	Ask	Unlisted.	August 13 Bid	Ask
Associated Oil	40½	—	Mascot Copper	2	2½
Amalgamated Oil	85½	—	Noble Electric Steel	--	8
E. I. du Pont com	—	135	Natomas Consol.	5	—
Pac. Coast Borax, pfd.	—	—	Pacific Port. Cement	59	—
do com	—	100	Riverside Cement	45	—
Pacific Crude Oil	29c	--	Standard Cement	--	19
Sterling O. & D.	70c	95c	Santa Cruz Cement	25	—

NEVADA STOCKS

(By courtesy of San Francisco Stock Exchange)

San Francisco, August 14.

Atlanta	$ .14	Mizpah Extension	$ .43
Belcher	.24	Montana-Tonopah	1.05
Belmont	6.90	Nevada Hills	.89
Big Four	.38	North Star	.90
Con. Virginia	.08	Ophir	.18
Florence	.25	Pittsburg Silver Peak	.48
Goldfield Con	1.60	Round Mountain	.52
Goldfield Oro	.06	Sierra Nevada	.05
Halifax	1.35	Tonopah Extension	2.25
Jim Butler	.67	Tonopah Merger	.73
Jumbo Extension	.12	Tonopah of Nevada	4.20
MacNamara	.13	Union	.09
Mexican	1.00	West End	1.20
Midway	.49	Yellow Jacket	.17

COPPER SHARES—BOSTON

(By courtesy of J. C. Wilson, Mills Building.)

	August 14. Bid	Ask		August 14. Bid	Ask
Adventure	$ 1½	2	Mohawk	$ 43½	44
Allouez	36½	37	North Butte	28½	28½
Calumet & Arizona	64½	65	Old Dominion	49½	50½
Calumet & Hecla	435	440	Osceola	80	82
Centennial	13½	14	Quincy	61	62
Copper Range	40	40½	Shannon	7	7⅛
East Butte	12½	13	Superior & Boston	2⅜	2½
Franklin	4½	5	Tamarack	29	29½
Granby	63	63½	U. S. Smelting	37½	38
Greene Cananea	6⅞	7	Utah Con.	9	9⅛
Hancock	18	19	Victoria	1¼	1½
Isle-Royale	18½	19	Winona	1½	1⅝
Mass Copper	3	3½	Wolverine	45	46

NEW YORK QUOTATIONS

(By courtesy of E. F. Hutton & Co., Kohl Building.)

August 14.

	Bid.	Ask.		Bid.	Ask.
Alaska G. M.	19⅛	19¼	McKinley-Dar.	1¾	1⅞
Braden Copper	6¾	6⅞	Mines Co. Am.	2¼	2½
B. C. Copper	2⅜	2⅝	Nipissing	8⅞	9⅛
Davis-Daly	1⅞	2⅛	Ohio Copper	½	⅝
Dolores	2	4	San Toy	20	22
El Rayo	1	2	Sioux Con.	1	5
Ely Con.	7	9	So. Utah	⅛	¼
First Nat.	2⅝	2⅞	S. O. Calif.	192	195
Giroux	1	1½	Tri Bullion	⅛	¼
Greene Can.	6¾	7	Tuolumne	1	1⅛
Hollinger	14½	15	United Copper	½	¾
Kerr Lake	3⅜	3½	Wettlaufer	10	12
La Rose	2¼	2⅜	Yukon Gold	2	2⅛
Mason Valley	6¾	7½			

LONDON QUOTATIONS

(By cable, through the courtesy of Catlin & Powell Co., New York.)

	August 14. £	s.	d.		August 14. £	s.	d.
Alaska Mexican	1	15	0	Kern River Oilfields	[illegible]	7	6
Alaska Treadwell	[illegible]	5	0	Mexico Mines	5	12	6
Alaska United	3	15	0	Messina	1	10	0
Arizona	2	0	0	Oroville	0	5	0
California Amalg	0	10	0	Pacific Oilfields	0	2	6
California Oilfields	4	10	0	Rio Tinto	77	2	6
Camp Bird	0	16	9	Santa Gertrudis	0	17	6
El Oro	0	15	0	Stratton's	0	2	6
Esperanza	1	2	6	Tanganyika	2	7	6
Granville	0	10	0	Tomboy	1	7	6

AUSTRALIAN

	August 14 £	s.	d.		August 14 £	s.	d.
British Broken Hill	2	0	0	Mount Boppy	0	15	0
Broken Hill Props	1	16	9	Mount Elliott	5	3	9
Golden Horseshoe	2	14	9	Mount Lyell	1	5	0
Great Boulder Props	0	12	6	Mount Morgan	3	10	0
Ivanhoe	2	17	6	Waihi	2	6	3
Kalgurli	1	18	9	Waihi Grand June	1	2	6

JULY COPPER PRODUCTION

	Pounds.
Ahmeek	1,020,500
Allouez	398,565
Arizona	2,600,000
Calumet & Hecla	3,640,651
Centennial	195,455
Copper Queen	7,439,864
Copper Queen (custom ore)	929,700
Detroit	1,549,224
Franklin	216,000
Isle Royale	343,750
Mohawk	788,000
Montezuma	2,693,006
Old Dominion	2,526,000
Osceola	1,217,255
Tamarack	476,725
Wolverine	568,000
Superior	307,260

All Lake Superior mines show a decrease compared with June.

The following are abstracts of the half-yearly reports of three Lake Superior copper companies:

	Osceola.	Wolverine.*	Tamarack.
'Rock' stamped, tons	594,856	388,502	205,466
Copper produced, lb.	9,029,340	8,350,312	3,634,421
Mine costs, cents per lb.	8.95	7.55	12.62
Construction	0.71	....	....
Smelting, etc.	1.04	1.11	1.08
Total cost	10.70	8.66	13.70
Profit	.....	$601,514	$51,000
Dividend	$528,825	600,000	.....
Surplus on hand	1,778,567	748,034	.....

*Full year.

THE COPPER SITUATION

With the Lake copper off the market entirely, it is therefore natural that copper continues to rise in price, the advance being helped by the fact that there is practically no metal available for spot delivery, the United Metals Selling Co. being reported to be the only agency which has any copper for delivery this month; indeed, the other large agencies are reported to be sold out for September delivery as well. London cables on August 7 stated that the Amalgamated and A. S. & R. agents were quoting £71 10s. for September and £71 15s. for October delivery. Large sellers in New York stated that an early advance to 16c. was imminent. On the other hand, an item in the Nevada Consolidated report for the second quarter of this year, showing 22,400,000 lb. on hand and in transit, sold and unsold, has been made the basis of much comment. The item is not especially remarkable, since it is well known that it requires about three months from the time of mining the ore to deliver refined copper, but it illustrated the amount of copper in the invisible stocks on each side of the refinery. The Lake mines are entirely out of production and the Butte mines are working on a reduced scale, but some of the Arizona properties are booming; Chino having made its high record to date last month.

THE quarterly report of the Giroux Consolidated Copper Co., filed with the White Pine county, Nevada, assessor, is as follows:

Ore mined, tons	98,810
Gross value	$380,976
Mining cost	169,195
Transport	24,419
Treatment	156,311
Net yield	31,051

Company Reports

ASSOCIATED GOLD MINES OF WESTERN AUSTRALIA, LTD.

This Company has 52 acres at Kalgoolie, and a mill with a capacity of about 11,000 tons per month testing sulphide ore. The report covers operations during the year ended March 31, 1913. The articles of association of the Company have been altered to allow of its acquiring property outside of Western Australia, and with the Huronian Belt Syndicate, Ltd., has secured an option on the Keeley mine, at South Lorrain, near Cobalt, Ontario.

The report of Duncan F. McAulay, the general manager, contains the following notes on the year's operations at Kalgoorlie. Mine development covered 6776 ft., of which 2457 was in unprofitable ore in six different lodes, and 879 ft. in ore worth $4.80 and over per ton. The width of profitable ore sampled was 60 in., averaging $10.32 per ton. The usual development was done on the Australian East, West, North, Cross, Central Boulder, and No. 7 Shaft lodes, the first named producing nearly 50% of the ore mined. Owing to the nature of the ore-shoots, an estimate of ore reserves is most difficult, but it might be said that development has nearly kept up with ore extraction. Broken ore in stopes amounts to 43,199 tons worth $5.60 per ton, which is indicative that the maintenance of a mill value equal to that of last year is doubtful. However, there are several encouraging points, namely, the north branch of the West lode, the Australia East lode, over No. 17 level, and the new work on the latter lode between No. 2 and No. 5 levels, which, apart from an unforeseen but possible improvement in some of the existing stopes, may enable the present mill average to be approximately maintained. But a daily working connection with the mine for a further year has, if possible, brought greater conviction than before of the futility of any forecast. Results were as follows:

Ore treated, tons	125,169
Gold output, ounces	37,892
Silver, ounces	826
Total value	$773,000
Mining, treatment, general, and plant expense	672,000
Balance	$101,000
Dividend	58,000
Value of investments	600,000
Depreciation (development and machinery)	105,000
Production to date:	
Ore treated, tons	1,337,097
Value	$16,150,000
Dividends	3,500,000

SIMMER DEEP, LTD.

This Company was registered in 1906 to acquire property lying to the south of the Simmer & Jack mine on the Witwatersrand goldfield, Transvaal. The capital consists of 1,750,000 shares of $4.80 each, of which 1,650,000 shares have been issued fully paid, leaving 100,000 shares held in reserve. The mine is low grade, profit being dependent on low working costs, which can be achieved only by dealing with a large tonnage and with cheap unskilled labor. As compared with 1911 the report for 1912 shows 52,950 more tons treated, the average recovery being $4.22 as against $4.50, the working cost per ton $3.92 as against $3.98, the net result being a working profit of $172,000, or $100,000 less than for 1911. Attention has been given to securing better health conditions underground, and as there is a decided tendency toward an improved native labor supply, it is hoped the mine will soon be working on a larger scale. The estimated ore reserve December 31, 1912, was 1,430,393 tons, fully developed, of an average value of $4.20 per ton, and 144,292 tons, partly developed, of an average value of $4.08 per ton. The fully developed ore reserves the year before were estimated to be 1,469,719 tons of an average value of $4.40. The profits from operations for the year were $249,000 as against a debit account of $268,000, leaving a net loss for the year of $19,500.

SHAMVA MINES, LTD.

This Company was formed in 1910, with a capital of £600,000, and took over 243 mining claims in the Abercorn district of Rhodesia from the Abercorn Syndicate and the Mayo Development Co., Ltd., for £250,000 in fully paid shares. Other claims have since been bought, bringing the total up to 523 claims. The mine has been in course of development and a mill consisting of 56 Nissen stamps and 10 tube-mills is in course of erection. It was expected that this would begin operation in the course of the summer, but construction work has been delayed through lack of railway facilities, as the extension of the Blinkwater railway was not completed until April 24, instead of December last, as expected, and it is probable that the

MAP OF RHODESIA.

mill will not be started before the end of 1913 or early in 1914. Development work during the past year amounted to 3610 ft. On March 31, 1913, the estimated ore reserves were 2,319,752 tons, of an average assay value of $5, as against 2,091,859 tons on March 31, 1912, of an average assay value of $4.97. By March 31 of this year 165,172 tons was broken and ready for the mill. The following figures give the development costs, both for machines and by hand, also for the main adit:

	Feet.	Per foot.
Machines	1472	£5 3s. 8d.
Hand	1417	£2 6s. 9d.
Main adit	721	£2 6s. 7d.

These costs do not include Bulawayo and general expenses, which amounted to a total of £5992, and depreciation account, amounting to £4863. The stoping costs on 123,692 tons broken during the year amounted to an average of 12 pence per ton. Satisfactory progress has been made in the mine, and although the width and length of the orebodies on the No. 3 level do not compare with those on the No. 2 level, yet the tonnage produced shows a higher average value; namely, $6.42, against $5.78.

ANTELOPE GOLD MINE (RHODESIA), LTD.

This Company was registered in 1908 and owns 170 mining claims in the West Gwanda district of Rhodesia, also the farm, Tabas N'Yoni, on which the claims are located. Good progress has been made with the reduction

plant, and it is hoped that it will be ready to start work about September next. The ore reserves on December 31, 1912, were 124,601 tons of $10.10, and 6217 tons of $8.50 and 14,579 tons of $5.90. The total development done to December 31, 1912, amounted to 23,401 ft. The increase in tonnage developed during the year amounted to 22,000 tons. Native labor has been found ample. A shortage in rain has retarded forwarding the machinery, as no grass could grow in the district and all animals engaged on the 50-mile haul from the railroad to the mine had to be provided with fodder from the railway. The water problem has now been solved by the erection of a dam.

THE ANGLO-FRENCH EXPLORATION COMPANY

The Company was registered in 1907 as the Anglo-French Exploration Company of the French Congo. The authorized capital is 150,000 shares of $4.80 each. The Company holds shares in a number of mining ventures, but does not itself operate mines. There is an examining department in Johannesburg, which showed a debit balance for the year in the report for 1912, as owing to the depressed times and to the suspension of operations by certain companies, the amount earned in fees shows a diminution. The Van Ryn Deep, in which the Company has a large interest, is developing satisfactorily and was expected to commence crushing in July 1913. The labor position is improved, coöperation being secured between the mines by a new organization, the Native Recruiting Corporation. The total assets of the Company for the year are $5,136,000 as compared with $4,820,000 the year before. A dividend of 6% was paid on the ordinary shares.

THE CASH MINE COMPANY

This Company is capitalized at $1,000,000 in shares of $5 each, of which 57,403 have been issued, and has $37,500 in outstanding bonds and notes. The Company's property is at Magnolia, Boulder county, Colorado, and consists of two patented mining claims. The main working shaft is down 465 ft., midway along the strike of the vein, which is approximately 2400 ft. long; drifts have been extended on five different levels. The ore is estimated to average $15 per ton; mining and milling expenses are about $6 per ton. The mine plant is equipped with electric machinery and mine equipment for handling from 30 to 40 tons of ore per day. The mill is designed for roasting and cyanide leaching, and is limited to the capacity of the roasting furnace, which is from 20 to 25 tons per day. With more cyanide solution storage capacity and several minor additions of small cost, the mill, by doubling the roasting equipment, can treat 40 to 50 tons per day. Sufficient working capital is now being arranged for, and it is hoped that the property will be put in operation in the near future. Assets include $61,000 of equipment and 6000 tons of ore with a net value of $50,000, while in the liabilities are bonds, notes, and other liabilities of $42,831.

PODEROSA MINING COMPANY, LTD.

This Company was registered in 1908, to acquire 37 mining claims in the Collahuasi district, province of Tarapaca, Chile, South America. The mine has an unfortunate situation, the ground being heavy and the water troublesome in the deeper part of the mine, making it necessary to timber in advance. It is difficult on account of these and other reasons to obtain workmen. In 1909 a dividend of 5% was paid, and that added to the loss already incurred made a deficit of $321,000 to be carried forward. No dividends have since been paid, but the report for 1912 shows the debit balance to be changed to a credit balance of $34,000, which the directors propose to carry forward. During 1912 the total hoisted from the mines amounted to 32,515 tons, about one-third of it ore, the rest waste. Most of this came from the Poderosa and Rosario mines, but the Venus mine is promising very well. The amount of ore shipped to Mejillones during 1912 was 11,318 tons, with an assay of 22.02% copper and 8.8 oz. of silver per ton. The product in pure copper, according to these figures, should be about 2492 tons, and deducting 1.3% for moisture from the assay value, the result would be approximately 2267 tons as the production of the year. The mine manager, C. Crompton, estimates the ore reserves on December 31, 1912, at 15,760 tons of 21% copper ore.

THE BUFFALO MINES, LTD.

The seventh annual report of this Company, covering the period from May 1, 1912, to April 30, 1913, shows that the mill treated during the year 55,783 tons of ore, averaging 45.83 oz. of silver per ton, or a total of 2,556,403 oz., of which 82.64%, or a total of 2,112,684, was recovered as follows: 39,798 oz. in metallics, 982,697 oz. in jig concentrate, and 1,090,189 oz. in table concentrate. The cyanide plant treated during the year 10,320 tons of slime concentrate from the mill, averaging 15.45 oz. per ton, or 159,511 oz. treated, of which 74.70%, or 119,160 oz., was recovered in precipitate. The new amalgamation plant and refinery began operation the latter part of November 1912, and to April 30, 1913, the plant treated 222 tons of table concentrate and 182 tons of jig concentrate from the low-grade mill, and 35 tons of high-grade ore direct from the mine. There was also refined at the plant 1438 lb. of metallics from the low-grade mill, 8012 lb. of precipitate from the cyanide plant, and 821 lb. of base bullion. The total production of refined bullion from this plant was 764,030 oz. of fine silver. During the year 28 cars of ore were shipped, containing 726 tons of concentrate from the low-grade mill and 35½ tons of high-grade ore direct from the mine, or a total of 761½ tons shipped, and some small sales of native silver, the returns of which amounted to 1,147,966 oz. There was also shipped during the year 56,431 lb. of bullion, the returns for which amounted to 818,246 oz. There was on hand at April 30 a total of 269,641 oz. Returns from ore and bullion shipped, sales of native silver and ore, etc. on hand, make a total production for the year of 2,235,853 oz. The ore reserves developed were approximately 57,330 tons of about 30-oz. ore, or 1,719,900 oz. This is about equal to the tonnage mined during the year, but slightly less in ounces. The development has been mainly along branch veins on third level No. 5, with the additional ore developed in the Nancy-Helen workings, also on the first level No. 7.

Comparing the production, recovery, and profit with the previous year, the mill handled 8982 tons more. The average value of ore per ton treated in the mill was 13.48 oz. higher. The total recovery was 710,591 oz. greater. Net receipts were larger by $440,038.80. The cyanide plant recovery was two and a half times greater. Total earnings were $1,258,864.34; operating expenses $310,279.80; and administration $57,391.58; a net income of $891,193. Dividends paid during the year amounted to $656,000. The total surplus, April 30, 1913, was $623,028.

ZEEHAN-MONTANA MINE, LTD.

The Company was registered in 1892 to acquire silver and lead mining property in the Mount Zeehan silver field of Tasmania. Since then, the adjoining property of the Tasmania Crown Silver Mining Co., Ltd., has been purchased, also 200 acres was taken under the Mineral Lands Act, and a portion of the adjoining Silver Queen property was purchased, making a total of 420 acres. The mine has been in constant operation for twenty years, and dividends have been paid except from December 2, 1908, to January 8, 1911. The general manager, J. Craze, found more reserves of ore, and since then dividends have been resumed. The net profit for 1912 amounted to $5700. A dividend of 12c. per share was distributed in May 1912, and a balance of $9600, the profits for 1912 plus the balance of profit in hand, was recommended to be carried forward. The ore shipped to Antwerp was 1200 tons, with a net value of $96,000. According to the contract with the Tasmania Smelting Co., all surplus ore and concentrate over 100 tons per month was sold to that Company, a net product of $19,000. Although the old levels are almost exhausted, there is yet a good deal of virgin ground to be explored, and it is probable that profitable reserves may be found. The concentrating plants treated 9980 tons of second-class ore during the year, at a cost of 87c. per ton.

Concentrates

Most of these are in reply to questions received by mail. Our readers are invited to ask questions and give information dealing with the practice of mining, milling, and smelting.

SHAFT-SINKING through gravel and sand at Poseidon, Victoria, Australia, is being done by the freezing process.

EIGHT Holman pneumatic stamps at the East Pool & Agar tin mine, Cornwall, working 26 days, crushed 5637 tons of dry ore in June.

COKED DUST, blistered coal, and stalactitic carbon were found in the Bureau of Mines experimental mine, at Pittsburgh, after explosions had taken place.

ROADS AND TRAILS constructed in Alaska to June 30, 1911, totaled 2891 miles, costing $1,869,890, an average of $645 per mile, including maintenance and repairs.

OVERBURDEN and tin drift amounting to 37,000 cu. yd. was removed in June from the Briseis tin properties, Tasmania, resulting in a clean-up of 45 tons of black tin.

ROCK-DRILLING CONTESTS at Fairbanks, Alaska, on July 4 resulted in the $250 prize being won by Colin F. McGillivray and David Browner, who drilled 33¼ inches in 15 minutes.

SHAFT-SINKING and other costs at the Buckeye Belmont mine, Tonopah, during the first half of the current year, were as follows: Sinking, $34.03 to $36.30; cutting station, $17.43; and cross-cutting, $10.61 to $16.12 per foot.

AUTOMOBILES are now being used successfully in Alaska and the Yukon, in handling freight and passengers. From Fairbanks to Valdez, 363 miles, was recently covered in 54 hours, and Dawson to White Horse, 365 miles, in 33 hours.

THE *Corozal* established a new record for one day for ladder dredges in the Canal service, on Friday, July 11, by excavating 13,700 cu. yd. of material, 90% of which was rock, in 19 hr. 50 min. actual working time, an average of about 685 cu. yd. per hour.

WATER from the Barnes mine, Quartz hill, Gilpin county, Colorado, has hindered amalgamation at the U. P. R. mill. The water is strongly acid and contains copper, and pipes and other metals are rapidly corroded. It is proposed to let the water flow over the scrap iron in launders between the mill and mine.

ANDESITE containing thin flakes of native silver has been found on the picking belt at the Tonopah-Belmont mine, Nevada. This is an unusual occurrence, and it has not been found in place in the mine so far. The rock is probably a somewhat altered trachyte that would contain about 66% silica.

THE PRINCESS PIT, now known as Sydney No. 1, of the Nova Scotia Steel & Coal Co., was in 1873 the first submarine mine in North America, the coal being won from workings under the sea. The shafts are of unique construction, consisting of metal cribbing or tubbing. The total length of metal tubing is 842¾ ft., weighing 776 tons.

SINCE 58% of all industrial accidents are shown by statistics to be due to negligence, carelessness, or lack of knowledge of employers and employees, the vital necessity of learning everything possible about the causes and means of preventing these accidents must be evident to every man concerned in mining. To the operators it spells business success or failure; to the miner, life or the physical ability to work and support a family.

ACCORDING to the electrolytic theory of corrosion, when iron is oxidized in the wet way it first goes into solution as ferrous ions. The ferrous ions are then oxidized by the oxygen present in the water to ferric ions and are precipitated as ferric hydroxide. Simultaneously with the formation of ferrous ions, hydrogen is liberated on the surface of the iron. The passage of the iron from the atomic to the ionic state and the passage of the hydrogen from the ionic to the atomic state are accompanied by a transfer of electricity. The ferrous ions derive from the metal surface a charge of positive electricity, the hydrogen ions give up a charge of positive electricity, and a current flows through the metal from the point where hydrogen is liberated to the point where iron is dissolved.

CISTERNS that are properly constructed and receive rain water from roofs generally afford water of good sanitary quality, but if water of doubtful quality is stored in cisterns the supply is, of course, not safe for domestic use. Filters used in connection with cisterns are of value in making the water clear, but are generally of no value in removing disease germs. Many cisterns are divided into two parts by a brick wall, the water being admitted into one compartment and drawn from the other. In such cisterns the water passes through the brick, and in that way is improved in clearness and color, but not generally in sanitary quality.

THE PULP RESIDUE from manufacture of sugar beet is valuable, among other things, as fodder for stock and as a fertilizer. The manure from animals fed on molasses contains valuable potash and nitrogen of the latter, and the use of such as a fertilizer has all the advantages and none of the disadvantages which result from the direct application of molasses to the soil. The approximate average composition of beet molasses in Germany, according to C. A. Browne, from which no more sucrose will crystallize is as follows: water, 20%; sucrose, 50%; salts, 10% (5% K_2O); nitrogenous substances, 10% (2% N); and gums, acids, etc., 10%. These figures suggest at once that molasses might have some value as a fertilizer; and such in fact has been demonstrated to be the case upon certain kinds of soil, more especially those deficient in humus. The application of molasses to other soils, however, has caused an acid fermentation with souring of the soil and loss of fertility, so that this method of utilizing molasses is not always successful. The press-cake obtained from cane sugar consists of fine particles of bagasse ground off in milling, with an admixture of wax, proteins, gums, lime sulphate and phosphate, iron oxide and alumina, and considerable earthy matter which was brought in on the cane stalks from the field. Where the carbonation process of clarification is used, as is the case with beet-sugar manufacture, the press-cake is mostly calcium carbonate, the remainder consisting of the wax, proteins, gums, etc., found in defecation press-cake. Great benefit has been derived from the use of filter-press cake as a fertilizer, the nitrogen existing in a form which is readily available. The excess of calcium carbonate in carbonation cake has also been found beneficial upon certain soils. The employment of press-cake as fertilizer is about the only means of utilization. In the manufacture of beet sugar, lime is used to clarify the juice before concentration. By use of the lime the organic matter other than the sugar coming from the beets is precipitated. This organic matter is composed chiefly of nitrogenous material, but also contains various minerals including potassium and phosphorus. Any excess of burned lime is precipitated by running carbon-dioxide gas through the juice. The whole material is then passed through the filter-press, which separates the burned lime in the form of calcium carbonate or limestone together with the organic matter of the juice, which includes potassium, phosphorus, and nitrogen. Lime acts on the soil both physically and chemically, according to Charles S. Knight of Fallon, Nevada. Its chief physical effect is upon heavy soils, making them more receptive to water and permitting better drainage. Probably the most important chemical effect of lime is the neutralization of organic acids as they are formed in the soil by the decomposition of vegetable matter. Besides, lime forms an important food material for the lower organisms in the soil, and also helps to a considerable extent in rendering the potassium, phosphoric acid, and nitrogen in the soil available as food for the growing plants.

Book Reviews

STEAM POWER PLANT ENGINEERING. By G. F. Gebhardt. Fourth edition, entirely revised. P. 989. Ill., index. John Wiley & Sons, New York. For sale by the *Mining and Scientific Press*. Price $4 postpaid.

Engineers will welcome the revised edition of this old friend, and will be glad to note that the author and publishers have coöperated to reduce the cost of living by making the price $4 instead of the previously rather high figure of $6. To quote from the preface the changes are as follows:

"The chapters on Fuels and Combustion, Engines, Turbines, Condensers, Finance, and Economics, have been entirely rewritten and others have been revised and enlarged. The chapter on Finance and Economics contains many operating charts, showing current practice in power plant cost and accounting, typical load curves illustrating daily, monthly, and yearly load characteristics for a wide range in practice, and numerous tables giving recent results in cost of operation. Over three hundred new illustrations have been added, and the entire text has been reset."

GENERAL AND INDUSTRIAL ORGANIC CHEMISTRY. By Ettore Molinari. Translated by Thomas H. Pope. 770 pp.; 506 ill. P. Blakison's Son & Co., Philadelphia, 1913. For sale by the *Mining and Scientific Press*. Price $6.

As a sequel of Mr. Molinari's monumental work, 'General and Industrial Inorganic Chemistry,' the present volume is a most valuable addition, dealing as it does with that interesting branch of the science which has shown such a marked development of late years. It is only necessary to recall the advance which has taken place in the manufacture of artificial gas with its innumerable by-products, and refining of petroleum as well, to realize the extent of application of organic chemistry and its importance in the industries. Sugar refining, starch manufacture, the making of alcohol, wines, yeast, beer, and ferments has been an especially productive field for organic research. In the textile industries, organic chemistry has found a valuable application in the testing of fibres, analysis of mixtures of textile fibres, dyeing, and printing. In the present work there is presented that happy combination of the theoretical and practical which is lacking in most works of this nature, the practical side of the subject being so hidden that to one who is not an absolute theorist the work is exceedingly tedious. The practical or commercial side of the subject is written in a manner full of human interest, which with the abundance of illustrations present the text in a way which appeals to the eye as well as the intellect. With modern environment it does not suffice that the young chemist should have a thorough knowledge, for instance, of the various syntheses and constitutional formulae for sugars. He should at least be acquainted with the general outlines of the industrial processes and of the technique of the manufacture of sugar, beginning with the slicing of the beets and proceeding to the exhaustion of the pulp, defecation, saturation, filtration, boiling, vacuum concentration in multiple-effect apparatus, refining, utilization of the residue, and so on. He should understand the plant and chemical processes of the more important industries, as these often find application in the manufacture of products of a secondary or entirely new character. What would avail a study of the wonderful artificial coloring-matters derived from coal-tar if it were limited to a simple mnemonic exercise for the student and no notice were taken of the interesting practical application to the dyeing of the various textile fibres? It has been the object of this work to present a suitable fusion of these two sides of the subject.

Among the subjects discussed are included illuminating gas, furnaces and retorts, purifiers, gas testing, petroleum, distillation, purification, desulphurizing, methods of testing, treatment of residues, asphalt, acetylene, fermentation, yeast, alcoholometry, brewing, ethers, explosives, organic acids, soap, sugar, starch, dyes, etc. The scope of the work is exceedingly broad, and while it cannot be said that all the minute details have been covered, as a general survey of the subject the work presents a most valuable addition to the literature of this science.

Recent Publications

BIBLIOGRAPHY OF SMOKE AND SMOKE PREVENTION. Compiled by Ellwood H. McClelland. Smoke Investigation Bulletin No. 2. P. 164. University of Pittsburgh, Pennsylvania, 1913. This is an interesting bibliography of the subject dealing mainly with coal smoke, and does not include the literature of dust, metallurgical fumes, firing, and other subjects more or less related to the suppression of smoke.

AMERICAN MINING CONGRESS. Report of the proceedings of the fifteenth annual session held at Spokane, Washington, November 25 to 29, 1912. P. 251. Denver, Colorado, 1913. This volume includes the annual address of the president, and the following papers: 'National Forests and Development of Natural Resources'; 'Protection of Investors in Mining Stocks'; 'The Relative Hazard of All Vocations in Comparison with Mining'; 'Government Construction of Railroads and Leasing of Coal Lands'; 'A "Day in Court" for the Alaska Coal Claimants'; 'Law Enforcement for Alaska'; 'Transportation Facilities in Alaska'; 'The Leasing of Mineral Lands'; 'Mineral Land Laws and the Decadence of Prospecting'; 'The Washington Compensation Act'; and three papers on 'Workmen's Compensation.'

THE NICKEL INDUSTRY. With special reference to the Sudbury region, Ontario. By A. P. Coleman. Department of Mines Monograph. P. 206. Ill., maps, index. Ottawa, 1913. This is a valuable contribution to the growing nickel industry. The use of nickel in steel adds greatly to its strength, reducing the quantity of steel needed in structures and the cost. The Sudbury district is the most important nickel ore producer in the world, the annual output being about 700,000 tons, the next in importance being the French island of New Caledonia, 900 miles east of Australia, which produces about 120,000 tons of ore. In the volume under review the following points are dealt with: general geology of the Sudbury district, historical sketch of development, the various companies operating, description of the nickel ores, source of the ores, individual deposits and methods of working, other Canadian nickel deposits, with those in the United States, Cuba, Europe, New Caledonia, and Cape Colony, mechanical treatment of Sudbury ores, metallurgical processes, uses of nickel, what is monel metal, and an appendix dealing with patents for separation of nickel and copper, and refining of nickel. The book is well illustrated.

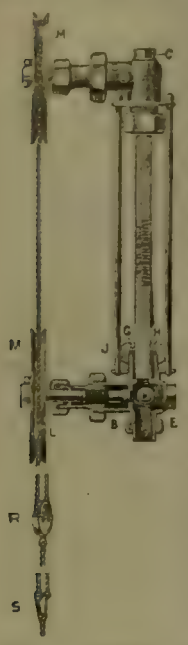
Bureau of Mines publications, Washington, 1913:

AN ELECTROLYTIC METHOD OF PREVENTING CORROSION OF IRON AND STEEL. By J. K. Clement and L. V. Walker. Technical Paper No. 15. P. 19.

FIRST SERIES OF COAL-DUST EXPLOSION TESTS IN THE EXPERIMENTAL MINE. By George S. Rice, L. M. Jones, J. K. Clement, and W. L. Egy. Bulletin 56. P. 115. Ill. The Bureau of Mines has spent a considerable amount of time and money in making these tests, since the idea was adopted in 1910. For the purpose a new mine was developed to the extent desirable, and then the tests were begun to determine the natural laws underlying ignitions and explosions in coal mines. Lessons from these tests showed the following among others: that an explosion could be obtained by a single blown-out shot at the face; coal-dust explosions may occur when the atmosphere is nearly saturated, and the floor, ribs, and walls are damp, but not wet, provided the coal-dust is dry and sufficiently abundant; and the comparatively slow development of some explosions, the relatively slow speed of the pressure wave, and the rapid overtaking of the pressure wave by the flame of the explosions.

Improved Automatic Water Gauge

The improved automatic water gauge herewith illustrated, was designed and patented by the Lunkenheimer Co., of Cincinnati, Ohio. The gauges are made in two patterns, termed 'medium' and 'extra heavy,' and are intended for 200 and 300 lb. working pressures. Should the gauge glass break, the ball check-valves *K* will automatically seat themselves, owing to the rush of steam and water on the side thereof, and the lack of pressure on the other. This automatic closing feature is a valuable one, as it prevents the escape of steam and water, and permits the safe closing of the hand-operated valves for the purpose of renewing the glass. To renew the glass, it is only necessary to loosen the stuffing-boxes *G*, take off the cap *C*, remove the broken glass and substitute a new one, after which the stuffing-boxes are tightened and the cap *C* replaced. The change can be performed with perfect safety, for owing to the quick-closing valves, which should be closed upon the discovery of the broken glass, there is no danger to be anticipated from escaping steam and water.



Care has been exercised in the design to facilitate cleaning, and access can be readily had to any part. The plugs *C*, *D*, *R*, and *N* are provided for this purpose. By removing the plugs *D* and opening the regrinding valves to their greatest extent, a rod can be inserted entirely through the body and tail-pieces, and any sediment that might have collected in or around the entrance of the tail-pieces can thereby be easily removed. By unscrewing plugs *E* and *N*, the check-balls will of their own accord fall from the body, as they rest on inclined surfaces. The arrangement illustrated herewith was designed, as will readily be seen, so that both valves can be made to positively seat independently of each other. This arrangement consists of a block pulley operating over a chain, which is pinned to both the upper and lower pulleys, this method being employed for closing the valves. Should one of the valves become closed before the other, a continued pull on the block-chain will close the other. The valve-seat opening is large, and consequently a free and unobstructed passage for the water and steam is insured. The gauge cannot show a false level, as the ball-checks are so constructed that unless the glass breaks, they will, owing to their weight and position, fall away from their seats. The Lunkenheimer Co. has issued an attractive booklet describing this gauge, which is being distributed free to anyone desiring a copy. The gauge has been given the trade name of 'Monitor.'

Drilling Equipment at Mt. Royal

The air for operating the entire outfit of Sullivan drills, now in use in the Mt. Royal tunnel, and the hammer drills used for putting in holes for supports for ventilating pipe and light wires, is furnished by two direct-connected compressors of Sullivan 'WN-2' type, 2000 ft. capacity at 100 lb. pressure. One is situated at each end of the work, and in each plant, in addition to the direct-connected compressors, are three Blaisdell belt-driven units of about 1100 ft. capacity, making a total of 5300 ft. at each end of the tunnel. The Sullivan 'WN-2' compressor is so well known that it requires no further description.

When it is considered that in driving this 810 ft. of 8 by 12-ft. heading, the crew at Mt. Royal drilled a total of 20% more holes and excavated a total of 18% more hard rock than was excavated in the Loetschberg tunnel in driving 1013 ft. in soft rock, a world's record can hardly be disputed for tunnel driving where air-driven percussive drills were used.

Four 'FF-12' Sullivan reciprocating percussive drills of water type, using hollow steel 1⅛ in. diam., through which alternate pulsations of air and water are forced to the bottom of the hole, were used in this heading. 'FJAB' steel was used, made up in 22-in. changes; about 500 sharp steels were used each 24 hours. When the hard dikes were numerous, it greatly exceeded this number. The gauges were as follows:

	Cuts to in.	Gauge, in.
Starter	22	2¼
No. 2	44	1⅞
No. 3	66	1⅝
No. 4	88	1½
No. 5	110	1⅜

The No. 5 was rarely used, and the gauge of 2¼ in. on the starter was used to give more freedom at the collar of the hole, also making it easier to remove the steel. The size of hole required at the bottom was only large enough to receive 1¼-in. dynamite.—*Mine and Quarry.*

Commercial Paragraphs

The Hardinge Conical Mill Co. reports that, after operating two Hardinge mills for fourteen months, the Tomboy Gold Mines Co. is installing two additional mills of the same type.

The new Equitable Life Insurance building in New York, 38 stories high, will contain approximately 36,000 tons of structural steel, the inspection of which, both mill and shop, has been intrusted to Robert W. Hunt & Company.

In accordance with its long established policy of business expansion, H. W. Johns-Manville Co. has recently opened a branch office at Charlotte, North Carolina. The new office, which is in the Commercial Bank building, is in charge of E. U. Heslop, who is assisted in covering the western part of North Carolina by P. J. McCusker and Paul W. Whitlock.

The Dodge Manufacturing Co., of Pittsburgh, has contracted with the Fairmont Mining Machinery Co. of Fairmont, West Virginia, for a carload of self-oiling ball-and-socket pillow blocks (dustproof), adjustable floor stands of special designs, and standard split iron pulleys, the latter to weigh about 2400 lb. finished. The adjustable floor-stands, according to specifications, will each be 58½ in. high to shaft centre.

The National Tube Co. announces that it has entered the electrical conduit field and that it has contracted with the National Metal Molding Co. and the Safety-Armorite Conduit Co., both of Pittsburgh, Pennsylvania, to manufacture and sell this product for it as its agents, under the various brands. It has also been decided to sell this product on the 'Pittsburgh basing discount' plan in the same manner as all wrought pipe for other purposes has been sold for the past thirteen years.

The Inspiration Copper Co. has just purchased two double-drum hoists, to be built by the Nordberg Mfg. Co., of Milwaukee, Wis. Each hoist is designed to lift the following load: ore, 24,000 lb.; skip, 12,000 lb.; rope, 1¾ in. This load is to be lifted in balance from the present working depth of 650 ft., at a hoisting speed of 750 ft. per minute. Each hoist will have two drums, 10 ft. diam. by 65-in. face, grooved for 1000 ft. of 1¾-in. rope. One drum will be keyed to the shaft, the other equipped with the Nordberg axial clutch. Both drums will be equipped with Nordberg post brakes with parallel motion supports. Clutch and brakes will be actuated by Nordberg air-operated thrust cylinders with oil cataract cylinders and the Nordberg floating lever mechanism, for flexibility of control and positive locking of brakes for any position of the operating lever. The normal hoisting rate will be 30 trips per hour, or 5000 tons of ore in 14 hours for one hoist. The hoists will be driven through Wuest herringbone gears by General Electric direct-current motors operated by an Ilgner motor generator set.

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EDITORIAL

MOTHER JONES has left the Superior district for Washington. With the present attitude of the Administration toward lobbyists, it is a question whether a hearty welcome into the inner circle of the Solons will be accorded, or the greeting which awaited 'General' Coxey, to 'keep off the grass', will be the order of the day.

THE closing of the famous old Lundberg, Dorr & Wilson property, as recorded in the current issue, marks the passing of one of the old pioneer properties which, during a long life of usefulness, has added a full quota to the advancement of the science of metallurgy. The results of the experimental work as conducted at this mill and the refinements of the cyanide process as developed in the treatment of the ores of this property, have been far reaching in effect and can be seen in almost every mining district of importance in which cyanidation is practised.

WIRELESS TELEGRAPHY is finding an important use in connection with mining operations in Mexico. Owing to the constant interruption of the ordinary service, because of the activity of the 'revolutionists', a wireless service has been installed at some of the more important properties and direct telegraphic communication is now being maintained between these properties and their anxious owners on this side of the Rio Grande. While an aerial fleet for the transport of bullion and supplies has not as yet made its appearance, it would seem that some such means of transportation will have to be devised if the mines and mills are to be kept in operation.

IN the present issue we publish the last of the series of articles by Mr. A. Sydney Additon on 'Under-Estimating the Cost of Milling Plants.' While no two general managers or boards of directors will agree as to the one most economical and efficient method of mill construction, and the general methods of contracting and professional supervision are subjects which can not be decided by a rule of thumb, but must be adjusted to fit the particular case under consideration, there are, however, fundamental principles which might well be called 'horse-sense' in mill construction, which are often neglected. The subject of design and supervision is, of course, one which offers a great field for difference of opinion as to policy and method. The position of the large machinery houses in acting as both metallurgical adviser and contractor

is often criticized and many times unjustly, as the field which is occupied by the machinery manufacturer, especially as adviser to the small operator, is an important one by which the operator has profited on innumerable occasions. Our attention is called to one particular example where the identical equipment for a 10-stamp mill, when erected and placed in operation under the supervision of a competent engineer, was 40 per cent in excess of a contract price offered for the same work by a machinery house. While this case can not be looked upon as the rule, such cases are numerous and would tend to show that the matter of design, supervision, and contracts is one in which the machinery house holds an important position, which in many cases may be taken advantage of by the prospective builder. In the construction of milling plants the preliminary work is of the greatest importance, as the success or failure of the completed plant is largely dependent upon the accuracy of this investigation, and it is to be noted that in our most successful mills the process and design have only been arrived at after the most careful investigation by the best metallurgical talent. The 'pilot' mill or test unit has been proved the logical forerunner of large plants, and the comparatively large amount of capital expended in equipment and preliminary ore testing under expert supervision is conceded to be money well invested. These are facts which are attested to by the number of derelict mills, and mills which have had to be practically rebuilt after being erected. A closer relationship between the machinery manufacturer and the metallurgical engineer would undoubtedly redound to their mutual benefit as well as advance the interest of the operator, as it is only by the avoidance of this friction, which occasionally makes an appearance, that the best results are to be obtained.

THE Butte meeting of the American Institute of Mining Engineers has been one of the most successful in the history of the organization. One hundred and forty members registered for the session, among whom were some of the most eminent engineers that the industry affords. The technical program is conceded as the best which has been rendered in years, the papers presented on concentration being of especial interest and value. The exceedingly liberal attitude of the Anaconda company in the matter of furnishing complete information and data regarding the operations at this property is to be commended and has proved of great interest to the visiting engineers. The sessions at Butte, Anaconda, Great Falls, and Southern Cross have all been well attended and keen interest has been taken in the papers presented. The social program has been most attractive, and while properly subordinate to the main purpose of the meeting, the departing engineers will carry away remembrances of a few days well spent in a most enjoyable holiday. The mine rescue car, which accompanied the engineers' excursion train, proved both interesting and instructive. The demonstration of the use of this comparatively new factor in mine rescue work is conclusive as to its value as an aid in the great humanitarian service, for which it was designed.

The Brown Process Decision

The recent decision of Judge Edward G. Bradford in the District Court of the United States for the District of Delaware, in the suit of Joseph A. Vincent *versus* Tonopah Mining Company of Nevada and Desert Power & Mill Company, is one of most importance in that it pertains directly to a branch of milling practice which has come to be recognized as standard for the treatment of ores containing the precious metals. The patent in suit was that granted to Alden H. Brown for 'Improvements in Processes for the Treatment of Precious Metal Bearing Ores,' on February 7, 1905. The scope of the decision, which was rendered in favor of the complainant and held that an infringement had been made by the Tonopah company, may be judged from the grounds for the suit, or the practice at the Tonopah mill, which has been adjudged an infringement. The patent claims a process for the treatment of precious metal bearing ores by cyanide solution followed by classification, leaching, and concentration. The process as patented is in contradistinction to the practice to treat first by concentration and secondly by cyanidation, it being held as a reversal of this process with the addition of certain special features in connection with cyanidation. The advantage in treating many ores by this system, it is claimed, is due to the fact that in the case of most gold and silver-bearing ores, the use of water in crushing by stamps or rolls or in connection with concentration occasions much loss of metal by 'sliming' because a large percentage of the metal content is reduced to so fine a state of division, that it is taken up in suspension by the water used, making it difficult to settle that portion of the metal content for further treatment within the limits of a plant of ordinary construction, as it remains in suspension for many hours. In the treatment patented the metal content of the fine material is recovered by the cyanide process in the beginning, leaving only the coarser material, which is readily recoverable by concentration. The special features claimed for the patent consist in decreasing the volume of solution used by settling, and pumping back the solution to the stamp-battery and the use of cyanide solution to create the ascending current in the classifier. The charge of infringement has been granted on one claim, which is as follows: The herein described process for the treatment of ore consisting in, first, pulverizing the ore in the presence of cyanide solution; second, subjecting the ore to hydraulic classification by the introduction of cyanide solution at the bottom of an overflow-tank to produce an ascending current; third, leaching the ore by the use of cyanide solution, whereby the finer metal content of the ore is dissolved; fourth, removing the dissolved metal from the ore in any suitable manner; and finally subjecting the residue to concentration.

In summing up, Judge Bradford holds that the defendants have used in their process all of the steps contained in the complainant's process and in the order required by the patent. That there is, first, the pulverizing of the ore in the presence of cyanide solution in the stamp-battery; second, the subjection of the ore to hydraulic classification with-

in the meaning of the second step; third, leaching of the ore, not only in the stamp-battery, but in the Huntington mills by the use of cyanide solution, whereby the finer content of the ore is dissolved; fourth, the removing of the dissolved metallic content of the ore to the concentrating tables; and finally, the subjection of the residue of the ore to concentration. While the defendants have added a number of steps or features not included or required in the patent, the court holds that these features do not operate to negative infringement of the combination process as embodied in the earlier steps of the process practised by them, and that the patent in suit must be sustained and a decree rendered in favor of the complainant.

The decision as rendered is one of the most far reaching that has been handed down to the metallurgical fraternity, and unless reversed or modified by a higher court will mean that a large percentage of the mills, both old and modern, which have been beneficiating ore since the date of the patent by means of cyanidation, will be directly obligated to the patentee for the process employed.

Balkan Mining

War has ever been a topic of large interest, but the changes which follow a war are usually of more real significance than the campaigns themselves. In 1898 the United States and Spain were drawn into what must in fairness be denominated a minor conflict, but the changes wrought by that war, especially in the United States, have been enormous, and the end is not yet. War stimulates powerful emotions. It stirs a people up as does nothing else, and it has often happened that this intellectual awakening brings more benefit to the vanquished than the nominal victory brings to the victor. Of more immediate interest, however, is the fact that war usually opens or closes great areas to development, and in this particular the Balkan war seems likely to be as potent as any.

In a brief but interesting paper read a few weeks since by Mr. Herbert K. Scott, before the Institution of Mining and Metallurgy, it was shown that Bulgaria includes considerable areas well situated for development and of large potential mineral wealth. The same statement regarding the other Balkan states could easily be supported, and yet the Balkan peninsula has for centuries yielded but insignificant amounts of mineral. At an earlier time, mining was extensive, but at present, aside from the Rumanian petroleum fields and the manganese mines along the Black Sea, little is heard of mining in the territory over which armies have been moving this past winter. It may be worth while to inquire to what extent the conditions that have retarded mining will be removed.

First and foremost must be placed the matter of government. It is notorious that poor government, almost no government, has obtained over much of the peninsula. There was not that security for life and property that is necessary before capital can be induced to enter a country. Furthermore, the Turks were not interested in mining. They knew little about it and cared less. They are a people whose ideals lay in other directions, and to a large extent the same has been true of the other peoples of the Balkan states. The second great factor, therefore, was the fact that the thoughts and energies of the people were bent in another direction. This cuts deeper than appears at first glance. While in Bulgaria and Servia mining laws have been favorable enough, and deposits that in other countries would have been worked have been known, mining has not proved much more attractive to foreigners than to natives. Only those who tried to develop a new industry in an old country and have had to face the resultant labor problem, are prepared to appreciate fully why. The people of the Balkans have been devoted to agriculture and to war. The first was for the sake of making a living, and the second was for accomplishing the century-long purpose of expelling the Turk. The latter has been accomplished, and at the same instant, by a combination of circumstances, the country has filled with hundreds of experienced, hardy, and native miners.

Hard living conditions drove thousands of Greeks and Slavs to emigrate in the last quarter century. As is always true, the more enterprising were the ones to go, and, as is usually true with change of country, came change of occupation. The great bulk of these emigrants came to the United States, and, landing in big cities with few friends and little money, they in the main found places for themselves in the mines, mills, smelters, on construction gangs, and in various industries to which they had been strangers. How mightily they contributed to the rapid industrial progress of the United States is evidenced by the fact that 85 per cent of the meat packing, 80 per cent of the work on leather goods, 70 per cent of the mining of bituminous coal, 75 per cent of the iron and steel making, and similar percentages in other great industries, is conducted with foreign-born workmen. The average annual income of the immigrants in 1907 was approximately $400. From time to time individuals, accumulating what was to them a competence, returned to their home country, freighted not only with money, but with new ideas, and they formed recruiting centres for further immigration. When the war came, whole regiments and shiploads of these peoples drew their pay and left to answer their countries' call. For a time production in the United States was crippled. In one district fourteen mines were closed for lack of labor.

From New Jersey to California, from Spokane to Bisbee, the drain was felt. These men are now in Thrace and on the Balkan peninsula. Whatever may be the outcome of the present fighting, when the armies are disbanded they must needs go to work, and since it is the nature of man to prefer his home country, it would be easy to man a number of mines and metallurgical works from foremen down with trained workers speaking or at least understanding English as well as their native tongue. This abundance of labor coupled with the desire for new things, and for industrial supremacy which may be expected to follow the successful completion of the war, removes the chief difficulties in the way of a highly successful and profitable mineral industry in the Balkans.

The Leaching of Copper Ores

By John Rooke-Cowell

The bodies of low-grade and, for the most part, oxidized copper ores which occur in the southwestern part of the United States, in Canada, Mexico, Central and South America, Australia, Africa, and in fact throughout the world, which, owing either to their inaccessibility, metallurgical condition, or their low copper content, cannot be profitably treated by smelting methods, and the huge accumulations of tailing from the great concentrating plants of the West, in which millions of pounds of copper is being lost every year, have turned the attention of metallurgists to the investigation of hydro-metallurgical or electro-chemical processes by which this copper may perhaps be profitably recovered at a small cost and added to the world's supply.

Leaching at Rio Tinto

At the mines at Rio Tinto the leaching of copper ores has for many years been successfully accomplished by a somewhat complicated and very lengthy process, by which the copper in the ore is converted into soluble copper sulphate by the natural oxidizing agencies of air and moisture and the copper precipitated from the solutions on iron. This process is too lengthy and entails the tying up of too much capital to find much favor under present commercial conditions. At Clifton, Arizona, the low-grade oxidized ores of copper have been for some years past leached with sulphuric acid manufactured on the ground at a small cost from a nearby deposit of pyrite, and the copper precipitated on scrap wrought iron and old tin cans.

Although the copper produced by this method is of inferior quality, this is the simplest and, where possible, the ideal method of leaching copper ores, but it is only applicable to oxidized ores and cannot be used to advantage in localities where sulphuric acid and iron are not obtainable at a moderate cost. The problem, therefore, which now confronts the investigator, and which during the past decade has given rise to half a hundred processes, most of which are now happily defunct, is to find a method suitable to both sulphide and oxidized ores of copper, by which the solvent may be regenerated at a small cost and the heavy expense of precipitation by means of iron eliminated.

Prospecting for Leases

With the thorough knowledge now possessed regarding the chemical reactions which occur among the compounds of copper, among themselves and also with relation to the known copper solvents and the associated minerals in the different ores, and the amount of accumulated data regarding the electro-deposition of copper from leaching solutions, and with the many improved mechanical devices at our disposal, the invention of such a process, with a fairly universal application, should not present any great difficulty. Yet the costly failures of many processes within the past few years have created a certain atmosphere of skepticism, and the inventor of a new process is likely to be regarded in some quarters as a harmless crank, or as having sinister designs on the pocket of the investor.

Ammonia has been used as a solvent for certain oxidized copper ores, the copper being subsequently recovered as cupric oxide by simply heating the solution, but mechanical difficulties, the loss of ammonia during its operation, and the high cost of this solvent, have limited the usefulness of the process. Sulphurous acid, made by dissolving sulphur dioxide in water, has also been used as a solvent, the copper being recovered as cuprous oxide by heating the solution. In this, as in the ammonia process, the solvent is simultaneously regenerated with the precipitation of the copper. Sulphurous acid is an excellent solvent of copper ores, especially as it does not attack the other metals present with the same avidity as many other solvents. Only mechanical difficulties and the necessity for using extremely dilute solutions have prevented the successful application of the process. Sulphuric acid has been generally found to be the best and most convenient solvent for copper ores, while ferric sulphate and chloride, which have been found to readily attack certain chalcocite ores and act with less energy on chalcopyrite, have also been successfully used. In certain processes the copper in the ore is converted into a soluble sulphate by a careful roasting at a low temperature, and then leached with water; in others, a soluble chloride of copper is obtained by roasting the ore with common salt or passing free chlorine, obtained by the electrolysis of a solution of common salt, over the ore while it is being roasted. Sulphide ores for the most part require roasting before they can be successfully leached, but modern large-capacity mechanical roasting furnaces enable this to be accomplished at a low cost.

Solubility of Copper

There appears to be no great difficulty in dissolving the copper out of the ore, though cuprous oxide is soluble unless heat is applied, and chrysocolla (the silicate) is practically insoluble. The ore does not require a fine crushing, as is the case in the ores of gold and silver; about 10-mesh will generally be found sufficiently fine, while in some cases a reduction of the ore to pieces about one inch in size, and even larger, will be all that is necessary to obtain a good extraction of the copper. This naturally reduces the cost of crushing and does away with the difficulties of percolation encountered in other processes, as practically no slime is formed.

The action of the solvents on copper ores is increased by the application of heat to the ore charge, is extremely rapid, and the extraction of the copper from properly prepared copper ores is usually high. The numerous mechanical devices which are now available, such as stoneware and hard-rubber pumps for handling acid solutions, lead-lined pipes, and the several excellent non-corrosive compounds which

are now on the market for protecting the tanks and thus avoiding the necessity for using an expensive lead lining for the tanks, have done a great deal toward permitting the successful leaching of copper from its ores. In fact, it may be considered that most of the difficulties encountered in the actual leaching of copper ores have now been surmounted, and the others relegated to the precipitation of the copper from the solutions.

Practicable Methods

With the exception of the ammonia and sulphurous acid processes in which the copper is recovered as a high-grade oxide of copper, or those processes where the production of copper sulphate is the ultimate object, and neglecting the precipitation of copper by means of iron as generally too expensive, the only practicable methods in use for the recovery of the copper from its solutions are either chemically by the use of hydrogen sulphide, which is passed into the solution and precipitates the copper as copper sulphide, or electrolytically, by which the copper is obtained as cathodes of pure copper. In the former method the precipitation of the copper is rapid and complete, but at the same time the other metals of the acid group, such as arsenic, antimony, and bismuth, are precipitated with the copper, while other metals which are not precipitated in an acid solution, such as iron, continue to accumulate in the solution until it becomes so saturated and foul that it has to be thrown away and the whole of the contained acid lost. In any case, only the acid in combination with the precipitated metals will be regenerated, and so a constant addition of part of the acid at least will always be necessary. In some places the manufacture of hydrogen sulphide would be extremely costly.

Electro-Deposition of Copper

In the electro-deposition of copper from leaching solutions many difficulties have been encountered. They are partly due to the fouling of the electrolyte, owing to the accumulation of the sulphates of iron and other metals which make it necessary to periodically send some of the solution to waste, thereby causing a loss of all the acid; to the difficulty of finding a suitable anode for sulphate solutions other than lead, which is at present used but is rapidly oxidized; and to the reactions which occur among the foreign metals present in the electrolyte. Although a complete regeneration of all the acid is effected, and in fact when sulphur dioxide is injected into the electrolyte as a depolarizer, an excess of acid is obtained by its combination with the nascent oxygen liberated at the anode, so many reactions and counter-reactions occur among the foreign metals present in the electrolyte, and so much difficulty has been encountered in properly regulating the current density, that a great deal of electrical energy is wasted and the consumption of current is greatly in excess of that required for the actual electro-deposition of the copper. Theoretically, the electrical efficiency of the deposition of copper from sulphate solutions is 2.14 lb. per kilowatt-hour. In practice, from leaching solutions, only about one pound per kilowatt-hour, or about 50% of the theoretical efficiency, has hitherto been obtained. With a pure copper sulphate electrolyte, free from other metals, and the proper precautions taken to prevent the impoverishment of the copper ions around the cathode, there is no reason why at least 90% of the electrical efficiency, or about two pounds of copper per kilowatt-hour, should not be obtained. The difference between this and the theoretical is due to the resistance of the conductors. This would mean a reduction in the cost of the electrical installation and of the electro-deposition of the copper of about 50%, which would be of considerable importance in a large plant.

Advantage of Electrolytic Methods

Such a condition could be obtained if the electrolyte were freed from the presence of foreign and interfering metals, by chemical means, before being introduced into the electrolysis, instead, as is the practice at present, of precipitating the foreign metals when the electrolyte has become thoroughly saturated and foul and a great loss of electrical energy has already occurred. The great advantage of recovering the copper by electrolytic means is the complete regeneration of the solvent and the production of pure copper which can be readily marketed. The first cost of such an installation, especially if a high degree of electrical efficiency can be obtained, is not prohibitively high, as many people imagine, and the cost of precipitating the copper, especially where water-power is available, will in very few cases exceed one cent per pound. There seems every reason to believe that electrolysis will in time take the place of all other methods for the precipitation of copper from leaching solutions. Roasting, by rendering insoluble in acids many foreign substances which in the crude unroasted ore would be soluble, and by converting insoluble into soluble copper compounds, has been found beneficial before leaching. Yet in most cases where both the sulphides and oxides of copper occur in the same ore a preliminary concentration of the sulphides and the leaching of the oxidized tailing and roasted concentrate will prove most economical. Ferric salts, which may be generated during the operation of the process, will dissolve part at least of the small amount of sulphides which escape concentration. Ores containing much lime are, for the most part, unsuitable for an acid-leaching process on account of the excessive consumption of the solvent, but in certain cases this has been overcome by roasting the ore at a low temperature and converting the lime into an insoluble sulphate.

Chemical Reactions

So thoroughly have the chemical reactions of the various copper compounds been investigated during the past few years that the process which will have the most general application in the treatment of low-grade copper ores is not likely to depend on the discovery of some new solvent or be a panacea for the treatment of all low-grade copper ores. It will comprise a simple, scientific, and economical arrangement of certain well known and thoroughly understood chemical and electrolytic reactions, and form a process capable of modification so as to meet

individual metallurgical and economical conditions. By taking advantage of modern labor-saving devices, and, so far as possible, eliminating the cost of chemicals, it will enable copper to be produced at a price which will prove profitable under almost all possible market conditions. Such a process would not only add considerably to the world's supply of copper by enabling the low-grade deposits and old tailing dumps to be profitably treated, but would prove a great boon to the small mine-owner, who is at present between the Scylla and Charybdis of courting almost certain disaster by erecting his own smelter, or of sacrificing a large part of his legitimate profits by selling his ore to customs smelters. There is no reason that such a process should not be used in the treatment of high-grade as well as low-grade copper ores, especially if freight rates to the smelter are high, and its introduction would lead to increased activity in all classes of copper-mining.

Concentration and Power for the Mt. Morgan Mine

Many changes in equipment at this great mine in Australia are under way, including the construction of a plant to deal with certain ores too highly silicious or too low in copper for profitable smelting, and the installation of a new power-plant. The following notes are from the annual report of B. Magnus, the general manager.

Concentrator

On the site of the old Mundic works, which have now been dismantled, the erection of a 500-ton per day concentrating plant is well under way. Although this plant is being erected for the treatment of this tonnage, the different units installed will be liberally designed, and it is expected that after working for some time, the capacity of this mill will at a small additional expenditure be increased to a much greater tonnage, probably 1000 tons per day. Before designing the plant, complete investigation was made of the best features in many of the large sized concentrating mills, so that they could be incorporated in the new plant. An experimental concentrating unit on a working scale has been running for some time, and results have been obtained which are better than those used when calculating the possible profit in the treatment of the low-grade unpublished ore reserves. This experimental plant will continue to operate for some months, so that when the new plant is started, investigations necessary to assure it being a success will have been made. Owing to the mineralization of the ore being so intimately disseminated throughout the silicious gangue, it is necessary to resort to exceptionally fine grinding before any concentration is attempted. This will, of course, add some expense to the cost of the treatment. Up to the present $14,400 has been spent on the concentration experiment. Improvements now being made at some of the large American copper plants in the treatment of tailing will be investigated before any decision is arrived at as to what method will be suitable for the treatment of the tailing.

In the experimental plant some trial runs on the tailing from the old Mundic and West works are being made. At the present time definite results cannot be given, but it is believed that these large tailing dumps will in the future become an asset to the Mt. Morgan company.

Power Plant

The erection of the boiler-house and engine-room is now well under way. The boiler-house will consist of large-sized units automatically fired with coal. Its arrangement is along the most up-to-date lines in modern power-plant construction. The engine-room will contain the following machines: two turbo-blowers, each one capable of delivering 40,000 cu. ft. of air per minute to the blast-furnaces at a pressure of 5 lb. per square inch. One mixed-pressure turbo-blower capable of delivering 10,000 cu. ft. of air per minute to the converters, at a pressure of 14 lb. per square inch. Three reciprocating air-compressors, delivering compressed air at 90 lb. pressure for the mine and general purposes. Three turbo-alternator rotary-converter sets of a combined capacity of 4000 kw. The existing blower-room will be used as a standby to take the place of the blast-furnace and converter blowers, in case of emergency. There will be sufficient power in the steam-driven units for all the requirements of the new plant, and will in addition have a 50% standby reserve in the electrically operated turbo-blowers. This portion of the new plant is expected to be ready early in the year unless some unforeseen delays arise in delivery of the machinery. The foundation for the three new blast-furnaces, each 28 ft. long, is now completed, and both the buildings and furnaces are under course of erection. It is anticipated that everything will be ready to blow in the new blast-furnaces in March next year. In the meantime the present plant will be kept going to its full capacity.

Gold production of Bendigo, Australia, for the first half of the current year was as follows:

	*Dividend-paying mines.	†Lansell group.	‡Non-dividend paying mines.
Ore treated, tons...	81,679	21,930	82,469
Gold yield, ounces (at $18 per oz.)..	34,362	8,110	24,032
Dividends	$283,000	.....	.....
Assessments		.....	$254,000

*13 mines. †5 mines. ‡65 mines. These include lessees.

Private mines and pyrite-treatment companies reported a yield of 10,996 oz. The most prominent producers were the Central Red, White and Blue, 13,065 tons yielding 6713 oz.; Golden Pyke, 7217 tons yielding 4516 oz.; Carlisle, 9825 tons yielding 3105 oz.; Virginia, 12,810 tons yielding 4064 oz.; North Bendigo, 4530 tons yielding 1921 oz.; South New Moon, 7591 tons yielding 1921 oz.; and Great Northern, 4181 tons yielding 1842 oz. Lessees' tonnages are not included. The total production of Bendigo to date is $376,800,000.

Water used in April by 11 mining companies at Kalgoorlie amounted to 34,276,000 gal. in the mining and treatment of 146,247 tons of ore.

The proposed change of railway gages in Australia to the standard gage will cost $177,600,000.

Leasing and Low-Grade Milling at Cripple Creek

By Stephen L. Goodale

Two gentlemen, both of whom have been successful in the mining or allied businesses, have expressed to me in strikingly similar language an important point in their success. Several years ago a prominent mining engineer, a graduate of the Colorado School of Mines, said: "As I want to make money, I associate with people who have money." Only a few days ago a successful lessee at Cripple Creek said: "I want to make a success of leasing or mining, therefore I stay where the good mines are, and that is why I am at Cripple Creek, for Cripple Creek is where the live ones are." The mines of Cripple Creek are producing gold at the rate of about one and one-fifth million dollars a month, and still the people are complaining of things being quiet!

GOLD DOLLAR SHAFT.

GOLD DOLLAR ORE-HOUSE.

The present large production is due in great part to the development of the leasing system of operating the properties, and also in large part to the development of the means of treating low-grade ores. Both of these factors are being still further developed. A large number of miners are wandering about the properties where ground is offered for lease, poking into old workings in search for promising ground. Most of the men who are leasing are continually on the lookout for further lease opportunities.

Prospecting by Lessees

To illustrate this, I visited one old mine with two people who have a lease on it, to examine the property for a friend who was considering purchasing an interest in the lease. Two other miners were found in this mine, one of whom was prospecting an adjoining claim through this shaft; the other was simply poking about to see what he could find of interest with a view to a possible lease. I also found that a friend who accompanied him to assist in the examination, a man who is now leasing at Cripple Creek and has had long experience there, was well posted on this property before I visited it, his incentive being to know of any good opportunities for leasing. And this mine was practically without equipment and would need considerable expenditure for timbering and cleaning to get in working order.

Lease Contracts

Most of the leasing is on the basis of a flat rate royalty of about 25%; and in many cases whole properties are let on about this basis to one or more sets of lessees. Other mines lease on a system of graded royalties, the royalties increasing with higher grade of ore, and some even increasing the rate if production exceeds a fixed sum per month. Lessees working on such a basis are not able to do any dead work, and can simply strip out what ore they can secure most easily without regard to developing more. This is said to be particularly true of the Stratton's Independence lease work.

In certain cases larger operators take a lease on the entire mine and sub-lease in blocks to smaller operators. In these cases it is usual to provide the sub-lessee with all equipment and supplies, such as tools, air-drills, compressed air, steel, powder, and the like, so that the sub-lessee risks only his time. The basis of settlement in such leases is first to take out of the returns from shipments the company royalty of 20 to 25%, then the original lessee and sub-lessee 'split the check'; that is, divide equally the remainder. This arrangement seems to work well. The miner can break so much ground and handle it with machine drills and good equipment that he can still make good wages in many places on this basis. Many prefer to do this rather

than pay a smaller royalty and work with hand steel.

Some of the larger companies have recently adopted this plan of 'staking the miner.' One company has opened to this scheme of leasing what is considered to be worked-out ground in its mine, and a number of sets of lessees are doing well for themselves. On these terms, which are more favorable than in the case of sub-leasing because the returns are not first diminished by deduction of any company royalty before the equal division between miner and company, the lessees have been able to do considerable prospecting and have opened some good shoots of ore. In most cases of leasing here the terms are not made sufficiently liberal to allow the ordinary lessee to undertake any considerable development work. So many miners are wanting to lease that the royalties are held high, and few, if any, concessions are offered to secure the performance of development work on a large scale. On the other hand, leasing companies which are able to secure outside capital do not seem to be afraid to undertake more or less dead work in promising ground.

JO DANDY MILL, RAVEN HILL.

NICHOLS SHAFT OF EL PASO, BEACON HILL.

Economy of Lease System

There are so many ways in which lessees' expenses are lower than company costs in the same work that these men working on their own account can often make a place pay where it could not be made to pay for company work. Miners will often work harder for a lessee than for a company, and also will work with less equipment than would be demanded on company work. The companies are reimbursed for the large winnings of the fortunate lessee by the fact that other lessees may be making money for the company when they are not making any for themselves. Many of the companies are making money on the leasing basis which were losing money to work the mine on company account. Freight and treatment rates are now so much lower than formerly that lessees are able to ship ore of as low grade as $10 per ton and realize a small profit, although, of course, this kind of material will not stand a heavy mining expense. This assists materially in prospecting, the rate on ore of up to $10 value being $4 for freight and treatment. When leasing on a dump, it is usually considered that men can make wages if they get rock of $7 grade to ship, and anything above that is 'velvet.' It can easily be understood that with so many miners on the ground hunting for leases, there are not many mines open for lease which are idle if there is ore in sight. It is often men who have worked in the mine for the company and who know of some promising stringer overlooked in company work or considered too small to follow who are most anxious to secure a lease.

Safety Measures

Before turning to the milling in the district, which is the other large factor, with leasing, in maintaining the great production, a few remarks may be made about some other points in mining. To a person used to seeing the many safeguards to men which have been adopted in many of the Eastern mines and industrial plants, it seems that a 'Safety First' campaign would not be amiss in many of the mines and mills of Colorado. One of the striking things to a visitor at Cripple Creek is the number of maimed men to be seen there. The dangers in the gold mines and mills are in general different from those to be overcome in coal-mining and steel works, but they are, according to statistics, productive of a greater number of fatalities in proportion to the number of men employed. It would seem, therefore, that even more stringent safety measures should be adopted than in the case of coal-mining. Some improvements along this line have been accomplished, but much more remains to be done.

Many of the improvements along this line are incidental to changes designed to lessen costs, etc. For instance, many of the mines have changed from the use of cages for hoisting to the use of a moderate-sized skip. Of course, the skips are used primarily to reduce the cost of getting ore and waste handled, but the safety feature of the change would seem to be one of no little importance also. The miners riding in a skip with sides three or four feet high are protected to a considerable extent from accidents in the shaft. I know of at least several fatal accidents due to men falling when on a cage, or in some way moving enough to get caught in the shaft timbers, which accidents might have been prevented had a skip been in use in place of the

cage with a platform which is not protected.

There are minor points of interest in the equipment of most of the properties, large and small. There is a marked tendency toward the application of little devices to save labor and make work more efficient for an equal effort. A good many lessees are compelled to start their operations at least using the old Armstrong, back-breaking hoist. Almost every kind of hoisting rig can be seen at one mine or another from old to the most modern steam and electric hoists with steel head-frame as at a number of places, and occasionally with the hoist housed in a fine brick building as at the Gold Coin and the more recent Nichols shaft of the El Paso. On several of the smaller steam-hoists using buckets, a device is employed, or several devices, so that the engineer can close the door over the shaft, dump the bucket into the receiving bin or car, then release the bucket and let it down again without leaving his seat at the engine. At most places with bucket hoist this operation requires two trips from the engine to the shaft. This labor saving can be accomplished, as at one place, by ropes over pulleys to manipulate the door over the shaft, and by a steel 'V' frame hung from an outrigger which can be pulled by another rope under the bucket so that a chain and ball under the bucket will catch in the point of the 'V', and on releasing the hoisting cable the 'V' frame catches and overturns the bucket, drawing it away from the shaft and over the receiving car as it catches.

Surface Tramming

Motor cars have been adopted at many of the mines for surface hauling. Two views at the Gold Dollar mine are shown, where the equipment is good in certain respects. Surface tramming is done by electric cars using 3-phase, 550-volt motors. The three trolley wires are mounted in a channel built of boards which can be seen about two feet above the ground at the left of the track in the view. There is not much likelihood of anyone coming in contact with these wires accidentally, protected as they are in the deep channel by the overhanging boards. At the hoist is an electric annunciator with a number for each level, connected in the same way as the call-bells in a hotel, so that the engineer, instead of having to listen to a signal given by a number of rings of a bell, merely has to look at the annunciator to see what number has been called. This must leave his attention more free for other signals, such as those telling him what he has in the skip each trip, whether it is waste, or, if ore, to what bin in the ore-house to send it. This annunciator is also a safety measure, for the number is in sight until released by the engineer himself.

At many other mines, calls for the cage are given by flashing an electric light, this flashing showing in a light at the landing of each level so that the cage-tender knows of any call for the skip as well as the engineer; and the call has to be answered by a return flash from the engineer. This system has the advantage over the annunciator that the call may be known at any level, and the person giving the signal is answered by the engineer, thus making it certain that his signal has been received.

In the view of the ore-house a bell can be seen above each sorting table. This is used to announce to the sorters into which bin ore is to be dumped at any time. Men working at other tables are in this way secured from interruption of their work by having to wait for the ore to be dumped after they hear the ore-car coming above. This view gives an idea of the interior of a modern Cripple Creek ore-house, with the men working at the sorting tables. Notice the excellent light obtained by windows in the roof as well as in the side walls,

DUMPING WASTE AT THE AJAX TO MAKE TAILING DAM.

and also the ample radiator provided for heating in winter. The heating is an important item, both that the ore shall not freeze in the bins, and that the men's hands shall not get too cold from handling it to do efficient work.

Types of Mills

A large number of mills are now working in the district, and several other large companies are experimenting on different treatments and considering the installation of mills. Metallurgically, the operating mills fall into two groups. The mills of one group practice coarse crushing only, have simple equipment and low initial expense; while those of the other group represent a heavy initial installation cost and grind at least a part of the ore very fine. Mills of the former type, such as the Wild Horse and Isabella (the Isabella not working just now) have been working for a long time in the district; while the latter type of treatment for the most part has been developed within the last three years.

The simpler type of mill is well represented by the Jo Dandy, of which a view is shown. This plant is treating a large mine-dump on Raven hill, and is right at its source of supply of ore. The ore is shoveled and trammed by hand from the dump to the mill, where it is dumped over a grizzly into a 10 by 20-in. Blake crusher set to break to about 1½ inches. Two stands of 16 by 36-in. rolls take the product of the crusher. The product of the rolls is elevated to a hexagonal trommel screen

8 ft. long and set with 1 ft. inclination in the 8 ft. This screen is 3-mesh No. 12 wire and runs at 15 r.p.m. Oversize from this screen returns to the rolls again; and the undersize is delivered to a belt-conveyor which transfers the material to the leaching vats. There are four of these leaching vats, 5 ft. deep and 30 ft. in diameter, and of about 125-ton capacity, in use. In charging the material into the vats, considerable care must be exercised to avoid channeling later on account of the large range in size of the material treated. Solution is first applied from below for the same reason. But one strength of solution is used, from 1½ to 2 lb. per ton. The first solution stands on the ore for 12 hours and is then withdrawn and the ore allowed to drain for aeration. The cyanide leaching treatment is continued for about three days, the vats being allowed to drain well between applications of solution to promote oxidation as thoroughly as time permits, the complete cycle for one charge being about seven days. Just enough water wash is used at the last to keep up the solution in the mill; and then the exhausted ore is shoveled out of the vat by contract and trammed in hand-pushed cars to the dump. This would seem to be one of few mills in the district not troubled by a lack of convenient dumping room.

The pregnant solutions are precipitated by zinc shavings in the usual 6-compartment boxes, the barren solution going to the storage vats. The cyanide solutions are made up to strength by adding the salt at the head of the zinc-boxes to keep the precipitation good.

Thomas Kavanaugh, who is operating both this and the Homestake plants, says the rock is a sylvanite ore containing considerable arsenic and manganese and is extremely refractory, with not over 10% of free gold. He says he is securing about an 85% extraction and that the ore runs about $2 grade, which is an extremely good result on such coarse refractory material. Mr. Kavanaugh has but recently started up the Homestake plant. This and the Wild Horse and Dante mills are following nearly the same practice; but they are working on oxidized material, whereas the Jo Dandy dump ore is said to be refractory.

Position of Gold Minerals

The explanation of the development of this simple inexpensive treatment lies in the position of gold minerals on the seams in the rock, along which seams the rock almost invariably breaks in crushing. If it were not for this distribution of the gold, fine grinding of the material would be required, for the rock itself is usually extremely dense. It may even be said that if it were not for this fact of the seams containing metal and being extractable largely on crushing, it is probable that no such development as the present could ever have occurred at Cripple Creek. The ore content, considering the ore-shoots as a whole, are usually too low to be commercially valuable without screening and sorting and saving for the most part the fine only, and discarding the coarse material. Of material which is hoisted from the ore-shoots themselves, not much more than 20 to 40% on the average is saved as ore. As the waste from this is in addition to the large amount of waste raised from ordinary development work, the size of the Cripple Creek waste dumps is enormous. But it is far cheaper to dispose of this large mass of low-grade coarse rock by leaving it on the surface at the mine than to handle it further as would be necessary if the mineral content were uniformly distributed throughout the rock, and all the rock had to be crushed and milled.

Modern Mills

The later more elaborate mills can be considered to be a development of the simpler practice above outlined. Without going into the detail of any one mill, a few general points of the treatment may be mentioned. The practice has been adopted at two places of breaking the rock to walnut size, then screening through a finer screen of from 4 to 8 mesh, and saving only the fine material for further treatment. When the coarse material is muddy, it is washed to recover the fine material. This practice saves perhaps 20 to 30% of the fine material out of ore which may assay perhaps $3 before breaking, the portion saved being of some $8 or $10 value. The erection of a crushing and screening unit to apply this treatment preliminary to shipment is being considered by other mine managers, and careful experiments are being made to determine just what screen and crushing sizes are best and how much washing should be applied.

The treatment at one plant includes grinding of the above material in cyanide solution in roller mills, then concentrating on Wilfley tables. The tailing from these tables after dewatering is discarded, as it is of such low grade as to make the leaching cost about as much as it would return. The concentrate, after being cleaned on a second set of tables, is shipped to the smelter; and the middling from this set of tables is reground in a tube-mill and cyanided as slime. The slime overflow from the sand tailing is also treated by agitation. Gold-bearing solution is precipitated with zinc dust. The details at the large new mills vary greatly; but the above may be considered to be an outline of the treatment adopted.

Most of the mills are facing difficulties in disposing of their tailing. The finely ground material discharged while wet tends to spread over the ground and not to stack well. One of the mills at present is storing the tailing in a deep gulch behind a dam of waste rock from the mine. The dam is being built by means of an aërial tramway dropping rock where needed for the purpose.

From the present situation in the district, it seems probable that both leasing and the milling of low-grade ores in mills situated near the mines are to be greatly extended in the next few years.

The Cobar copper and gold field, New South Wales, to the end of March 1913 has produced approximately 103,000 tons copper, 500,000 oz. gold, and 1,250,000 oz. silver, valued at $38,500,000.

Iron-ore shipments on the Lakes in July totaled 8,204,416 tons, against 7,600,233 tons in that month of 1912.

Under-Estimating the Cost of Milling Plants—IV

By A. Sydney Additon

Building construction includes many sources of excess cost. Most common of these are the failure to provide detailed working drawings. When such drawings are furnished, the failure to stick to them and the taking off of the bill of material from sketches instead of from detail drawings. The usual estimate comprises the cost of main buildings, housing specified equipment, and the omissions in the equipment estimate indirectly affect this item. In addition, upon making an installation it is found that, besides the buildings estimated, it is necessary to provide some or all of the following; storehouses, machine shop, hoist-house for incline tram, transformer house, enlarged assay office for laboratory, temporary or permanent office, enlarged or new bunk-houses, special bunk-houses, individual dwellings or cabins, enlarged or new dining and cook-houses, stables, and cement houses. Such estimates usually fail to sufficiently cover the details of buildings, such as floor systems, stairways, gangways, platforms, temporary and permanent braces and staging, motor rooms, foreman's office, or report and testing rooms, windows and doors in sufficient number, material for appliances for use in constructions, such as gin poles, trucks, dollies, falls, and bars. Estimates of buildings are sometimes made by allowing a certain amount per square foot of ground covered, according to style of building, but there can be no adequate basis for such figures. Aside from these general points, the usual excess cost of material for buildings can best be discussed under the headings of lumber, iron and hardware, and structural steel.

Bill of Lumber

The first error usually arises at the start in taking off the bill of lumber from the plans. This is done from insufficiently detailed drawings, too much being held up in the mind of the estimator, while his pencil records the items. Too little attention is paid to lengths, and after the bill has been taken off it is customary to add a certain amount of lumber to cover errors and possible omissions and to "make sure of the amount needed." Here large errors are made, not always in the amounts, but in the specification of sizes and lengths. This results in two or three subsequent orders being necessary in order to complete the buildings while a large amount of lumber remains unused in the yard. It is necessary to make additional allowance in a most carefully computed bill, as it is impossible to foresee the exact amount of waste, bad lumber, minor alterations, and additions. But in making this allowance great judgment must be used. An experienced engineer knows that there is an allowance factor for every size and length of lumber in the bill, and by using such factor but little error is possible if the bill has been carefully taken off. In placing orders for lumber, one of the specifications should be the weight per square foot. There is a big difference in first cost as well as in erection charges, between lumber weighing 8 lb. per foot and that weighing 2½ lb. per foot. Delivery should be timed to suit the readiness of the plant to receive, otherwise large sums can be easily added to cost. Perhaps the greatest amount of added cost in this lumber item occurs on account of improper delivery and improper caring for the lumber at the site. In order to save this the estimate should include the cost of the proper yarding of the lumber. This is itself an added cost in most estimates, but it is insignificant when compared with the cost of failure to provide for it. When lumber is delivered at the site, suitable and roomy yards should be ready, and as the lumber is unloaded every stick sorted out and piled with reference to the size and length, checked off, and reported to office daily. When it is possible to prepare a suitable yard at each grade level, the lumber for use at this grade (or the next grade below) should be yarded there, as far as possible, all other lumber going to general yard. The reasons for this are important ones. (a) The time spent in hunting for lumber when wanted, handling over piles and piles to get what is being looked for, is in many cases, greater than the time required to frame the piece and erect it. Besides this, the hunting is usually done by a high-priced carpenter who should be at work with his tools.

Time Losses

It is not unusual for a $6 per day man to spend 15 minutes getting a piece of 2 by 6 in. by 20 ft. long, thus adding 1c. per foot or $10 per thousand, to the cost of erection, instead of a $2.50 laborer getting the piece from its correctly placed pile in 2 minutes, costing but 1/20c. per foot or 50c. per thousand. (b) Lumber used for parts of construction for which it was not ordered or allowed is another reason. Carpenters or their helpers go to mixed piles for certain lengths of lumber and, finding that they cannot be conveniently reached, take a longer piece that will cut to the length wanted, but wasting the cut-off and leaving it in the yard, a piece of lumber that will not be of any use later on in that part of the building where the long lengths are cut up. This results in additional 'rush' lumber orders nearly every day toward the close of the building operations, often having to be shipped in less than carload lots and causing expensive delay. I might add that this sometimes happens even when the lumber is sorted and piled properly, but can be easily avoided by providing the chief carpenter or the framers with a list of the sizes and lengths to be used in the job in hand. This is easy and it costs nothing at the time when the bill is taken from the drawings.

The estimating of the amount of corrugated iron needed by computing the number of squares to be covered is the usual method, but this will not suffice and insures an added cost. The bill for this material must be taken off even more carefully than the lumber bill, by following the details of the construction of the frame, and specifying the lengths neces-

sary to cover each wall and roof with the least amount of waste. This can easily be done and in designing the frame for a corrugated iron building, standard lengths of iron must be considered in spacing the purlins, girts, and openings. After the bill is properly taken off, the next point to watch is that proper delivery is made to the site, as added costs can be incurred in the same way as in the case of improperly delivered and improperly cared for lumber. Lengths should be piled together at the grades most convenient for use for that portion of building for which they were ordered. Another small item which is almost inevitably forgotten until wanted, is the proper barbed nails and lead washers for putting on the corrugated iron. Bar iron: the usual estimate lumps this item at so many bars of various sizes, "in order to have an assortment in case it should be needed." The tonnage ordered is often excessive while the sizes wanted are short and have to be rush-ordered. It takes but a few minutes to run through the working drawings and take off a true list of the bar iron required; by adding a certain allowance, using the proper factors for each size, the added cost will be avoided.

Quantity of Nails Required

The quantity of nails is usually guessed at, with the result that if sufficient weight is estimated, the sizes wanted are incorrect and more of certain sizes must be sent for, while a quantity of other sizes remains in the storehouse. There is an accurate set of factors for nails, based upon the amount and sizes of lumber to be erected available. This was compiled and published by Charles T. Hutchinson in the *Mining and Scientific Press* of October 28, 1911.

Builders' and miscellaneous hardware is but a small item but is usually entirely overlooked in an estimate, especially the hardware necessary for the houses and cabins supplementing the main buildings. In the case of a steel-frame building, the estimate for the actual material cannot be far wrong, as it is necessary to prepare detailed plans, all parts being framed and marked before shipment to the site, and their cost is known at the time estimate is made. There should, therefore, be no added cost for material used in the wrong place but the delivery is as important, or more so, as in the case of lumber. It is expensive to find that a heavy member needed at the top of the plant has been delivered at the lowest level, but it is not unusual. Great care employed in checking parts as delivered and placing them on the grade needed, or next grade above, will save a heavy excess labor cost. It can readily be seen how much excess cost may be incurred in the single item of building material.

Permanent Utilities

The excess cost of utilities about a plant is necessarily controlled by its size, the distance from the mine, and the adequacy of the utilities already available. Estimates of plant usually fail to cover this item, so that whatever is installed of this kind is an added expense. The principal items have been covered in a general way above under 'Utilities During Construction,' and are discussed in more detail later.

The pipe and fittings for a water system, as specified in the usual estimate, include a main line from the source of supply through the plant, but the distribution of the water to the many places where it is needed is usually omitted, mainly because the actual position of the taps is not shown on the drawings. An estimate of the cost of a lot of pipe and fittings has to suffice. As necessity arises, the distribution system is extended, much to the embarrassment of the one responsible for the supply of material provided. It is found that water is required not only in the plant, but in other buildings such as the laboratory, stables, houses, cabins, and bunk-houses, and is usually provided, but the expense becomes another item of excess cost.

Fire System

Fire system, which is an important item, is nearly always left out and is later installed at an added cost. In some instances it is thought to cover this item by simply placing a few extra plugs for hose at points in the building on the main water line, but this is always found inadequate, especially after there has been a fire scare, or after an insurance inspector has visited the plant. The result is that an adequate system is installed, with main lines and laterals, and with plugs for hose placed outside of buildings, to covering protection to other than main plant. Hand grenades and buckets are usually placed inside of the plant and other buildings. All of this should have been included in the original estimate, thus avoiding this additional cost.

When the laboratory and assay plant is being built at or near the mine, this cost item is usually omitted from the estimate, as "the mine assay office will be used." It is very seldom that an assay office that has been laid out for the work of the mine is at all adequate for the work of a milling plant. Besides the greatly increased number of daily assays required there is a large amount of laboratory work to be done, for which the mine assay office is not equipped. There results the necessity of building a new assay office for the mill, or enlarging the old one, either alternative constituting another excess cost.

The same remarks can be applied to the office building as to the laboratory. Additional building, either as additions or separate constructions are found necessary, as well as additional equipment. Especially is this true for accommodation during construction work and the estimate that has not provided for this will have to bear an additional excess cost.

Superintendence

This refers to superintendence during construction and covers the salary of the constructing engineer, and the cost of his assistance on the building work and in the office. By referring to 'Organization' it will be seen that this is not a small item. It is usually covered in an estimate by combining the salary of the engineer with a certain allowance for the maintenance of the office. This amount is seldom sufficient to cover the cost of the necessary traveling expenses, to say nothing of other office expenses and incidentals. The cost of superintendence is much greater during construction work than

during operation, and nearly the whole amount can usually be put down as an excess cost.

The cost of supplies during construction work aggregates quite an amount, and is usually left out of the estimate entirely. Such items as coal for blacksmith, oil and waste for machinists, special tools for mechanics, carpenters, and pipe fitters, feed for teams and other horses, gasoline and repairs for automobiles, paint, putty, oakum, white lead, brushes, grease, tar, pitch, rope, chain, babbit, solder, kerosene, packing and gasket rubber, lanterns, torches, extra fittings, fuel for office and bunkhouse, steel for picks, and office supplies total up to a large sum.

Labor

The exact amount of skilled and unskilled labor necessary for installing equipment is somewhat difficult to estimate. It differs from estimating material, owing to the consideration necessary to be given to the 'human factor.' However, an estimate can be made that will work out to within one or two per cent of the actual cost, if sufficent thought is given to the details of labor necessary, when preparing the figures. It is customary to arrive at the estimate of labor either from the advice of machinery dealers, or from the past experience of estimator. Both are generally at fault; the first through the lack of experience in the field on actual construction, or from off-hand guessing, the second through failure to correct his figures to suit the conditions governing the case in hand. Both systems lead to excess cost. In addition to these two causes some other important reasons for excess cost of labor are: (1) error in the selection of a foreman, and failure to recognize his importance and responsibility; (2) lack of perfect organization; (3) failure to recognize the importance of many of the factors discussed above in leading to excess cost, and to make proper allowance for the same; (4) failure to provide a proper number of unskilled laborers to assist the skilled laborer; (5) the employment of a foreman or laborers for any other reason than because of their efficiency; (6) failure to make men contented.

Importance of the Foreman

The selection of a foreman is of the greatest importance. The cost of a piece of work can easily be doubled by the wrong man, or the right man wrongly handled. Surprising as it may seem, the correct time to select the foreman, in order to insure efficient labor results, is at the time the estimate is being prepared. Certain qualifications in a foreman are highly important. He must be able to do and to have done any portion of the work he is called upon to superintend, for only in that case can he intelligently direct, or know what constitutes a day's work. This is not a position for young college graduates, regardless of how valuable his services may be at some other work. He must understand men, and how to handle them. All men cannot be handled alike. To get greatest service from some they must be 'jollied' or praised, other must be 'cussed,' others must be left alone, and the man who cannot quickly distinguish these traits in his men is an expensive foreman. He must be a man in whom utmost confidence can be placed. He must be loyal to the engineer in charge. The importance of selecting such a man at the time of making the estimate is this: His knowledge of the work may be no greater than that of the engineer making the estimate, but in calling him to assist in making the estimate of labor, confidence in him is displayed, and if he says that certain work can be done for a certain amount, he will see to it that, when the work is done, it does not cost more. He must be given an absolutely free hand in employing and discharging his men. It is often not convenient for him to hunt for men, and this may be done for him, but no one must dispute his authority in discharging. Take quick action when he asks for more men, and leave it to him to reduce the crew at earliest possible moment.

Organization of the Working Force

The failure to perfect the organization of the working force insures an added cost in the same way as does the failure to properly yard and care for equipment and supplies. Every man must have certain work for which he is responsible, and there must be no question of authority in any department. Excuses must be entirely eliminated. When excuses get on the payroll excess cost piles up very fast. The failure to properly proportion a crew with skilled and unskilled labor is a most common source of excess cost. It is quite usual to see a high-priced mechanic hunting for a tool, a part, cleaning rubbish from about his work, uncrating a piece of machinery, or tugging on a chain-block or truck, while the work of preparing the foundations and getting everything ready to quickly put the pieces in place, is waiting. A tank-builder will often be found uncleating or uncrating tank material, instead of putting it together. High-priced carpenters are often found nailing on siding or laying rough floor. There is a certain amount of work about every construction that can be done best, and another part that can be done as well, by common labor. Every stroke of work that is done by skilled labor is adding unnecessary cost. On the other hand, there is comparatively little construction work requiring skilled labor that can be done by common labor, and every attempt to so use the common labor will also insure added cost. Too often the efficiency of the laborer is not the only reason for his employment on the work. Friends of officers or employees, friends of friends, or men put on construction because they are wanted later in operating the plant, all find employment on work for which they are not qualified, and thus the added cost is swelled. No man will give a fair day's service who is not properly taken care of and treated like a man. He must be well fed and housed. His reasonable personal wants must be attended to. Much excess cost is caused by poor bread on the boarding-house table or too hot or too cold a place in which to sleep.

Another point in connection with labor in general is worth mentioning. In making calculations for the service of a pump, a compressor, or other piece of machinery, the efficiency of that machine is taken into account. But in calculations for men to do

work, they are accepted at rated capacity. When 100 men are hired at $2.50 per day, it is evident that not all of these men do the same amount of work. They do work just as the machine does, according to their design or make, all having their individual factor of efficiency. This ranges from, say 30% (few fall below this) up to 100%, perhaps averaging 70%. This average of 70% is satisfactory, but when the number of men on the payroll whose efficiency is below 70% gets to be greater than the number whose efficiency is above, excess cost is being incurred. The regulation of this balance is in the hands of the foreman.

So much for the reasons for excess cost due to labor in general. To this may be added a long list of items of work to be done during construction, which are not included in the usual estimate, in addition to what has been mentioned above. Some of these are: assistance to be given teamsters in unloading; handling of equipment and material to yards or storehouses; handling of equipment and material from yards and storehouses to points of use; unboxing and uncrating equipment and supplies and removing rubbish; checking and marking; cleaning of parts and preparing them for assembly; chipping, drilling, and cutting; rectifying errors of manufacturers; shop-work, making of rods and bolts; carrying to and from shop; labor for erection or use of material not included in estimate, as above; labor for erecting or using material not included in estimate; care of office and other quarters; care of horses (other than regular freight teams); messengers; and others according to circumstances. Taken altogether then, it will be found that probably the greatest amount of excess cost can be attributed to labor alone.

Miscellaneous

Under this there comes a long list of all sorts of items, more or less expensive according to the conditions existing and how thoroughly the estimate has been detailed. A piece of road to be built here or there; a ditch to be built, a bank to be raised, a dry wall to be made, furnishings for houses and cabins, equipment for the boarding-house, teams and wagons, and many other items are sometimes claimed to be 'unforeseen necessities' but they all increase the excess cost.

Freight on the material and equipment specified in the estimate, is an item that should give rise to very little added cost, but it often does, in the following ways: failure to secure f.o.b. prices on small items of material, thus allowing the dealers to add hauling charges at point of shipment; failure to arrange for shipment in manner to avoid less than carload rates on some of the equipment and material; failure to allow for switching charges at the railroad point; demurrage; lumber freight estimated on basis of lumber weighing 2½ lb. per foot, when lumber delivered weighs 6 lb. per foot; less than carload freight rates on equipment and material not included in the estimate. Estimate of the hauling cost if done by company teams, usually fails to cover wear and tear and repair of wagons, repair and wear and tear of harness and other equipment, horse-shoeing, roadwork, forwarding at railroad, and accommodations for horses. If hauling is contracted for much the same added cost may occur as in the case of freight. In addition to these must be added the cost caused by continual concessions granted to teamsters and delay of work owing to failure to get teamsters to bring from the railroad material most needed at time wanted. Hauling from the railroad, if at any distance, is really one of the most annoying parts of the constructive work and is extremely difficult to estimate correctly. Liberal allowances must be made. Because a freighter agrees to deliver equipment and material from the railroad at so much per ton is no reason for believing that this is what it is actually going to cost. Inability to secure teams, having teams quit hauling at critical points in the construction work, and losses due to damaged material owing to improper loading or hauling, are all additional items of cost. The added cost directly due to these items is often but a small part of the real excess cost they cause as they effect to a greater or less extent all parts of the construction. I have gone into the factors which unite to produce a total cost of construction work that is in excess of the estimated cost in detail in order to indicate how easily many of them may be overlooked and yet how important they may be in swelling the final cost. If my discussion proves of service in aiding other engineers in avoiding the under-estimation of the cost of construction work which may be under their charge, and in dissuading owners from adopting plans which appear economical but are in reality unduly expensive, I shall feel amply repaid.

Mineral Production of the Philippines

The following figures for 1912 were compiled by the Bureau of Science at Manila:

Products.	Quantity.	Value.
Metallic:		
Iron, metric tons	141	$24,636
Silver, fine ounces	7,121	4,332
Gold, fine ounces	27,582	570,212
Non-metallic:		
Coal, metric tons	2,720	10,100
Clay products	....	226,500
Lime	....	46,013
Sand and gravel	....	234,375
Stone	....	325,524
Salt, metric tons	19,147	287,255
Mineral water, gallons	....	27,925
Total		$1,756,872

The total value in 1911 was $1,413,205, the main increase being in gold output.

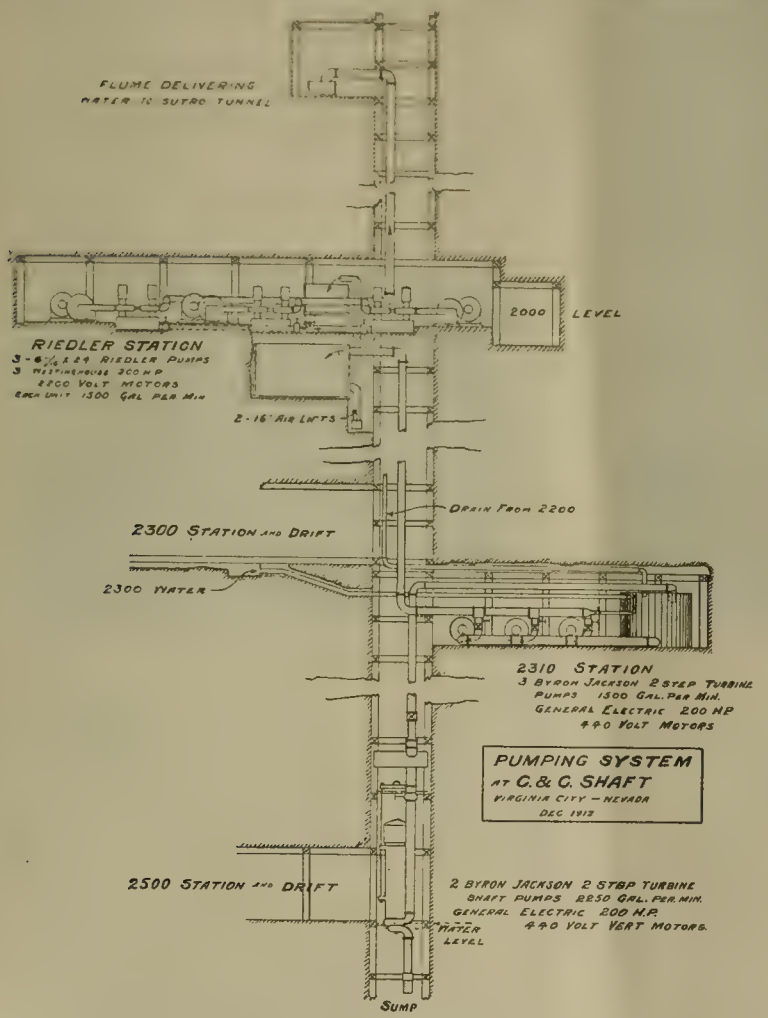
During May the railways of the United States received for their services to the public an average of $8,230,000 per day; it cost to run their trains and for other expenses of operation $5,920,000 per day; their taxes were $341,500 per day; their operating income was $1,972,322 per day for the 220.897 miles of line reporting, or at the rate of $8.93 for each mile of line for each day. Thus for every six dollars of their earnings which remained available for rentals, interest on bonds, appropriations for betterments, improvements and new construction, and for dividends, the railways had to pay more than one dollar in taxes.—*Bureau of Railway Economics.*

Pumping at the Comstock

By A. M. Walsh

The water question has always been a serious one at the Comstock mines, where the mine water has a temperature ranging from 130 to 155 F., and is contaminated with alum and acid. The temperature of the air on the pump station varies from 105 to 125° F., and it can be readily seen that ventilation is just as important as pumping.

By arrangement with the mining companies, the United Comstock Pumping Association is doing its best to handle the water, and the following notes and illustrations should give an idea of the work done.


FLUME DELIVERING WATER TO SUTRO TUNNEL
2000 LEVEL
RIEDLER STATION
3-6¾ x 24 RIEDLER PUMPS
3 WESTINGHOUSE 200 H.P. 2200 VOLT MOTORS
EACH UNIT 1500 GAL PER MIN
2-16" AIR LIFTS
DRAIN FROM 2200
2300 STATION AND DRIFT
2300 WATER
2310 STATION
3 BYRON JACKSON 2 STEP TURBINE PUMPS 1500 GAL. PER MIN.
GENERAL ELECTRIC 200 HP 440 VOLT MOTORS
PUMPING SYSTEM AT C. & C. SHAFT VIRGINIA CITY — NEVADA DEC 1913
2500 STATION AND DRIFT
2 BYRON JACKSON 2 STEP TURBINE SHAFT PUMPS 2250 GAL. PER MIN.
GENERAL ELECTRIC 200 H.P. 440 VOLT VERT MOTORS.
WATER LEVEL
SUMP

Electric Turbine Pumps

Suspended in the C & C shaft at the 2500-ft. level are two vertical turbine pumps which were manufactured by the Byron Jackson Co. and are driven by two General Electric 200-hp. 440-volt motors. Each unit has a capacity of 2200 gal. per minute. One of these units is in constant operation and the other is held as an auxiliary in case of accident to the operating unit. About 1500 gal. of water per minute is pumped from the 2500-ft. level to the 2310-ft. station.

The installation at this station consists of three horizontal turbine pumps. These pumps were manufactured by the Byron Jackson Co. and are driven by three General Electric 200-hp. 440-volt motors. Each unit has a capacity of 1500 gal. per minute. Two units are in constant operation and the third unit is an auxiliary to be used in case of accident to either of the other units. This station is pumping approximately 2100 gal. of water per minute to the Riedler station. Lubricating oil in motor and pump bearings varies from 150 to 160° Fahrenheit.

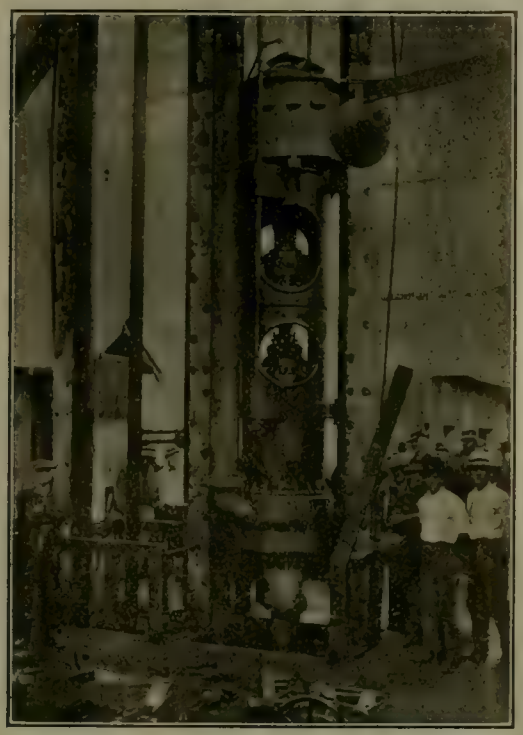
The installation on the Riedler station, 2000-ft. level, consists of three $6^{11}/_{16}$ by 24-in. Riedler pumps. They are the horizontal duplex double-acting plunger type and are driven by three Westinghouse 200-hp. 2200-volt motors. Each unit has a capacity of 1500 gal. per minute. These pumps were designed by Riedler and manufactured by the Allis-Chalmers company. Two units are in constant operation and the third unit is an auxiliary to be used in case of accident to the other units. This station is pumping approximately 2100 gal. per minute into the Sutro tunnel which connects with the C & C shaft at its 1600-ft. level. The main part of this drainage tunnel is 20,489 ft. long and cost $2,100,000, it being finished during 1879.

The diagram shows two 16-in. air-lifts immediately below the Riedler station. Under the former management the turbines at the 2310-ft. station pumped the water to the lower Riedler tank. The water was then pumped an additional 10 ft. to the upper Riedler tank with two 16-in. air-lifts. This has been rearranged so that the turbines at the 2310-ft. station pump directly to the upper Riedler tank which is the feed tank for the Riedler pumps. By this change the continuous use of these air-lifts has been eliminated and an economy affected thereby.

The scope of the work being done by the Pumping Association may be judged by the following weekly report. The Riedler pumps on the 2000-ft. station ran as follows: No. 1, 119 hours, 35 minutes; No. 2, 146 hours; No. 3, 59 hours, 50 minutes. The centrifugal pumps on the 2310-ft. station ran as follows: No. 1, 165½ hours; No. 2, 99¼ hours; No. 3, 65 hours. The shaft pumps on the 2500-ft. level ran as follows: No. 1, 56 hours; No. 2, 109 hours.

The 2500-ft. north drift, started from the winze

station at a point 565 ft. east from the shaft station, was cleaned out, and repaired a distance of 10 feet. Three tunnel sets of timbers were put in at the connection with the southwest drift. At this point the ground is badly caved, and must be thoroughly timbered before work can be continued. Total length in repair from the winze station is 455 ft., and the total distance from the shaft station is 1020 ft., the face being in caved ground. The ventilation of the 2500-ft. drift is greatly improved since the connection was made with the southwest drift. Water was held at all points.



VERTICAL TURBINE PUMP USED AT 2500-FT. LEVEL.

Following is a statement of the cost of operation from December 1, 1912 to June 1, 1913:

Month.	Regular expense.	Extra expense.	Total expense.
December	$16,581	$3,138	$19,720
January	17,393	3,000	20,393
February	15,850	2,209	18,058
March	15,363	870	16,233
April	14,437	841	15,278
May	13,712	1,944	15,656

The items comprising the regular operating expenses include salaries, labor, supplies, power, water, hoisting, compressed air, all repairs on the pumps and the pumping system, and the general expense of maintaining the Association. All supplies used, with the exception of the ladders, which were taken from the Ward shaft, have been charged in the above account. The extraordinary and installation expenses comprise such items as the cost of the Mexican-Ophir winze winches, damages through personal injury, cost of removing hydraulic elevator, repairing and preparing the C & C shaft for the lowering of the 2500-ft. turbine pump, testing and installing this pump, repairing the 2500-ft. station and east drift, etc. The principal cause of the greatly reduced expense since my appointment on January 25, 1913, is the fact that the efficiency of labor has been raised and the work conducted with fewer men. Many changes have also been made in the operation of the pumps which were along the lines of economy.

Included in the statement of costs is a water bill which amounts to $2500 per month. The water contract gives the Association the use of 200 miners inches of water, which was consumed when the Association operated the Evans hydraulic elevators. As soon as the electrically driven turbine pumps were installed on the 2310 and 2500-ft. stations the operation of the elevators was discontinued, and there is no immediate use for this pressure water.

Progress at Panama

The grand total of canal excavation to July 1 was 203,383,539 cu. yd., leaving to be excavated 14,812,034 cubic yards.

The total excavation for the month of June was 2,659,424 cu. yd., as compared with 2,339,770 cu. yd. for the corresponding month last year, and 2,646,442 cu. yd. in June 1911. The dry excavation for the month amounted to 1,152,299 cu. yd., entirely by steam-shovels. The dredges removed 1,507,125 cu. yd., nearly attaining the total of the previous month, 1,525,493 cu. yd., which was the highest of record on the canal. In the Atlantic division, the total excavation was 814,980 cu. yd. Of this amount, all but 388 cu. yd. consisted of material dredged from the Atlantic entrance and approach to Gatun locks. The total excavation in Central division territory was 878,300 cu. yd., 57,274 cu. yd. of which consisted of hydraulic excavation, back of Gold hill, performed by the forces of the Fifth division. Central division shovels removed 821,026 cu. yd., as follows: 805,109 cu. yd., classified as primary excavation from Culebra cut; 13,017 cu. yd. charged to plant excavation, and 2900 cu. yd. from the drainage ditch between Empire and Culebra on the west bank. The total excavation from the Culebra cut section in June 1912 was 1,348,780 cu. yd. In the Pacific section, the total excavation was 966,144 cu. yd., 330,885 cu. yd. by steam-shovels, and 635,259 cu. yd. by dredges. The dry excavation consisted of 229,894 cu. yd. from the canal prism, south of Miraflores locks, and 100,991 cu. yd. from the terminal site. The wet excavation consisted of 604,080 cu. yd. from the Pacific entrance, between the dike and the sea, and 31,179 cu. yd. from the terminal basin.

H. D. Avis' patent for coating aluminum or its alloys for soldering is as follows: Chlorides of tin and zinc are mixed in the ratio of 2 to 3 parts of the former to 1 of the latter. The mixture is heated and excess of hydrochloric acid is expelled. On cooling, the mass becomes of a pasty consistence, after which a small amount of powdered tin is added. To tin the surface of the aluminum this paste is applied and the parts are heated below redness. When the proper temperature is reached, the aluminum is coated with the oxide of tin and zinc, which on removal with a brush or other means leaves a bright film of tin. The soldering is a simple matter.

Metallurgy at Broken Hill

By J. Malcolm Newman

*At the recent meeting of the Australasian Institute of Mining Engineers at Broken Hill, many valuable mining and metallurgical papers were read, especially on the subject of metallurgy. Broken Hill mines have produced a total of $360,000,000 to date, and paid $87,000,000 in dividends, of which the Broken Hill Proprietary has contributed 50 and 65%, respectively. The nominal capital of companies contributing is about $28,000,000. It is as well, perhaps, at the outset to describe the average Broken Hill ore. The unaltered ore consists of a mixture of galena, blende, quartz, rhodonite, garnet, calcite, and pyrite. The galena is almost pure argentiferous lead sulphide, while the blende is an impure zinc sulphide, combined with sulphides of iron and manganese. The percentages of rhodonite and calcite vary at different points along the line of the lode. For instance, the north end of the North mine, the south end of the South mine, and the whole of the South Blocks mine yield calcite ores, and contain less than 5% of rhodonite. The rhodonite percentage on the other mines varies from about 15% in the Proprietary to 45% in the Junction North.

INTERIOR OF REFINERY.

MOLDING MARKET LEAD.

Concentration Problems

The higher specific gravity of galena ore enables a large percentage of that mineral to be recovered by jigs, concentrating tables, and vanners, but owing to the fact that the specific gravity of blende differs very little from that of garnet and rhodonite, it is impossible to make a separation of these minerals by water concentration alone. The Broken Hill garnet has a specific gravity of about 4.2; the blende, about 4.0, and the rhodonite about 3.6. James Hebbard, of the Central mine, submitted a historical account of nearly twenty years' struggle to solve the problem of segregating the lead, zinc, and silver of the ores into products capable of being marketed and smelted commercially. The chronology is as follows:

From 1895 to present date.—Water concentration in jigs, tables, and vanners, producing high-grade galena concentrate, and as by-products, zinc, middling, tailing, and slime.

1901 to 1907.—Mechernich magnetic process, treating rich zinc middling produced by water concentration for the recovery of the following products: (1) garnet, rhodonite product, waste; (2) blende product, a marketable concentrate; (3) galena, blende, quartz products, which on further treatment on wet concentrating tables and vanners, produced lead concentrate, zinc concentrate, and waste quartz product. The wet mill tailing and slime were not treated by this process.

1901.—Experiments on flotation by frothing conducted at the Central mine without commercial results.

1901 to 1902-3.—Potter and Delprat processes. In these, hot solutions, containing sulphuric acid and salt cake (acid sodium sulphate) respectively, are applied to fine granular ore or tailing, producing carbon di-oxide gas, which floats off the galena and blende, leaving the quartz and rhodonite behind. This process has been commercially successful in treating middling and tailing but will not without modification treat slime. It is limited also to the rhodonite ores, containing only a small percentage of calcite, because of the solubility of calcite in sulphuric acid.

Cattermole Process

1904 to 1905.—The Cattermole or granulation process, consisting in the agitation of a mixture of pulped ore, oil, and water, containing a suitable acid or an alkali with soap or other emulsifying agent, so as to agglomerate the oil-coated particles into granules. The oil was thus employed in a state of emulsion in water in the presence of an emulsifying agent, such as soap. After agitation, the mixture was passed into an up-current separator or classifier to remove the lighter non-oil-coated particles from the agglomerated masses of oil-coated particles. The lighter sand having been eliminated, the pulp passed to a second series of agitators to increase the size of granules, and thence

*Abstract from *Australian Mining Standard.*

to a second classifier for the removal of the heavy sand. From the bottom of this second classifier some granulated concentrate was recovered, but the heavy sand from the overflow also carried over with the up-current a large amount of granulated mineral. This mixture of granulated mineral and heavy sand passed then to a third series of agitators, and thence to a shaking table, where the granulated mineral, rendered more buoyant by directing on to the surface of the moist pulp jets of compressed air, was buoyed to the surface of the water, and floated off the bottom of the table, while the gangue sank and was delivered over the end of the table. The plant for this process consisted of: (1) grinding apparatus; (2) vat for emulsifying various oils; (3) set of six mixers in series; (4) up-casts for separating sand and float; (5) second set of mixers for further aeration; (6) up-casts for further separation of sand and float; (7) third set of mixers for re-aeration; and (8) Wilfley tables for the separation of coarse sand from granulated sulphides.

This process is especially noticeable as being the first process to treat slime successfully.

Mineral Flotation

1905 to 1906.—Frothing process (flotation), developed in connection with the granulation process. It was found that by lowering the percentage of oil a mineral froth was produced as distinct from the granules produced with a higher percentage of oil. Based on this fact, Messrs. Sulman, Picard, and Ballot took out their patent under which finely powdered ore suspended in acidified water is mixed with a small proportion of an oil substance, such as oleic acid, amounting to a fraction of 1% on the ore, and agitated until the oil-coated minerals form into a froth which can be separated from the gangue by flotation. Heat may be applied to facilitate oiling, and either shaking tables or spitz boxes may be used to separate the frothy mineral from the sand and the gangue slime. This was followed by Mr. Chapman's patent, under which, (1) the ore, suitably crushed, is agitated with acidified water in the first mixer and heated, (2) oleic acid is subsequently added in the second vessel; (3) the pulp is maintained at the desired temperature in the third and following mixers with violent agitation in each mixer to ensure complete and thorough emulsion.

1907.—A slime plant, started at the Central mine, treating accumulated dump material, closed down after treating 40,000 tons.

1908 to 1911.—A Minerals Separation plant treated 710,000 tons of Central mine accumulated tailing.

1909 to present date.—Zinc department added to the wet mill on the Central mine, treating all the by-products of the wet mill. It may be mentioned that up to January, 1913, this plant has treated 1,225,011 tons of ore, and recovered 239,408 tons of lead concentrate and 399,090 tons of zinc concentrate. In addition to the progress described by Mr. Hebbard, the following, which was done at mines other than the Central, have had far-reaching results, namely:

1903 to present date.—The Broken Hill Proprietary Co. has worked the Potter-Delprat process on a large scale, treating old accumulated and current mill tailing, but not slime. The capacity of the plant is 12,000 tons per week.

1907 to 1912.—The Elmore vacuum oil process worked at the Zinc Corporation treating old tailing with a capacity of 700 tons per day. It was also in operation on the British mine. On both these properties the Elmore has been replaced by the Minerals Separation process.

1910 to present date.—The Amalgamated Zinc (De Bavay) Co. is treating 11,000 tons of tailing per week by the De Bavay skin float process, which depends on the property of greased particles of sulphides floating as a film on the surface of the water. This process, though entirely successful on granular material, does not treat slime.

1911 to 1912.—Bradford's slime process at Broken Hill Proprietary mine. A modified Potter acid process, depending on the principle of enclosed agitation and aeration. This process treated accumulated slime dumps, and had a capacity of 2500 tons per week.

The foregoing is then the history of the struggle, the net result of which has been the large increase in recovery of metals stated by Mr. Hebbard to be as follows: recoveries in 1895, silver, 45%; lead, 65%; zinc, 7%; and, recoveries in 1912, silver, 92.7%; lead, 94.1%; and zinc, 91.8 per cent.

Central Mine

Based on these recoveries, the figures given by Mr. Hebbard, summarizing the work done in the Central mill during the twelve months ended December 28, 1912, show a metal value extracted from the ore of over $33.60 per ton of ore at recent metal prices. Allowing, say, $16.80 for Broken Hill costs and profits, it is shown that $16.80 per ton of ore, or $33.60 per ton of combined lead and zinc concentrate, is required to cover the smelting charges and smelting losses. It is well known that smelting, of zinc ores in particular, is expensive, and that some metallurgical loss is unavoidable in all smelting operations, but $33.60 per ton of concentrate strikes one as an exceptionally high figure. The spelter convention and metal brokers can, no doubt, be blamed to a certain extent, but of course the great source of loss lies in the fact that the various Broken Hill concentrates are still complex in composition, with the following results: (1) The lead concentrate contains from 6 to 10% of zinc, which not only is not paid for by the smelting companies, but is charged for in their returning charges; (2) the silver in the zinc concentrate is subject to a big reduction from the assay, the remainder only being paid for at about 50% of its value; and (3) the lead in the zinc concentrate is subject to deduction from the assay, and the remainder is then also only paid for at about 50% of its value.

Further treatment of slime is to be done by the selective or preferential flotation processes.

Gold production of Queensland in May was 23,509 fine ounces.

Precipitation of Gold in Orebodies

Some interesting experiments on the condition of gold occurring in quartz have been made by P. Von Veimarn, who reports in *Zeitz. Chem. Ind. Colloide*, Vol. 11, p. 287, that by mixing equal volumes of 0.1 to 1% solution of NaAuCl and Na_2SiO_3 there was a gradual change in color from the yellow of $AuCl_3$ to colorless, then rose, lilac, and blue. A precipitation began to appear after about one year; coagulation being very slow and the solution remaining colored for a long time. This is explained as due to the formation of an unstable gold silicate which suffers self-reduction. The colorless filtrate from the precipitation of colloidal gold on evaporation to dryness gave a purple-red colored layer of silicic acid. Ultramicroscopic examination shows that the dispersed gold is so intimately mixed with the silicic acid that it cannot be recognized in the form of separate submicrons. It is quite possible that the natural occurrence of gold in quartz may be explained by such a series of changes.

In studying the secondary precipitation of gold in orebodies, Albert D. Brokaw (*Journal of Geology*, Vol. 21, p. 251) concludes that ferrous compounds derived from the oxidation of sulphides are the most important substances in causing precipitation of gold. In most deposits sufficient pyrite, or other iron-bearing sulphides are present in the primary ore to precipitate any gold that may be brought in. Less commonly siderite or iron-bearing calcite may be important. Siderite is readily attacked by acids and yields iron salts. In rare cases when gold is in a solution containing manganese salts, contact with the country rock may neutralize the acids present and allow the manganese to reduce the gold. Rhodochrosite resembles siderite in its action except that no precipitation of gold can occur if solutions are strongly acid, while in the case of siderite acidity does not prevent the reduction.

Influence of Metallic Minerals on Precipitation

A more elaborate study of the rôle of certain metallic minerals in precipitating silver and gold has recently been made by Chase Palmer and E. S. Bastin, of the United States Geological Survey, and appears in the *Bulletin* of the American Institute of Mining Engineers, page 843 (1913). Their preliminary experiments show that certain sulphides, arsenides, and sulph-arsenides of copper, nickel, and cobalt precipitate metallic silver very efficiently from dilute aqueous solutions of silver sulphate. As the waters descending through the upper portions of most sulphide orebodies are known to be sulphate waters, similar precipitative actions would be expected under certain natural conditions. The frequent association of silver in ore deposits with chalcocite and bornite, and particularly with niccolite and cobaltite, minerals which in these experiments were among the most efficient precipitants, warrants the belief that such reactions are of importance in secondary enrichment of orebodies.

The more common sulphides, such as pyrite, galena, and sphalerite, are relatively inactive as precipitants of silver from aqueous solutions of its sulphate.

The quantitative results obtained with niccolite and chalcocite indicate that the essential chemical changes in reactions of this type are due to oxidation through the hydrolytic action of water. It is apparent, therefore, that certain water solutions may act as potent oxidizing agents below the groundwater level.

Unlike gold, silver forms a large number of natural compounds. It is probable that the presence of certain other substances in the vein solutions, notably arsenic and antimony, may so modify the reactions that silver is precipitated not as native metal but as a compound such as polybasite or proustite. The conditions under which such compounds are made forms an allied and very important field of research.

The experiments indicated that nearly all of the sulphides and arsenides common in ore deposits were capable of reducing gold from a solution of its chloride, although the important differences in the rapidity of the precipitation were observed with different minerals. Most of the minerals that are especially efficient as precipitants of silver are also effective precipitants of gold, and a number of other minerals, such as galena, pyrite, stibnite, and millerite, that are inefficient in precipitating silver are efficient in depositing gold.

Chloride-Bearing Waters

It is known that the waters descending through the upper portions of sulphide orebodies universally carry chlorides, and it is probable that these chlorides have effected the solution of the gold. It is probable, therefore, that phenomena similar to those exhibited in the experiments with gold chloride solution play an important part in secondary enrichment in gold.

While the phenomena described find their most immediate application in secondary enrichment, it is perfectly possible that such reducing effects of the sulphides may be responsible in part for the primary association of the precious metals with certain sulphides in preference to others. It is recognized, of course, that certain mineral associations in ore deposits are probably the result of processes analogous to differentiation in rock magmas, but it is quite possible that other associations, such as the apparent preference of gold for chalcopyrite and tetrahedrite rather than for pyrite in deposits carrying these three minerals, may be due to differences in the reducing power of these sulphides themselves. Light could probably be thrown upon this point by the investigation of the reducing effect of various sulphides upon silver and gold salts dissolved in solutions having the composition of certain deep mine waters. The effect of increase of temperature on the reactions should also be studied.

It is a generally recognized fact that the purity of alluvial gold is greater than that of the veins in the neighborhood. This superiority in fineness has generally been explained by the well known fact that silver is more readily soluble in natural waters than gold, and is by them removed from the natural alloy, thus increasing its purity. Waldemar Lindgren

has recently discussed this matter at some length in a report on the Tertiary gravels of California,* and has presented a large number of statistical data leading to the same conclusion. It has been thought by certain geologists that this refinement of the gold was accomplished by solutions circulating through the gravels themselves, but Mr. Lindgren states that "so far as the Tertiary gravels of California are concerned, the conclusion of the writer is that solution and precipitation of gold have played an absolutely insignificant part." Under the conditions of the experiments here reported it was found that nearly all of the metallic minerals common in precious metal deposits were capable of precipitating gold, while a much smaller number, and these not the most common ones, were active precipitants of silver. When it is remembered that the source of the placer gold is the oxidized zone of the original deposit, and that the gold may have been dissolved and redeposited several times within the vein before erosion carried it into the alluvium, it seems probable that such selective precipitation may be a factor in this natural refining of gold.

Mineral Production of New York

The following table shows the output in 1912, this being valued at $36,519,382, an increase of 17% over the total for 1911, according to John M. Clarke, state geologist:

Product.	Value.
Clay materials	$11,947,497
Stone from quarries	5,718,814
Cement (4,783,535 bbl.)	3,631,097
Iron ore (1,277,677 long tons)	3,349,095
Salt (10,502,214 bbl.)	2,597,260
Petroleum (782,661 bbl.) } Natural gas (6,564,659,000 cu. ft.) } Gypsum (506,274 tons).	3,220,647

Among the minor industries, in some of which the state of New York has a prominent place by reason of its abundant natural resources, are those of talc, garnet, graphite, pyrite, mineral waters, millstones, feldspar, slate, and sand. Their record for the year was not attended by any unusual features.

Oil, Gold, and Coal Production of the Dutch East Indies

The production in 1912 of the oil wells in Dutch East Indies was as follows, in tons of 1016 kg., or 2239 lb.; Java, 184,809; North Sumatra, 379,014; South Sumatra, 259,215; and Borneo, 671,662.

The following figures give the production of the principal gold mines: Redjang Lebong (Sumatra), $1,223,925; Simau (Sumatra), $764,040; Ketahoen (Sumatra), $233,600; Totok (Celebes), $208,040; and Paleleh (Celebes), $368,637.

The production of the Government coal mines at Ombilien, Sumatra, was 408,204 tons, as against 406,508 tons in 1911. An electric plant for the bunkering of steamers at Padang has been installed and is working satisfactorily.—*Consular Report.*

*Lindgren, W., 'Tertiary Gravels of the Sierra Nevada of California,' *Professional Paper* 73, U. S. Geol. Survey (1911), pp. 68-70.

Stoping Drills at Sudbury, Ontario

By Albert E. Hall

*A stoper is cheaper to operate, since it can be handled by one man instead of two, as required on a large machine. In some cases a helper is assigned to two or three stopers, but as a rule this is not advisable. In addition, the use of stopers permits a larger proportion of the total time to be spent in actual drilling. With a big drill, much time is consumed in setting up after a blast or after moving to a new working place; with a stoper, on the other hand, the preparations for drilling are simple. As a rule, a stoper can be rigged up and set to work 30 to 40 minutes earlier than a big drill. One disadvantage of the stoper, when used for shrinkage stoping, is its tendency to create a large amount of shattered and partly loosened rock on the roof and walls of the working place. The men must first scale off this loose ground, which takes from 30 minutes to an hour. With a sufficient number of working places, however, this scaling can be done by a special gang, while the machine men are drilling in a previously scaled place.

As a result of the extra time applicable to drilling, and also of the more rapid drilling, stopers make an average of 30 to 40 linear feet of hole per shift, while a large drill will make 20 to 30 ft. As a rule, stopers work on a bench in the back. When necessary, a bench is created by taking out a diamond cut, and is then followed across the stope. The holes are made about 6 ft. deep. The amount of powder used (40% dynamite) as computed from several groups of holes, averages 0.63 lb. per cubic yard of ore. The amount of air consumed by a stoper is estimated to be about two-thirds of that used by the largest drills.

Some workmen object to the stopers on the ground that stoppages for small repairs are too frequent. It is true that the dust, which is a disadvantage in itself, from the runner's standpoint, sometimes clogs the valve and prevents the extension leg or standard from working properly, but only a few minutes are needed to clean out the valve, and if a screen or a bit of waste be put into the hose, this trouble is almost eliminated. Water sprays can also be used. On the basis of total repair bills, the stopers do not compare unfavorably with the larger machines.

In many places it is impracticable to use a stoper, and a big drill becomes necessary; for example, in hard rock, where the light drill makes little or no headway; but in shrinkage stoping the smaller machine does excellent work. The stoper has one advantage which is probably realized fully only by the men working underground: this relates to the matter of block-holding. Where the muck is being drawn off through chutes, the size must be fairly small so as not to block the chute and so hinder tramming and hoisting. With small stoping drills, the ground is generally broken small enough to pass readily through chutes, and very little block-holing is required. With large machines, on the other hand, considerable block-holing is necessary.

*From Columbia School of Mines *Quarterly.*

Periodicity of the Stock Market

About the most dependable movement of stocks annually is the advance of prices which almost invariably takes place around and after the middle of the year. It is commonly called the August rise, although a part or all of that month is not always included in the advance and may be regarded as a tribute of appreciation paid to the fact that crops are growing whether the promise be altogether satisfactory or not. In years of financial derangement or deficient harvests, or when politics is unsettling, the movement referred to has often been succeeded by a greater or less decline. In the years which are commonly spoken of as normal, the years such as it is usually our happy lot to enjoy, stocks are likely to go to still higher levels after the August upturn. The interesting fact of it all is, however, the regularity with which the August up-swing occurs. The following table, which is based on a well known set of statistical averages, shows the advances in the periods denoted since the beginning of the present century:

1900	June 23 to Aug. 15	5.20
1901	Aug. 5 to Aug. 26	5.81
1902	June 24 to July 27	5.53
1903	Aug. 8 to Aug. 18	7.32
1904	May 17 to Dec. 3	25.85
1905	May 22 to Aug. 25	9.56
1906	July 10 to Sept. 30	13.32
1907	Aug. 21 to Sept. 15	5.37
1908	June 22 to Aug. 10	12.43
1909	June 21 to Aug. 14	10.07
1910	July 26 to Aug. 17	8.84
1911	(No advance of any consequence.)	
1912	July 12 to Sept. 30	6.45

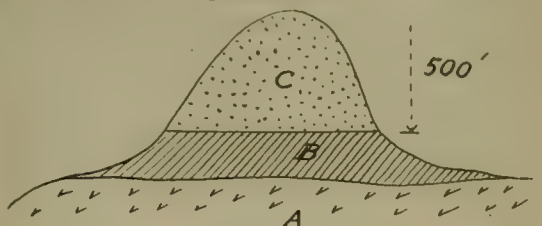
In twelve years out of the last thirteen, this movement has made its customary appearance. It has, of course, been affected by various circumstances antecedent or concurrent. In 1907 it was nothing more than a temporary rebound induced by chronological influences, and in 1904 the prolonged and sustained character of the advance was owing to the protracted liquidation which began in 1903 and carried over to the next spring, when stocks were almost as low as they were in the panic three years later. The average of all the August advances noted in the thirteen years analyzed is almost 9 points.

Now there may not be anything very prophetic in this, but it has a certain application to the course of the stock market since decline terminated on June 10 last. From the low average reached on that day to the high level achieved toward the end of last month, the recovery amounted to about 7¾ points. It can accordingly be said that stocks have already accomplished something like the average of rise which was to be expected around this season. One is not surprised, keeping in mind the customary tendencies of the stock market after the mid-year, to find that there has been this recovery. On the other hand, it would probably not be reasonable to look upon the recovery as necessarily significant of the further course of prices. As in other years, that will depend on developments in politics and finance and on the fortunes of the crops. So far as concerns values, the riddle of the future is yet to be read.—*New York Sun.*

The An-Chi Ironfield

By C. Y. Wang

The ironfield of the An-chi district, Fukien province, China, is about 60 miles from the coast and outcrops over an area about 17 miles square. There are several localities in which iron ore is found, but I only had time enough to visit one of these localities, named Pun-tien, about 27 miles northwest of Hu-tao. The ore consists of hematite and magnetite and was probably formed through processes similar to those which yielded the deposits of the Lake Superior region. The structural relationship is thus diagrammatically represented:



A = granite. *B* = quartzite. *C* = iron ore.

A rough measurement of the deposit gives 2000 ft. long, 1000 ft. wide, and 500 ft. high. This corresponds to 100,000,000 tons of ore, as a rough estimate. In *C* there are found pieces of ore that show the quartz grains very distinctly. The following shows the analysis of the ore:

	SiO_2	Mn	Fe	S	P
Sample 1	0.71	2.40	66.13	0.117	0.009
Sample 2	0.43	0.74	70.95	0.076	0.005
Sample 3	0.96	2.86	66.02	0.088	0.005
Sample 4	0.66	0.72	68.43	0.058	0.010

Wages on the Rand

The *South African Mining Journal* of July 5 published an interesting table of wages paid to white employees at the mines and mills on the Rand, which are as follows:

	Per day.
Machine stoping:	
Contract	$6.88
Day's pay	5.34
Hand stoping:	
Contract	6.46
Day's pay	4.64
Machine development:	
Contract	8.48
Day's pay	4.84
Hand development:	
Contract	6.60
Day's pay	4.56
Shaft sinking:	
Contract	12.10
Day's pay	6.00
Other miners	3.18
Other underground employees:	
Shift bosses	6.04
Timbermen	5.00
Pipemen	4.72
Fitters	4.80
Plate-layers	4.46
Drill-packer and carriers	3.14
Bankmen	3.50
Skipmen	3.78
Trammers	3.36
Pumpmen	4.50
Engineers on hoists.	4.90

	Per day.
Machine-shop, etc:	
Foremen fitters	$5.94
Fitters	4.84
Machinists	4.92
Ropes and riggers	4.92
Boilersmiths	4.84
Plumbers	4.84
Blacksmiths	4.84
Drill sharpeners:	
Contract	6.36
Day's pay	4.95
Carpenters	4.80
Masons and bricklayers	4.84
Engineers:	
Hoists	5.14
Stationary engines	4.68
Air-compressors	4.50
Locomotives	4.80
Mills:	
Foreman	5.44
Amalgamators	4.40
do assistants	3.22
Tube-mill men	3.40
Millwrights	4.96
Fitters	4.90
Cyanide foremen	5.40
Cyaniders	4.02
Slime plant	3.48
Tank-men	2.80
Fitters	4.84

Discussion

Readers of the MINING AND SCIENTIFIC PRESS are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment. Insertion of any contribution is determined by its probable interest to the readers of this journal.

Working Costs at the Standard Consolidated

The Editor:

Sir—I have read with interest the article by C. E. Grunsky, Jr., in the issue of May 31, on the cost of working thin veins in the Standard Consolidated mine at Bodie, California. I have in my note-books some hitherto unpublished figures giving working costs, etc., at the same property, taken from the annual report for the year ended January 31, 1906. This report was never printed, as the documents were all destroyed in the San Francisco fire. The figures herewith were taken from it before the report was sent down to San Francisco from Bodie.

STOPING COSTS

Vein	Average width, in.	Cost per ton.
Bullion	14	$ 2.760
Bechtel	20	1.567
East vein Bullion tunnel	24	1.702
Alpha	30	1.560
West Index spotty ore	12	4.021
East vein	60	1.401
Flat Index	20	1.464
New vein	40	2.444
East Graham	24	7.750
Brown Hill fills		12.404
Jackson	120	7.692
East vein	0	1.246
San Antonio	12	6.217
Bonanza	4	11.956
South vein	Irregular	9.096

DEVELOPMENT COSTS

	Total per foot.
Drifting	$4.175
Cross-cutting	5.035
Raising	3.955
Sinking shallow winzes varied from $5.55 to $8.75.	
Cleaning out old filled drifts	1.745
Cleaning out old filled crosscuts	1.405
Average cost per foot of development:	
Labor	$3.092
Supplies	1.124
Total	$4.216

It will be seen that the average cost per foot of development work has been brought low by the footage of old drifts and cross-cuts cleaned out, which were charged against this account.

It was found profitable to work over the filling in some of the old bonanza stopes, and when this was done the entire waste was carried out and all the fine material sent to the mill for ore. The foot-wall drifts were all carefully cleaned out and the foot-wall sweet here was taken. The metal in the old fills came from what the miners had carelessly left on the foot-wall and in the foot-wall hitches in the bonanza days. The stuff that was finally sent to the mill from some of these old fills sometimes ran as high as $50 to the ton. In a number of cases it was found profitable to go through the old bonanza stopes and scale off a few inches from the hanging and foot-walls to get the metal that had impregnated the wall rock outside of the veins.

No less than 120 veins and separate stringers have been mined in the Standard property. It will be realized what a 'honeycomb' the property now is, as many of these veins were only a few feet apart. The ground was rather soft, but it stood well, as otherwise a great deal of the work that has been done would not have been possible.

During 1905 there was 12,141 tons of waste hoisted, 18,542 tons of ore mined, and 18,521.5 tons milled. Of this, 4056 tons of ore was produced from development work. In the same period eighteen sets of timber were replaced in the Standard shaft, which has three compartments, at a total cost of $1287.47.

ALL COSTS

Mining:	Per ton.
General labor	$2.091
Development (labor and supplies)	1.546
Stoping (labor and supplies)	2.170
Distributed costs	0.580
Milling:	
Labor	0.625
Supplies	0.314
Distributed costs	0.466
Bullion charges	0.106
Cyaniding:	
Total, including redemption of capital	4.167
Total	$11.761

In the mill the following battery supplies were used to crush and amalgamate 18,521.5 tons of ore:

65 hammered shoes, weighing 11,180 lb.
91 hard white iron dies, weighing 10,963 lb.
14 front mortar liners, weighing 784 lb.
16 back mortar liners, weighing 1035 lb.
25 end mortar liners, weighing 475 lb.
10 stems were broken during the year.
237 30-mesh punched tin screens were used, and 9346 oz. of quicksilver.

From the beginning of operations with the Moore process plant, stamping was done in weak cyanide solution, in order to save dewatering the mill pulp. It was hard on the copper plates, but was the cheapest thing to do.

It will be noticed that the cyaniding costs were high. This was largely because the period covered was the one in which the original Moore process plant started operations, and the costs include expenditures on account of the various troubles incident to starting up a new plant, in which some of the machinery was especially designed for the work and built out of local scrap.

The original installation of the filter plant was modeled after the original Moore plant at the Mercur mill in Utah, and was one of the first movable-leaf filter plants that was a commercial success. Mr. Dorr had this plant in operation at the Lundberg, Dorr & Wilson mill in South Dakota a few months before the Standard Consolidated plant was ready to run. The Standard plant cost about $65,000 and the cyaniding cost, as given, includes amortization charges for a five-year redemption period at 5 per cent.

The most satisfactory period of Moore plant operations during 1905 was that of August, September, and October, and the cost per ton treated for these three months was $2.449, divided as follows:

General expense, including distributed costs	$1.220
Regrinding	0.572
Agitating and filtering	0.314
Precipitation	0.261
Total	$2.349

Some idea of the troubles experienced in starting this plant may be gathered from the following:

A 5 by 22-ft. tube-mill was furnished us with 1¼-in. smooth white cast iron liners which I was assured would last us six months. They were kept in place in the tube-mill by arching only, and were not bolted to the shell. After about two weeks of running, a heavy load came suddenly on the motor running the whole plant. I opened up the tube-mill and found that all the lining had dropped out and that the plates were practically worn through. No other lining had then been ordered, so as a makeshift I took 6 by 8-in. white pine timbers and sawed them into blocks about 6 in. long and made a lining of these blocks set endwise. A number of such lining were used up, as they lasted only about two weeks. I also tried one set of mountain mahogany, a hard wood which was gathered at considerable expense in the high Sierras, thinking this would be better and last longer; but this was a disappointment. As there was a lot of old machinery around Bodie, Cornish pump-rod straps, which were 6 and 8 in. wide by 1 in. thick, were tain mahogany, a hard wood which was gathered at stalling them lengthwise so that the inner section of the tube-mill was a polygon. The straps were bolted to the shell, and leakage was prevented at the bolts by putting under the washers what our millwright assured us was a 'gommet.' These linings did excellently well and were still in use when I left the Standard in 1906.

During the periods that the tube-mill was shut down I sent the stamp-mill pulp straight through to the filter vats, in which were installed agitators. It was not long before the coarser sand had cut out the bottoms of our filter leaves, which did not add anything to our gaiety, and, as A. D. Foote has well said, "we learned, slowly, something more."

The cost of operating the power-plant, which generated from 350 to 400 hp., for the year was $8582.62. Of this, the labor amounted to about $4200. The rate of pay for all labor was the same in 1905 as that given by Mr. Grunsky.

EDWARD H. NUTTER.

San Francisco, July 25.

Nevada Metal Output

The total value of the mine output of gold, silver, copper, lead, and zinc in Nevada in 1912, according to V. C. Heikes, of the United States Geological Survey, was $38,358,732, against $33,952,529 in 1911, showing an increase of $4,406,203, or nearly 13 per cent.

The total production of gold in 1912 was 650,942.70 oz., valued at $13,456,180, a decrease of $4,737,217, or 35% less than the 1911 production. Of the gold output, 11,206.21 oz. came from placers (mainly in Nye county), 608,132.85 oz. from silicious ores, 23,511.61 oz. from copper ores, and 8092.03 oz. from lead, zinc, and copper-lead ores. Silicious ores yielded over 93% of the entire gold production. From bullion in gold and silver mills was recovered 533,611.94 oz., concentrate produced 63,344.08 oz., and crude ore shipped to smelters contained 36,996.68 oz. The largest production of gold was from Esmeralda county, which was $7,014,559 in 1912, against $11,198,602 in 1911. Of this production the Goldfield district yielded $6,239,747, a decrease of $4,047,328, or over 39%, from the output of 1911. Nye county produced $3,123,935 in gold in 1912, against $3,617,276 in 1911. The Tonopah mines yielded $2,223,878 in gold, a decrease of $142,617, or over 6% less than in 1911. The Comstock mines produced $855,494 in gold, against $977,349 in 1911.

The silver production of Nevada in 1912 was 14,369,063 oz., valued at $8,836,974, against 13,184,601 oz., valued at $6,987,839, in 1911. Of the 1912 output, 13,135,677 oz., or over 91%, came from silicious ores, 841,733 oz. from lead ores, and 173,545 oz. from copper ores. Bullion at gold and silver mills produced 10,002,279 oz., concentrate 2,301,694 oz., and crude ore sent to smelters contained 1,546,220 oz. Nye county produced 10,210,296 oz. of silver in 1912, against 10,918,263 oz. in 1911. Of this output the Tonopah district yielded 10,144,987 oz., or 70.6% of the entire silver production of Nevada in 1912. Storey county (Comstock) produced 806,853 oz., against 618,006 oz. in 1911.

Copper production increased in Nevada from 67,377,518 lb., valued at $8,422,190, in 1911 to 86,477,494 lb., valued at $14,268,787, in 1912. This increase was due to the operation of the Mason Valley plant, which smelted ores from the Yerington district and other mining districts in Nevada. This smelter and the Steptoe plant in White Pine county produced, from the treatment of ores and concentrates, 83,389,088 lb., of 96.4% of the entire state production. Concentrates yielded 64,979,228 lb. of copper, and crude ore sent to smelters 21,423,801 pounds.

The production of lead in Nevada in 1912 was 19,500,100 lb., valued at $877,505, against 3,263,657 lb., valued at $146,865, in 1911, an increase in quantity of about 497%. The mines of Lincoln and Clark counties, the largest producers, yielded 17,315,250 lb., an increase of 15,230,189 lb. over the 1911 production. The mines of Eureka county produced 230,710 lb. in 1912 and 61,136 lb. in 1911. This increase is accounted for by the operation of the railroad which was washed out in 1910. Crude ore shipped to smelters contained 6,558,003 lb. of lead, concentrates 5,913,188 lb., and old tailing 7,028,909 pounds.

The zinc production of Nevada was 13,322,988 lb., valued at $919,286, in 1912, against 3,548,032 lb., valued at $202,238, in 1911. The entire production of 1912 was derived from Clark and Lincoln counties from ores shipped to smelters containing 4,669, 816 lb. and from concentrates containing 8,653,172 pounds.

There were 702 producers of gold, silver, copper, lead, and zinc in Nevada in 1912, compared with 661 in 1911. The total quantity of ore sold or treated in Nevada in 1912 was 4,763,965 short tons.

Special Correspondence

MELBOURNE, AUSTRALIA

FUTURE OF AUSTRALIAN MINING.—A SILVER-LEAD-NICKEL-TIN PROSPECT.—TIN-LEASE APPLICATION.—MOUNT CARRINGTON.

Before bidding farewell to Australia, W. J. Loring, one of the partners in the firm of Bewick, Moreing & Co., mining engineers, who is now on his way to England, gave in newspaper interviews his opinion upon the state of mining in the island continent. With an eye to the improved methods of treating lead, zinc, and copper-bearing ores, he looks for great development in the mining industry. He emphasized the fact that the Broken Hill was no longer to be looked upon as merely a silver and lead field, and that of those metals extraction was much higher than used to be the case. It is not surprising, in view of his firm's connection with the Company, that he illustrated his argument by the operations of the Zinc Corporation. Only seven years ago, he said, an extraction of 72% of the lead and 55% of the silver was considered remarkably good. Now the recovery is up to 85.3% lead and 68.6% silver, and an extra 2.3% lead is obtained from the treatment of the zinc middling, the total lead recovery constituting a world's record on this class of metal.

Some attention is being directed to the purpose of the Great Zeehan Dundas Silver Lead Mining Co., N. L. The Company holds an area of 33 acres near the town of Zeehan, near the west coast of Tasmania. Though it is called a silver-lead mining company, its purposes are not confined to these two metals, but extend also to nickel and tin. There are running through the property three lodes which are being prospected by another company whose property adjoins on the south. One of the lodes contains copper and has not as yet been properly opened; one is a pyritic lode 10 ft. wide on the surface, and another contains galena, on which most of the work done has been concentrated. A fourth lode, previously unknown, has lately been opened, and this, where cut in the adit driven into the hill to cross-cut the other three lodes, averages 63% lead, 7% copper, and 50 oz. silver per ton. This was narrow at first, but has since widened to 4 ft., 25% of it consisting of solid metal and the balance of good second-class ore. Still later, in the southwest portion of the Company's property, a promising lode has been discovered. It occurs in a large ironstone formation, is 20 ft. wide, and assays 3.5% tin, according to the mine manager, who states that the formation extends into the highest part of the range, and, so as to include all possible extensions, he staked another claim for the Company. It may be worth while to quote his words: "Here the ironstone outcrops in immense boulders and appears to be chains wide; in fact, the mountain appears to be one mass of iron, which stands out boldly from the surrounding country, and is about 900 to 1000 ft. above the point where I first found the formation, and distant about 60 chains. If we get the same metal values in the ore in the mountain as we got in south section, this will stand equal to Mt. Bischoff, as we have the quantity, and now we have to prove the metal content." There is a peculiar tone about this which is not quite convincing; but, in spite of that fact, it seems probable that something fairly big and good has been found. It is to be hoped so, for the sake of Tasmanian mining, which has not been so flourishing of late.

The Ardlethan tin boom has meant a good thing for the Mines Department of New South Wales. During the year ended June 30, no less than 1200 applications for titles on the field were received. In view of the fact, it is not surprising that the Department's revenue during the year amounted to over $658,000, nearly $73,000 in excess of the previous best year on record, and some $276,000 in excess of the expenditure. Unless another boom starts, the receipts for the current year are bound to show a great shrinkage.

Undeterred by the failure, none the less marked because unacknowledged, of the Victorian State coal mine, the New South Wales Minister for Mines is said to have the intention of putting on the state's estimate of expenditure a sum of several thousand pounds for the establishment of a state coal mine in this state. The public does not look forward to the outcome with confidence, but, after all, there is a considerable distance between the intention to do this and the actual business of putting the money down. Nor is it too certain that the present New South Wales government will continue to hold office.

F. B. Powell, a well known mining engineer, has reported upon the Mount Carrington, a copper mine near Tenterfield, New South Wales. In his opinion, the adit which was driven into the hill on which the mine is situated was disappointing in its results, because it was driven on the hanging wall of the Pioneer lode and left the lode standing. He thinks that, this being so, there is from 200 to 250 ft. of backs immediately available for development at a low cost. As to the Company's other main lode, the Carrington, he recommends the testing of the ore by the Minerals Separation flotation or Murex magnetic process, either of which he thinks should produce a high-grade concentrate. On the whole, Mr. Powell considers the mine more than an ordinary good mining gamble.

JOHANNESBURG, TRANSVAAL

OPERATIONS OF THE GOERZ GROUP.—PRESENT CONDITION AND FUTURE OF THE MINES CONTROLLED.

Although the Goerz group of mines is the most insignificant as regards scale of operations among the mining groups on the Rand, still the individual mines controlled by that group possess today several features of more than ordinary interest. At the recent annual meeting of shareholders here, the chairman of directors drew attention to several interesting features because the mines controlled by this particular group are scattered more or less over the whole length of the Rand. It is probable, however, that in the Geduld Proprietary Mines and the Modderfontein Deep, on the Far East Rand, the group controls mines of greater potential value than all the rest of the mines under their control. Nevertheless, for many years the Geduld Proprietary Mines were under a cloud and it was only during the last twelve months that these mines began to show an improvement. During 1912 the profitable ore reserves increased in amount from 736,000 to 1,475,000 tons, and in assay-value practically 24c. per ton. Meanwhile, the capacity of the reduction plant has been increased to 24,000 tons per month, which nevertheless is a tonnage far below the capabilities and requirements of the property if an adequate return is to be obtained on its large nominal capital. This Company has an issued capital of $3,700,000—a capital not too large for the size of the property—but operations hitherto have been conducted on such a limited scale that the shareholders, after ten years' weary waiting, have not been sufficiently fortunate to be rewarded with a dividend. The other property on the Far East Rand belonging to this group, which has come to the front during the year, is the Modderfontein Deep, where the main 'reef' was intersected at a depth of 3000 ft., which, on being driven on to the extent of nearly 8000 ft., assays $7.60 per ton over a width of 48.6 in. This property is regarded as one of the most promising on this part of the Rand; so much so that the May Consolidated Co., whose mine near Germiston is fast approaching exhaustion, is acquiring a large interest in the Modderfontein Deep property. The Van Dyk Proprietary Mines, also on the Far East Rand, however, remain closed, owing to want of capital, with but little prospect of being reopened.

With regard to the interests held by the Goerz group on the Western Rand, the year just closed has been a disappointing one. To the previous serious losses already incurred by this group, have now to be added those at the Lancaster mine, which was unfortunately closed during the year owing to the losses and unsatisfactory manner in which the property developed. Another disappointing mine on the Western Rand belonging to this group was the Princess Estate, where, despite its reconstruction and absorption of neighboring properties, the results attained during the year were anything but satisfactory.

The prospects of both the Lancaster West and Princess Estate are at present somewhat uncertain, while the Tudor, Randfontein Deep, and other properties belonging to the same group in the Western Rand are still closed, and in an undeveloped condition. The Goerz group, however, is interested in mining properties not only in German West Africa, but also in Mexico.

DEADWOOD, SOUTH DAKOTA

HISTORY, MINE DEVELOPMENT, AND PROGRESS IN CYANIDATION AT THE PROPERTY OF LUNDBERG, DORR & WILSON, NOW SHUT DOWN.

The property of Lundberg, Dorr & Wilson, which has recently been closed, is situated on both sides of Fantail gulch, just below the town of Terry, Black Hills district, South Dakota, and the following notes should be of interest.

It consists of the Buxton mine, on the north side of the gulch, with workings extending through the hill about 800 ft., to Nevada gulch, and the Bonanza mine just across the gulch on the south side. The mill is on the Buxton side and ore from that mine is trammed directly into the ore-bins. The Bonanza ore was delivered at the top of the mill by a Bleichert jig-back tram with buckets of 1200 lb. capacity. There is only a single span of 910 ft. The tramway has a capacity of 15 tons per hour and is operated by one man at the loading station.

The mines were opened in the early eighties, and as no recovery could be made by amalgamation or concentration, the first ore produced was shipped to Omaha, partly by wagon haul, with a freight and treatment charge of $40 per ton. A smelter at Deadwood, started in 1892, reduced the charges to $16 at first and finally to $8 per ton. After producing something over $1,000,000 gross, the Buxton Mining Co., owning the property, stopped operations and turned the property over to lessees. Later it was sold for a nominal sum, as entirely stripped of ore that could be profitably handled. The new owner leased it to John Lundberg, and during that period the ore mined was treated at a custom cyanide plant operated by Lundberg & Dorr at Deadwood for nearly two years. About ten years later the above firm enlarged to Lundberg, Dorr & Wilson, and bought the property, figuring that there was a large amount of $4 to $6 ore left in it which could be made to yield a profit with a modern mill on the property. The mill and tramway were begun in July 1903 and commenced operations in January 1904. Since then the property has continued steadily in operation, with the exception of two shut-downs during the eight-hour and closed-shop general strikes in 1907 and 1910, until it closed down at the end of July 1913 on account of the exhaustion of its ore supply. Its estimated capacity of 75 tons per day was gradually increased to 110 tons, and both mining and milling costs were reduced until ore as low as $3 was profitably handled.

The mill is of interest historically as having passed through the whole period of modern American cyanide practice. When designed, leaching was the standard practice. Slime was the *bete noir* of the millmen, both on account of the difficulty of separation from sand and the recognized losses in decantation, the only method of treatment in use in this country. The apparent necessity of holding all the mill tailing on the side of the gulch, as well as the efficiency indicated, led the firm to install the Moore process, then being tried at Mercur, and this gave it the distinction of operating the first leaf-filter plant to remain in successful operation for any length of time. The difficulties encountered in sand and slime separation by hydraulic cones were overcome by the invention of the Dorr classifier in July 1904, and from this mill its use and that of other mechanical classifiers has spread over the whole country and into most cyaniding districts in the world. With the very slimy ore handled at this plant, the machine was responsible for its success. Of local interest perhaps is the fact that it was the pioneer in the Black Hills in the use of electric power purchased from a central plant, and in the use of Chilean mills for fine crushing, and belt elevators for handling pulp crushed in cyanide solution. The total tonnage milled was approximately 285,000 tons, of which about 60% came from the Company's mines and the other from custom ore. Owing to its operation as a custom plant, no figures on operating costs or extractions have been published.

The total production has approximated $1,500,000. As the ownership of the property is a partnership, the earnings are not of general interest beyond the fact that the net profits after deducting the cost of the property and all improvements have been several times as great as the estimate made when the property was bought, although the actual value of the ore has been less than estimated. One reason for the success of the property has been the indefatigable energy and care bestowed upon it by J. M. Pennington, Jr., the manager. Mr. Pennington came with the firm as assayer at the beginning of operations, and gradually assuming more responsibilities, ended as manager when the plant was closed. Many of the men employed in the mines and mill, including the shiftmen, were with the firm nearly the whole time of operations, and by their faithful and intelligent service contributed materially to the success of the operations.

NEW YORK

EFFECT OF ELECTRICAL WORKERS' STRIKE AT BUTTE.—MIAMI SMELTING CONTRACT WITH GREENE CANANEA.—BRADEN COPPER.—QUICKSILVER MINING COMPANY.

The strike at Butte is probably more serious in its possibilities than has been generally recognized. The electrical workers in the employ of the Montana Power Co. constitute the storm centre of the disturbance so far, and their demands up to the present point have been met with a decided refusal. The Montana Power Co. supplies electric current for most of the mines and smelters in the Butte district, and in the event of a real test of strength these workers are in a peculiarly strong position so far as enforcing a shut-down is concerned. In addition to calling upon the miners to go out in sympathy with them, the cutting off of electric power would in a short time cause most of the mines to be seriously crippled, if nothing more. The directing head of the Montana Power Co. is John D. Ryan, who is now on his way from New York to Butte, to take charge of the situation in person. Butte has been the scene of some of Mr. Ryan's greatest achievements as a peacemaker, and it is quite safe to say that the interests or the respective rights and duties of the contending parties could not be in safer hands. No small part of the career of Mr. Ryan has been spent in bringing peace out of strife, in the earlier days in Butte, later in the work of getting the copper producers together, and securing and maintaining some degree of equilibrium for the copper metal market. Mr. Ryan's experience rather qualifies him to adjust almost anything except an 'irrepressible conflict,' and he would probably be equal to getting a long postponement in such a case.

The Miami Copper Co. has made a new 10-year smelting contract with the Greene Cananea on a basis understood to be distinctly more favorable to the Miami than the contract just terminated. The concentrate from the Miami mill is sent into Mexico in bond, and the smelter product is shipped for refining to the International Smelting & Refining Co.'s plant, at Raritan, New Jersey. The Miami, however, sells its own production, handling also that of the Shattuck-Arizona, which, like the Miami, ships its ore to Cananea and the product to Raritan.

Operations at the Braden Copper Co., Chile, have been interrupted by a storm, which necessitated repairs to the transportation equipment of the plant and forced a shut-down of the mill for the last 10 days of July. Production totaled 1,046,000 lb. Not all of the treatment problems at the Braden have been solved yet, but while results are not up to expectations so far, there is nothing but will be overcome in time and production brought up to approximately the estimated figures.

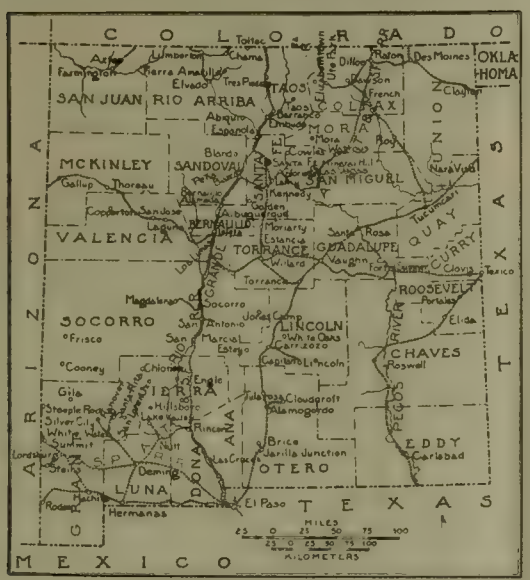
The Quicksilver Mining Co., which has recently had a hard time financially, has succeeded in making sale of a note issue of $25,000, and the management states that a receivership will be unnecessary.

MOGOLLON, NEW MEXICO

DEVELOPMENT AND MILL WORK OF THE ERNESTINE, SOCORRO, DEADWOOD, PACIFIC, OAKS, MAUD, AND LINCOLN MINING COMPANIES DETAILED.

A contract was recently let for sinking the main shaft of the Ernestine Mining Co. Considerable water was encountered, necessitating the installation of a pump. A large amount of other development is adding to the already large ore reserves. The mill is treating 150 tons per day with 30 stamps, and 10 stamps are in reserve for emergencies. The new oil-engines installed several months ago are giving satisfaction, and the Company now has a surplus of power.

Two additional oil-engines of the De la Vergne type were also installed by the Socorro Mining & Milling Co. recently. A proposal to light the business houses of Mogollon with electricity is being discussed by the Company. Some of the best grade ore is coming from the 800 and 900-ft. levels. The mill is treating about 175 tons per day. In July over two tons of gold and silver bullion and



MAP OF NEW MEXICO.

a large amount of high-grade concentrate was shipped, breaking all previous records.

A new orebody has been cut by the different levels south of the main shaft of the Deadwood mines toward the Sunburst mine, one of this Company's properties. The mill is treating from 350 to 400 tons of ore per week, and 600 lb. of gold and silver bullion and 1500 lb. of concentrate were shipped from last clean-up. A considerable tonnage of custom ore is sent in from developing companies.

A large amount of machinery for development work is on the ground for immediate installation by the Pacific Mines Co., including a compressor, machine drills, crusher, motors and transformers, and electric hoist. Current will be furnished by one of the local companies. The main adit is now in 900 ft., and the new shaft has reached a depth of 240 ft. Drifts are being driven on No. 2 and 3 levels. The vein is 5 to 8 ft. wide and assays from $15 to $18 per ton. All ore taken out in development is sent to one of the local custom mills; 120 tons being shipped the week ended August 9.

The C. H. Putnam Engineering Co., of Los Angeles, has been operating the Little Charlie mine, one of the Mogollon Gold & Copper Co.'s properties, under bond and lease, for over a year, during which time several thousand tons of excellent ore has been mined, part of which was shipped direct to smelter and the rest to local custom works. A 25 to 30-hp. crude-oil engine and electric hoist have been installed. From 20 to 30 tons of ore is shipped daily.

The main drainage and transportation tunnel of the Oaks Co. on Mineral creek, which will cut the orebodies of the district at depths of from 1400 to 1800 ft., is advancing steadily. In the east end tunnel group, adit 'A' has been driven 300 ft., and a contract was recently let for sinking a winze. Work is also going on in the adits 'B' and 'C.' Ore from these workings is shipped regularly to the custom mill.

The new shaft of the Maud Mining Co. has reached a depth of 485 ft. and has been in good ore a greater part of the distance. The Company is sending 10 tons per day to one of the custom mills, all coming from shaft development.

The Lincoln Mining & Development Co., successor to the Enterprise Mining Co., is preparing to do extensive development work, chief of which will be sinking the shaft, which reached water-level some time ago, when work had to be discontinued on account of the excessive inflow. A pump will be installed. It is rumored that the mill will be altered to accommodate custom ore that is available from a number of properties developing in the north side of this district.

CANANEA, MEXICO

MINING OPERATIONS OF THE EASTERN CANANEA DEVELOPMENT, CALUMET & SONORA, MOCTEZUMA COPPER, MEXICAN METALS COMPANIES.—NEW EQUIPMENT AT VARIOUS PROPERTIES.

The Eastern Cananea Development Co. has resumed development at the Cananea-Eastern mine, situated about 18 miles east of Cananea. There are about ten men employed at present, the number to be increased as soon as possible; John Martin is in charge of the work. Operations were stopped about six months ago, and at that time the drift had entered an orebody of considerable value, about 20 ft. of the ore having been opened averaging 10% copper.

The Calumet & Sonora has stopped mining operations for the present and the only work done underground is raising ore which has been previously broken. There is sufficient ore broken to supply the mills for five or six weeks. The Company is planning to resume sinking soon, from the 525-ft. level to about 750 ft. The increased depth will undoubtedly be of great value to the property, as with every foot that has been sunk the copper content of the ore has increased, while the silver, zinc, and lead have decreased. The property will eventually prove a copper mine of considerable worth. The property will soon be examined by a prominent mining engineer for a number of large stockholders in the Company.

The Pilares, Guadalupe, and Esperanza shafts of the Moctezuma Copper Co., at Nacozari, are to be sunk from the 1000 to the 1500-ft. level, at which point all will be connected by drifts. Last year the shafts were sunk from the 750 to the 1000-ft. level. Development between the 750 and 1000-ft. levels has proved to be satisfactory, as the grade of ore is higher than that on the levels above.

Harold Whealton, of Nogales, manager for the Mexican Northern Mining Co., has taken over El Plomo mine near Sasabe, in the Altar district, which he recently purchased from Fred S. James of Chicago. There are twenty men employed at present.

There has been a high-grade orebody opened at the Copete property of the Copete Consolidated Mining Co., which is situated near Carbo. The ore runs high in glance and native copper and contains several ounces in gold. The orebody already exposed is estimated at 150 to 225 feet.

The Mexican Metals Co. (Moctezuma-Arizpe Development Co.) has received a carload of new machinery, which was freighted to the property, 18 miles from Cananea, during the past week, and is now being installed. The shipment included an Ingersoll-Rand compressor of 1400-cu. ft. capacity, and a Bessemer twin cylinder 165-hp. oil engine. A second Bessemer engine of the same capacity will be installed later, it already having been shipped. With the new machinery installed, the Company will have an up-to-date and complete plant, and it will enable the Company to increase its production considerably. Concentrate netting $54 per ton is being shipped to the El Paso smelter regularly. Shipments average about a carload per week, and this will

be about doubled when the additions to the power-house are completed. The Company is using a Pierce-Arrow 6-ton auto-truck to freight its supplies from Cananea to the property and concentrate to the railroad, and during the recent heavy rains, which made the roads almost impassable, the truck has been doing excellent service. It is predicted that the August production of the Cananea Consolidated Copper Co.'s smelter will total close to 7,500,000 lb. of copper gross. Four furnaces, besides two reverberatories, are in operation.

The latter part of the month will see the 75-ton smelter of the Chicago Exploration & Development Co., at Mina, Mexico, 45 miles from Tonichi, blown-in and in operation. It is impossible to get coke, and a large quantity of charcoal has been burned as a substitute. It is said that there is 500 tons of concentrate ready for treatment, which will average 100 oz. silver per ton besides the copper content. W. E. Pomeroy is manager, George Squire smelter superintendent, and Charles Gercken mine superintendent.

TORONTO, CANADA

DIVIDEND RECORD OF COBALT.—THE NORTHERN CUSTOMS MILL CHANGES OWNERSHIP AND WILL BE ENLARGED.—DRAINING KERR LAKE.—THE KIRKLAND LAKE DISTRICT.

A report by A. A. Cole, of the Temiskaming & Northern Ontario Railway Commission, gives the total amount paid in dividends by the Cobalt mining companies up to June 30 at $46,506,155.

Seven of the companies have redeemed their entire capital obligations. The group of English capitalists operating the Cobalt Townsite, Casey Cobalt, Cobalt Lake, and other mines, have purchased the Northern customs mill and concentrator, the price being stated as $250,000. It is the largest mill in the district, and has 180 stamps. The purchasers take control on November 1, and will enlarge its capacity by adding 100 stamps. The Northern Customs was the third plant to be built at Cobalt, and has done a profitable business, sufficient funds having been provided from the earnings for its enlargement from time to time, in addition to yielding good returns on the investment.

All arrangements for the draining of Kerr lake by the Crown Reserve and Kerr Lake mining companies for the purpose of developing additional ore reserves are expected to be completed by the end of August. The work will require three months of steady pumping. The overflow will be received into Giroux lake, about half a mile distant, which will be utilized as a reservoir for the supply of the Crown Reserve, Kerr Lake, and Drummond mines.

The Cobalt Lake has declared a dividend of 2½%, being the third declared for the present year. While only interim returns have so far been made, it is understood that henceforth they will be regularly continued on the basis of 10% per year. The financial position of the Wettlaufer of South Lorrain has somewhat improved. The latest report, dated July 11, showed cash on hand to be $158,631, and silver in transit or at the mine of an estimated value of $60,000. Ore development has not been satisfactory, and the reserves are approaching exhaustion. Prospecting is being carried on by diamond-drilling and a calcite vein is being opened in the hope of finding new orebodies. The Sterling mine, of Elk Lake, which was recently sold by order of the court for $300,000, is again on the market, owing to the default of the purchaser in the payment of the deposit required.

Kirkland Lake, for the present at least, has quite eclipsed Porcupine as a centre of mining interest. The Teck-Hughes vein has been cut at the 100-ft. level, about 35 ft. from the shaft, where it shows 14 in. of high-grade ore, equal to that on the surface. The vein had dipped out of the shaft at a depth of 40 ft. A winze will be sunk on the ore to the 200-ft. level. On the Robbins property, adjoining the Foster, a vein two to three inches wide shows visible gold and carries tellurium. It has been stripped for some distance. The Wright-Hargraves claims, on which good discoveries have been made, have been taken over on option by Barr Cartwright and associates, and development will be actively undertaken. The Hudson Bay Mining Co., of Cobalt, has acquired several claims in the district.

BOSTON

COPPER PRODUCTION OF THE MASON VALLEY SMELTER AND AFFAIRS IN THE YERINGTON DISTRICT, NEVADA.—IMPROVEMENTS AT EAST BUTTE.—THE BUTTE, WISDOM & PACIFIC RAILWAY.

The July statement of production from the Mason Valley smelter is a disappointing one, showing that the plant, for the first time since it was blown in at the beginning of 1912, has fallen below a monthly output of 1,000,000 lb. The total for July is only 990,000 lb., as compared with 1,132,000 lb. in June and 1,460,000 lb. in July 1912. The trouble is attributed to the failure of the Nevada-Douglas company to keep shipments of ore up to normal. It is claimed that the smelter receives ore from nearly 150 small shippers from mines in western Nevada and portions of California and Oregon. Notwithstanding these additions to the volume of business, a decrease is shown. The Nevada-Douglas company had a contract when the smelter started to furnish it with 250,000 tons of ore, and is presumably under obligation to complete this contract, so the decline in shipments from Nevada-Douglas must be due to conditions at its own property. The drift of things at Yerington, which was once proclaimed as the biggest copper possibility among the Western districts, indicates that a consolidation will be necessary, as it will be unsatisfactory to Nevada-Douglas and Mason Valley stockholders for conditions to continue this way much longer. Nevada-Douglas paid one dividend of 12½c. per share, which was generally considered premature, and has since not only failed to announce any more dividends, but a $2,000,000 bond issue was shortly after authorized. That kind of financing, while conceivably well intended, does not find favor, and there has been much criticism of the financial management. Now that the Company is not keeping up ore shipments, further dissatisfaction is expected. It is stated that the management has engaged in other promotions and prospecting pursuits, while financial and mine conditions apparently suffer. Little Mason Valley stock has been distributed among the public, but Nevada-Douglas probably has over a thousand stock and bond holders who have been given to understand that their money has gone into a mine which would be a large producer and dividend payer. Evidently the best thing that can eventuate in Yerington would be the acquisition of Nevada-Douglas and Bluestone by the Mason Valley interests, which have enlarged their original 800-ton smelter to a capacity of 2000 tons without increasing the Company's outstanding capital a dollar. The Yerington mine should have liberal and able financing in order that investors may be satisfied as to the productive merits of the district.

It is announced that the improvements at East Butte will be completed by the end of the year. This includes the duplicating of the present smelter capacity, the practical rebuilding of the concentrator, and increase of about 600 tons per day and electrical equipment of the East Butte mine No. 1, and its reopening. The No. 1 mine operations were suspended about six years ago, since which time the property has lain idle. The shaft is down 900 ft. and it is proposed to unwater it and sink deeper. The Pittsmont property is said to be in good condition. Some criticism is made in Butte of the East Butte statements failing to show the output of the mine itself. The production given is that of the smelter, which receives custom ores from several properties in Butte, the Radersburg district, and others. It has been stated that these monthly figures have been handled in such a way as to give the impression that the amount of ore contributed by East Butte is larger than is evidently the case.

W. R. Allen announces that surveyors and engineers are in the field over the route of the Butte, Wisdom & Pacific railway, and that actual construction work is to be hurried this fall. This road is controlled, through stock ownership, by the Boston & Montana Development Co. It will operate within Silverbow, Deer Lodge, and Beaverhead counties, traversing the richest mining and ranching country in Montana. The road will be extended into the Big Hole basin of Beaverhead county.

General Mining News

ARIZONA

Gila County

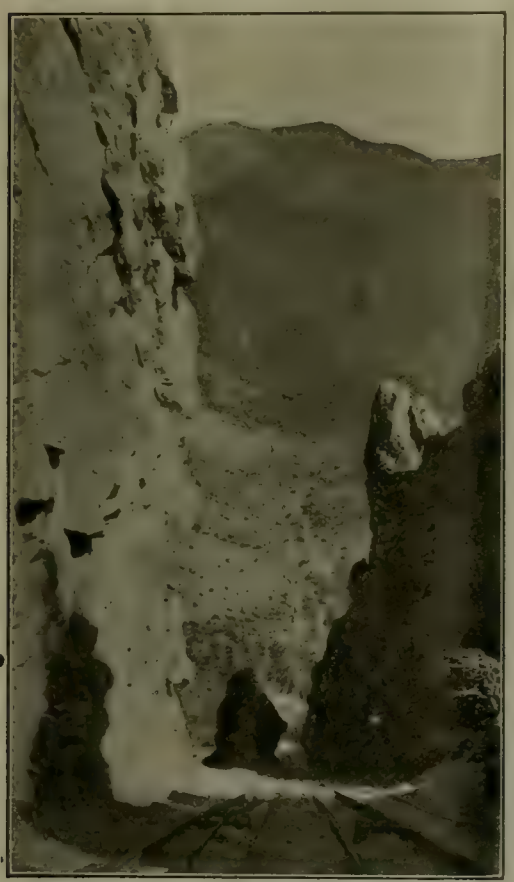
(Special Correspondence.)—At the Copper Hill shaft of the Arizona Commercial, at Globe, considerable exploration work is being planned in the ground below 600 ft., where a raise, recently completed from the 700 to the 600-ft. level, showed the presence of rich chalcopyrite ore, convincing the superintendent, R. R. Boyd, that the ore-body formerly explored on the 600-ft. level extends to greater depth. Considerable low-grade sulphide and abundance of iron has been found on the 1200-ft. level. An electric furnace with a daily capacity of 50 tons is being used at Globe to test Copper Reef ore, of which about 50 tons recently was brought in for the test.

At the Southwestern Miami the casing has been pulled from No. 4 hole, and No. 16, about 250 ft. southwest of No. 15, has been started. The Inspiration Extension shaft is now about 40 ft. deep and the bottom is so thoroughly impregnated with carbonate stains and sulphide stringers as to have the appearance of low-grade ore. The schist being cut by the shaft is identical with the ore-bearing schist of the Inspiration and Live Oak groups, the former of which is adjoined by the Inspiration Extension.

Miami, August 14.

Greenlee County

Owing to a draw-bar breaking on an ore-car of the Coronado mine incline, on August 13, nine men were killed



LOOKING DOWN ON METCALF, ARIZONA, FROM TOP OF CORONADO INCLINE.

and others injured. This incline is 3300 ft. long, and is at an angle of 38°, and has been used for fifteen years, but is being displaced by a tunnel, as described in our issue of August 16. Passenger traffic was not permitted as a rule. The safety chains broke when the loaded cars jerked them.

Maricopa County

A large quantity of machinery is on its way to the property of the Sunflower Cinnabar Mining Co., 80 miles northeast of Phoenix, in the Mazatzal mountains. The dump at the mine contains 10,000 tons of ore averaging 6% mercury, and the Company expects to produce about 14 flasks per day.

CALIFORNIA

Amador County

The west cross-cut on the 2500-ft. level of the Keystone mine has cut a body of well mineralized quartz. Assay-values are not yet known, but the presence of the vein is encouraging. The superintendent, C. R. Downs, is having the cross-cut run farther west, as he believes that the main fissure has yet to be opened. In all probability it will be necessary to continue west at least 100 ft. These new workings are at a depth of 2500 ft., and 1500 ft. under the lowest level of the old mine.

Nevada County

(Special Correspondence.)—At the Grizzly Ridge mine, the installation of 8 electric motors, 3 transformers, and a large duplex air-compressor was recently completed. The equipment, consisting of compressor, mine fans, mine pumps, hoist, rock-crusher, ten 1200-lb. stamps, tables, and machine-shop are electrically driven. Telephones are being installed on all levels from the 300 to 1000-ft. level in the mine. Everything is working at full capacity.

Nevada City, July 14.

Placer County

Development work in the Eldorado mining district is increasing. It is understood that the Central Eldorado Mining Co., which is operating the old Davidson mine, is adding 10 stamps to the mill of the same size already in operation.

Shasta County

Machine-drills and 21 men are at work in the Balaklala mine breaking ore, and the aerial tramway at the smelter is ready to carry ore. At the smelter, 62 men are busy, and the following work has been done: The gas plant is approaching completion; a new brick smokestack connecting with the McDougall furnaces has been built; tramways have been laid; the rock-crushing plant has been put in order; machinery for the Hall smoke-eliminating plant is on the ground, and much of it is in place. The Field washer, which plays an important part in the elimination of smoke, is at hand, and part of it has been set up. F. M. Leland is general manager, and he hopes to have a trial run in about three weeks.

Siskiyou County

(Special Correspondence.)—Reeves Davis is installing apparatus designed to establish an undercurrent in the sluices at his hydraulic property. The device is intended to save the black sand which has hitherto run to waste. This marks the first attempt to save the gold contained in the black sand of this district, as it has been previously considered too poor to warrant saving. The Siskiyou Mines Co. continues to operate on Morgan's Point with a full head of water. Late heavy rains largely increased the water flow, prolonging the season several weeks. Several placer-mining companies are working later than usual as a result of the heavy rains of a month ago. Small shipments of rich ore have recently been made from the Homestake mine, Salmon River district, to Yreka. The shoot is several inches wide and apparently improving in size as work advances. R. S. Taylor, of Yreka, is principal owner. Operations have been suspended at the Sheba mine, which has been a steady producer since 1899. The plant has been dismantled and offered for sale. W. H. Linforth, F. Belden, and other San Francisco people are the owners.

Fort Jones, August 10.

Tuolumne County

(Special Correspondence.)—J. E. Holden and C. L. Manley have assigned their interests in the Chilano mine, near Tuttletown, to the Jamestown Consolidated Mines Co. A force of eight or ten men, with Mr. Manley in charge, is

working at the property. The old shaft, 100 ft. deep, sunk through crossings in the hanging wall long ago by miners who look only for 'pockets,' will be enlarged to three compartments and sunk to at least 300 ft. Drifts will be driven along the hanging wall and cross-cuts to the foot-wall at each 100 ft., and the ore extracted in development will be put through the small mill, which is being thoroughly repaired, to determine the exact value of the ore in every part of the vein. Assays taken in a cross-cut from the hanging wall to a point 20 ft. into the vein average $3 per ton. According to report, the Shawmut company has purchased the machinery of the Tarantula mine and will remove it from the latter property.

Sonora, August 9.

Rich ore has been opened in the Eagle-Shawmut mine at Shawmut, the shoot being 12 in. wide. It is proposed to sink a shaft from the 400-ft. adit-level.

COLORADO

Clear Creek County

(Special Correspondence.)—On the Hancock level of the Sunburst mine, Democrat mountain, a streak of ore 5 in. wide has been exposed, valued at 50 oz. silver per ton. The shoot is showing for 15 ft. E. J. Butts is operating under a bond and lease. The Oriental adit on Lincoln mountain has cut the Lucky Gus vein at a distance of 250 ft. from the portal. A body of galena is showing which is 7 in. wide, assaying $82 per ton in gold, silver, and lead. A. T. Swanson is owner. Work was resumed this week on the World's Fair property in East Argentine. L. Hoery is manager. The Toledo property, on Pendleton mountain, is undergoing development. T. W. Cunningham has been appointed manager. Herber & Co., leasing on the Independence through the Wilcox adit, are shipping on an average of three carloads of smelting ore each week. The product is consigned to the Salida smelter and returns averaging $38 per ton are being received. Carload shipments are going out from the Virginia City on Lincoln mountain. The ore shows a fair quantity of 'wire' silver and brings a net settlement of $45 per ton. A. Robert is operating under lease. Work was resumed this week on the Central Capital mine, situated on Griffith mountain. Shipments of lead-zinc ore are to be started. The Argentine Central railroad is now delivering ore from the mines of East Argentine. Shipments are going out from the Kittie Ousley, Tobin, Santiago, and Waldorf mines. B. J. O'Connell, operating the Gambetta mine on Republican mountain, has secured a right-of-way and lease upon the Magenta-Turner vein, cut 850 ft. from the portal of the adit. The west drift will be extended for 1300 ft. to undercut the Gambetta workings by 400 ft. Heavy shipments are being made from the Ohio property on Lincoln mountain, operated by the Bard Creek M. Co. The product is worth $55 per ton in gold, silver, and lead. F. Nelson is manager.

Georgetown, August 8.

Las Animas County

Labor is unsettled in the southern Colorado coalfields, and the United Mine Workers of America are discussing the situation at Trinidad. If a strike is declared, it will involve several thousand men in district 15, comprising Utah, Colorado, and New Mexico.

Teller County (Cripple Creek)

The new ore-shoot in the El Paso company's property was opened on the 900-ft. level of the new Nichols shaft, this level corresponding and connected with No. 6, or 800-ft., level of No. 1 El Paso shaft on the south end of the estate. These blocks are situated south of the Nichols shaft, and the discovery is on the Beacon hill Ajax vein. The orebody, which is 5 to 8 ft. wide, has already been proved horizontally north and south for a distance of 175 ft., with rich ore in both headings and back of the drift. The vein contains streaks of sylvanite, some being 1½ to 2 in. wide.

The active mines on Beacon hill include the Commonwealth, Requa Savage, Gold Dollar, Black Belles, and Prince Albert on the eastern side, the Prince Albert and Hiawatha on the south, with the properties of the Henry Adney Gold Mining Co., the Henry Adney & Maid of Orleans, and the El Paso Consolidated estate with two shafts and an adit.

The San Juan

On No. 6 level from No. 3 shaft the Camp Bird company has cut the vein again, which is similar to the level above. During July 265 ft. of work was done in the Mountain Top mine, of which 168 ft. was on the vein. In the north drift the vein was from 2½ to 6 ft. wide, with a streak 8 in. averaging $8.14 gold and 64.84 oz. silver per ton. The last 20 ft. averaged 18 in. wide.

Crude ore and concentrate shipments from Silverton during July were as follows: concentrate, Gold King, 725 tons, Sunnyside, 660; Iowa Tiger, 468; Barstow, 460; Frisco Tunnel, 60; and Intersection, 19 tons; and ore, So. Expl. & Mining Co., 347 tons; Silver Lake lessees, 282; Dives, 132; Gold Tunnel, 130; Allerton, 108; Aspen, 62; Sultana, 40; Celtic Leasing Co., 24; Contention, 23; Perino, 21; Dr. Fox, 20; Frank Hough, 15; and Bonner, 15 tons.

The Tomboy mill worked 29 days in July and treated 11,500 tons of ore, yielding $23,000 in bullion and $60,500 from 1400 tons of concentrate shipped. Working expenses were $48,000, and the estimated profit $35,500.

IDAHO

Shoshone County

It is stated that the Federal company is planning to enlarge its concentrating plant at Mullan, and that the slime will be properly treated. Net earnings of the Stewart Mining Co. in July were $70,000, and it is expected that regular quarterly dividends will result from the profits now being earned.

MICHIGAN

Houghton County

The strike is being continued in a half-hearted manner, and about 75% of the Calumet & Hecla employees have asked for work. Western Federation members are deserting the cause and tear up union cards, while business men and men returning to work will stand by one another. The miners' union at Butte, Montana, has sent a second installment of $7000 to Houghton to help support the strikers. 'Mother Jones,' said to be the greatest labor agitator in the United States, has suddenly left and gone to Washington, D. C., to enlist the support of certain senators.

The Calumet & Hecla Mining Co. reported its condition at April 30, 1913, as follows: Real estate, $48,146,329; merchandise, $5,190,789; cash and debts receivable, $3,788,526; and holdings in other companies, $15,025,438; a total of $72,151,082. Liabilities include capital stock, $12,000,000; accounts payable, $396,758; profit and loss, $66,420,324; and indebtedness, $4,134,000. Officials of the Company announced on August 9 that enough of the men who have been on a strike had agreed to return to work to enable the Company to resume its operations. The Company claims to have 3000 men ready to work. The Western Federation of Miners officials, who have been in charge of the strike, asserted that not enough men would return to bring about anything like normal conditions.

MISSOURI

St. Francois County

All the mines in the lead belt of this county were closed on August 15 on account of the strike of 5000 members of the Western Federation of Miners. The closing resulted from the failure of a conference between representatives of the companies and the union. The miners ask 30 cents per day increase and recognition of the union.

MONTANA

Fergus County

(Special Correspondence.)—The Barnes-King Development Co.'s earnings for July did not come up to expectations, and it now seems as if it will be November 1 before the earnings will be sufficient to pay off the indebtedness and receive a clear title to the North Moccasin property. A considerable amount of low-grade ore was treated, bringing the net bullion returns down to $7.33 per ton as

against $9.60 per ton in June. The gross earnings for July were $32,113, as against $35,387 in June—a decrease of $3276. The balance still due on the North Moccasin property is $41,844. Development work is making fine progress, and the improvements at the Barnes-King mill are so far advanced that there is no doubt they will be finished by the end of the present month.

Kendall, August 15.

LINCOLN COUNTY

(Special Correspondence.)—J. B. Arons, of Duluth, Minnesota, who is interested in the Montana group of silver-lead mining claims on Cherry creek, has been in town during the past week. A number of men have started work on development. S. F. Ralston, manager of the Kalispell-Lincoln Gold Mining Co., came in from the property recently with about 60 oz. of gold taken from the last clean-up. The Company's 5-stamp mill is being operated steadily at the property on West Fisher creek.

Libby, August 10.

SILVERBOW COUNTY

To enforce demands made for higher wages and Saturday half holidays, 200 electrical linemen of Butte and its vicinity declared a strike on August 12. Local telephone and power distributing companies say that on the strikers must rest all responsibility, since they gave the companies no chance to arbitrate or otherwise adjust the issue at stake. It is said that this strike will not affect the mines and plants working, unless a transmission line breaks down. A recent dispatch states that the men are returning to work.

The East Butte Copper Mining Co. makes the following statement for the quarter ended with June:

First-class ore mined, tons	22,664
Average copper content, per cent	6.4
Second-class ore mined, tons	6,485
Average copper content, per cent	2.96
Copper shipped, pounds	3,724,241
Silver shipped, ounces	140,980
Gold shipped, ounces	3,484

NEVADA

CLARK COUNTY

Fire destroyed the 40-stamp mill, engine-room, and the power-plant at the Quartette mine, near Searchlight, on August 20. The loss was $115,000, only a small part of which was covered by insurance. The assay offices, stables, and other buildings at the mine were saved by hard work on the part of the miners.

LYON COUNTY

At the Casting Copper division of the Nevada-Douglas property, the development on the 100 and 200-ft. levels is opening a large quantity of low-grade ore which will figure in the present plans for leaching. This ore, which is proving to be of large width, will average between 2 and 3% copper. Neither cross-cut as yet has reached the lime footwall. Work along the contact to the east on the 40-ft. level shows low-grade ore in the face. The back of the No. 1 stope is about 40 ft. above the level, with the ore remaining about 6 ft. wide. The June quarterly report of the Mason Valley Mines Co. states that the property produced 31,336 tons of ore, and smelted 59,494 tons yielding 3,587,693 lb. of copper. The net profit was $44,551. During the week ended August 13, the smelter treated 4020 tons of ore and shipped five cars of matte.

Foundations for the new converters at the Mason Valley smelter are almost completed, while iron flues to carry the converter fume to the main flue are being made at the smelter shops. A large motor-driven air-compressor is also being installed to provide air for the converters.

MINERAL COUNTY

The foundations for the 100-stamp mill at Aurora are nearly complete, while material is being shipped to the site as fast as the bad roads will allow teams to work. It is said that 20 stamps will be retained for customs ores.

NYE COUNTY

Eleven mines at Tonopah produced 12,310 tons of ore worth $283,790 during the past week. In July, the Belmont treated 13,558 tons yielding 339,903 oz. bullion, at a profit of $175,603. The Tonopah company treated 14,250 tons yielding 222,625 oz. and 106 tons of concentrate valued at $226,575, at a profit of $123,550. The West End treated 4045 tons at a profit of $8.54 per ton. At the Halifax, the ore has been proved to be 36 ft. wide between walls of trachyte, but in the centre of the vein is an intrusion of trachyte 9 ft. wide. Apart from this, the average value of the ore is of good grade. On the 1050-ft. level of the North Star, the east drift is in lower-grade ore than usual. The winze below the Midway 600-ft. level is opening 4 ft. of $50 to $80 ore. The west drift on the 1170-ft. level of the Merger has cut rich black sulphide ore. At Manhattan, the War Eagle mill is treating 115 tons of ore per day from the Riley Fraction lease, and has treated 7500 tons of low-grade ore so far.

OREGON

JOSEPHINE COUNTY

Numbers of mining men are arriving at Grants Pass in connection with mine examinations. Arthur H. Gruber and associates of Milwaukee will provide capital to equip the Old Glory mine, on Silver creek, with modern plant. James W. Neill, of Pasadena, California, has secured an option on dredging ground on Grove creek, near the Columbia mine, and prospecting is under way. About 1500 acres of dredging ground, situated on Pleasanton creek, 17 miles from Grants Pass, is being tested by J. K. Kendrick of California. The Bill Nye mine is being developed by French people.

UTAH

JUAB COUNTY

The Victoria mine is being sampled by the Eagle & Blue Bell officials. Surveyors are examining the Centennial Eureka in connection with the suit for alleged wrongful extraction of ore from the Emerald company's property. Promising development is under way on the 1100-ft. level of the Emerald mine. The Colorado is shipping 100 tons of 15 to 20% and 40 to 45 oz. silver ore per week.

SALT LAKE COUNTY

The Utah Copper Co. produced 9,849,043 lb. of copper in July.

SUMMIT COUNTY

Ore shipments from Park City during the past week were as follows: Silver King, 794 tons; Daly-Judge, 393; Daly West, 261; American Flag, 60; and King Consolidated, 27 tons. A large orebody is said to have been opened in the Silver King Coalition in a drift off the main Alliance adit.

WASHINGTON

FERRY COUNTY

Another chapter was added last week to the series of changes in the past few months involving the Republic Mines Corporation, owning and operating mines at Republic, when the properties passed into the control of J. L. Harper, former general manager for the Company, and his associates, under a two-year bond, for $600,000. The first payment of $100,000 is to be made January 1, 1914, the second, of $200,000, on August 15, 1914, and the remaining $300,000 is to be paid on or before August 15, 1915. The purchase contract stipulates, however, that payments may be made on a royalty basis of from 10 to 40% of the net smelting returns from shipments from the mines, depending upon the grade of the ore, but that the installments must be made as agreed, regardless of whether a sufficient amount is produced by the properties.

KITTITAS COUNTY

(Special Correspondence.)—The 10-stamp mill on the Cougar mine, at Liberty, is running steadily on a good grade of ore. H. D. Harkness is doing well with his placer claim, and last week one nugget netted him $257. J. Powles has bonded his placer claim in Louis gulch to Seattle people. The old placer dumps on Williams creek were leased to J. F. Powers and J. T. Sugars. These dumps consist of thousands of tons of unwashed gravel and contain about 20c. gold per yard. A 1000-ft. flume

is under construction, and the ground-sluicing method will be employed.

Jack Stuart has a crew of men working on his placer at the junction of Lions and Williams creeks. The 'pay' channel in Lions gulch has been reached within the past few days. Jake Livingston has been working profitably at his placer on Swank creek for several months. There is plenty of water for hydraulic purposes. Ben. Killson, owner of the Hope quartz mine, near Liberty, is now mining high-grade ore.

Liberty, August 15.

MASON COUNTY

(Special Correspondence.)—A manganese-copper property is being opened by a company on the Olympic peninsula. About 20 tons of 4% copper ore is mined daily and put on the stock pile.

Seattle, August 15.

CANADA

BRITISH COLUMBIA

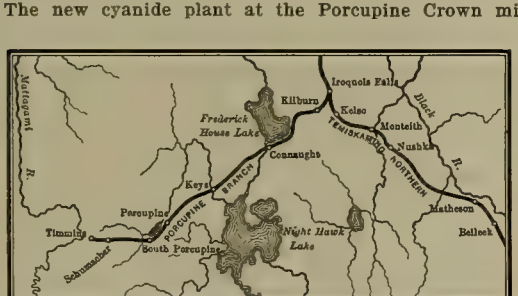
The Rossland payroll is now the largest in history, for in addition to the miners in the Consolidated company's employ there are 200 to 300 working in the many smaller mines under development in the vicinity. New mining machinery has been installed recently at the Center Star, Le Roi No. 2, War Eagle, and Josie, and the result is a heavily increased output and a material reduction in operating expenses. The four properties are shipping 25 cars of ore per day to the Trail smelter. There are now seven furnaces in blast and 600 men are employed.

Ladysmith, one of the coal towns on Vancouver island, where the miners have been on strike for several months, was in a riotous state on August 14, and the militia was called out to maintain order. Shipments of rich gold and silver ore from the Union group, at Gloster camp, 45 miles from Grand Forks, are now being sent out. During July, the Granby smelter treated 100,748 tons of ore, yielding 1,654,000 lb. of copper, and in the first seven months of the year a total of 727,348 tons, producing 12,665,697 lb. of blister copper. Steelite, the new explosive, is being used at the Argo mine. The British Columbia Copper Co. will shortly begin the erection of a concentrator at Boundary Falls to treat ore from the Lone Star mine. It is reported that the Granby company has bought the Big Copper mine, about five miles from Greenwood.

ONTARIO

Members of the International Geological Congress visited the old Wright mine near Lake Timiskaming. It is said to be the oldest silver property in North America, there being a stake near the mine bearing the date 1744.

The new cyanide plant at the Porcupine Crown mine



PORCUPINE AND DISTRICT.

is making good progress and should be complete in about forty-five days. The 10-stamp mill is extracting from 82 to 87% by amalgamation, treating 65 tons of $22 ore per day. At the mine the main vein has been found beyond the fault on the 200-ft. level by the diamond-drill.

The Hollinger company reports for the term ended July 15: The mill treated 10,056 tons of ore averaging $19.70 per ton, with an extraction of 96.5%. The month's profit was $129,147. Mining costs were $3.04 and treatment $1.65 per ton. Profits for the current year are $851,668, and the surplus after dividends, $573,469. Work upon the winze below the 300-ft. level of the Hollinger has been continued, and the winze has now reached a depth of 113 ft. The vein dipped out of the winze at 94 ft. The winze will be carried to a depth of 125 ft. before cutting the station, thus making the next level 425 ft. depth. The vein should be cut within 20 ft. of the winze on the 425-ft. level.

Shipments of silver from Cobalt totaled 139,117 oz., of which 129,164 was from the Nipissing and 4052 oz. from the Kerr Lake. The latter was sent out in one mass, owing to trouble in the melting-room. The bullion was cooled down in the crucible and shipped in that form.

In July the Alexo mine at Iroquois falls, shipped 794 tons of nickel ore to the Mond Nickel Co.'s works.

YUKON

Jacob Nielson, who was charged with dynamiting the Yukon Gold Co.'s No. 1 dredge on February 24, was found guilty at Dawson on July 31, after a ten days' trial, and sentenced to twenty years' imprisonment. Forty witnesses were called for the prosecution and sixteen for the defense, and there were 74 exhibits produced.

KOREA

A cable received in New York by the Oriental Consolidated Mining Co. advises that the clean-up for July was valued at $140,000. The following details supplementing the cable information already published regarding the June clean-up has been received by mail from Korea:

Tabowie mill	$ 28,026
Taracol mill	21,860
Kuk San Dong mill	3,113
Maibong mill	21,709
Candlestick mill	11,143
Taracol tube-mill	43,651
Kuk San Dong cyanide plant	3,896
Kuk San Dong dump plant	7,799
Candlestick cyanide plant	2,285
Total	$143,482

The total tonnage milled during June was 25,919 tons. The Candlestick mill ran during June on ore broken during that month and during May. This plant is shut down again, owing to the scarcity of labor in the mine. So far, it has been difficult to obtain sufficient miners to keep the mill running. All of the mills are being operated by steam power, owing to the lack of water for the hydro-electric power-plant.

MEXICO

AGUASCALIENTES

It is stated that ore valued at ₱3,000,000 is at present awaiting treatment at the American Smelting & Refining Co.'s plant at Aguascalientes. The smelter has been operating at reduced capacity for some time, owing to the difficulty in getting supplies for the furnaces.

WESTERN AUSTRALIA

(Special Correspondence.)—Developments in the Horse-Shoe mine continue to be satisfactory, and the winze on No. 4 lode to the 2780-ft. level has opened 16 ft. of $15.12 ore, while another winze has opened rich ore on the west branch lode. Owing to the departure of many Australian miners from Kalgoorlie and other districts, there is a shortage, and Italians have been employed at several mines. At the Golden Ridge mine, because the Australians refused to work underground with some Italians, the management has closed the property, and 150 men are out of work. At the Sons of Gwalia, the stamp-mill is being overhauled, amalgamating and Wilfley tables dispensed with, the pulp flowing to pans for reduction and amalgamating, and sand to tube-mills. A new vacuum-filter plant is to be erected to treat all of the current slime. There are also certain changes being made in handling miners, which will save 100 working hours per day, and horses will haul cars underground instead of men. The Westralia Mt. Morgans is being reopened, and suction-gas engines will replace the old steam plant. Sulphide ore having been opened in the Victorious mine, Ora Banda, experiments are being made for its proper treatment.

Kalgoorlie, June 16.

Schools and Societies

THE University of California has registered 4646 students for the fall term which commenced on August 18.

THE Michigan College of Mines at Houghton fall term opens on September 26. There are 35 on the staff of instruction. The courses given and descriptions of the various buildings of this excellent College have been given previously, so there is no need to cover the matter again. The Year Book of the institution is full of interesting matter.

OLD FREIBERGERS in America are to give a complimentary dinner on September 9, at Scranton, Pennsylvania, in honor of Dr. Richard Beck, president of the Freiberg Bergakademie, Freiberg, Saxony, Germany, who is now in Canada attending the International Geological Congress. After the meetings of the Congress, Dr. Beck expects to visit several places in the United States before his return to Germany.

THE monthly meeting of members of the Geological Society of South Africa was held at Johannesburg on June 30. The following papers were open for discussion: 'Note on the Origin of the Iridosmine in the Banket,' by R. B. Young; 'Structural Features of the Western Witwatersrand,' by E. T. Mellor; 'Notes on the Sea-Point Granite-Slate Contact,' by E. H. L. Schwarz; 'Note on Diamonds in the Banket,' by R. B. Young; and 'Notes on a Section from Barberton to the Komati River,' by David Draper (honorary member). The following papers were read: 'The Bushman's River Cretaceous Rocks,' by E. H. L. Schwarz, and 'The Geology of Katanga and Northern Rhodesia—an Outline of the Geology of South Central Africa,' by F. E. Studt.

THE Wallace, Idaho, chapter of the State Mining Association was organized on August 15 by Ravenal Macbeth, the secretary. He opened the meeting with an address in which was outlined the objects and purposes and benefits of the state organization. Herman J. Rossi, chairman of the grievance committee, and Harry L. Day, president of the State Mining Association, pointed out the instances in which the Association had already benefited the mining industry of the state. Earl Greenough, a member of the executive committee, acted as chairman and Rush J. White as secretary. The permanent officers elected were E. H. Moffitt, president; Joseph F. Whalen, secretary; and Jerome J. Day, treasurer. The Burke chapter of the Association was organized on August 16.

THE University of Washington, College of Mines, at Seattle, summer session closed on August 1, and the first semester of the 1913-14 year starts on September 12. There are 37 members on the teaching staff. Excellent opportunities for becoming familiar with mining and metallurgical operations are open to students in the College of Mines. The amount of time available during the college year for this purpose is not great, and even by using the summer vacations it is impossible for a student to cover the whole field of local industries included in his chosen profession. Mining machinery of the best type is in operation within easy reach of the University. Much of the heavy mining machinery used in the neighboring states and Alaska is built in the city of Seattle.

THE COLORADO SCHOOL OF MINES regular session opens on September 2, while in the meantime the Summer School is in session. The object of this school, which is open during July and August, is to enable conditioned students to regain full standing. It is also available for applicants for admission to advanced standing, who may complete their requirements in the Summer School in advance of the regular session. The working schedules of the School of Mines proper have been revised and simplified, although without any omissions of importance as to subjects. There are few faculty changes. Harry J. Wolf, who acted as professor of mining during much of last year, is appointed to that chair. No other department has any change to announce in its leading men. The applications for admisison indicate an increase over last fall. The graduation in May of 70 students illustrates the extent to which in recent years admission to advanced standing serves to augment the numbers in the upper classes.

Personal

Professional men are invited to send news of their engagements and travels. Such news is interesting to friends.

W. M. DAVIS is visiting Spokane.

R. CLYDE CAMERON is at Tonopah.

E. H. NUTTER has returned from New York.

THOMAS T. READ is visiting Toronto and Sudbury.

W. J. LORING left Australia for England early in July.

C. W. WRIGHT is visiting the United States and Canada.

W. F. LAMOREAUX has returned to Ducktown, Tennessee.

J. C. BRANNER arrived at Stanford University on August 13.

T. ANNEAR has been appointed superintendent of the mint at Denver.

JOHN T. ROBERTS, JR., of Buffalo, New York, is at Ouray, Colorado.

ROWLAND KING has left Greenwood, British Columbia, and is now at Spokane.

FRED V. BURNS has moved from Montezuma, Costa Rica, to Guanajuato, Mexico.

VERNE A. STOUT has returned to San Francisco from Pichucalco, Chiapas, Mexico.

W. W. MEIN and RALPH STOKES were at Hedley, British Columbia, during the past week.

JOHN DERN has returned to Salt Lake City after spending five months in Germany and Austria.

A. H. HEUSER, formerly of Charcas, San Luis Potosi, Mexico, has gone to Dona Ana, New Mexico.

WALDEMAR LINDGREN returned from Mexico in time to attend the International Geological Congress at Toronto.

C. K. LEITH and J. F. KEMP are in eastern Canada and northern New York examining the Grenville series of rocks.

GEORGE OTIS SMITH presided at the session of the International Geological Congress that was devoted to ore deposits.

BAILEY WILLIS, CHESTER WASHBOURNE, and J. R. PEMBERTON have returned from the Argentine and are busy preparing their reports at North Haven, Maine.

MORTON WEBBER has returned to New York after conducting examination work in New Mexico, and has left again for Canada, where he will be until about September 1.

W. R. CRANE, professor of mining in the Pennsylvania State College, has just returned from Alaska, where he spent the past year investigating the coal resources of that territory.

J. H. HOLMAN, a well known mining and machinery man of Cornwall, England, is reported to have been drowned in the wreck of the *State of California*, off the coast of Alaska, on August 18.

H. FOSTER BAIN will return tomorrow from Toronto and Butte, where he has been attending the meetings of the International Geological Congress and the American Institute of Mining Engineers.

F. DANVERS POWER, of Sydney, who was in charge of the Great Cobar during the absence of H. C. BELLINGER, is to take an extended tour, embracing Java, the Malay Peninsula, Japan, the United States, and London.

FRANCIS P. BRAY has just completed a visit of inspection to Mount Lyell, Broken Hill, and other mining centres in Australia, and is leaving for London by way of Manila, China, Japan, and across the Trans-Siberian railway.

CHARLES F. RAND and BRADLEY STOUGHTON will be in San Francisco on or about September 1, to confer with the San Francisco Chapter of the American Institute of Mining Engineers regarding the work to be undertaken by the local organization.

D. C. LIVINGSTON and C. A. STEWART have returned to Moscow from Dixie, Idaho, where they have been engaged in a geological survey of the district, the results of which will be published in bulletin form by the Mining Department of the University of Idaho.

The Metal Markets

LOCAL METAL PRICES
San Francisco, August 21.

Antimony	13—12½c	Quicksilver (flask)	$40
Electrolytic Copper	16—16½c	Tin	46—47½c
Pig Lead	5.00—5.05c	Spelter	7—7½c

Zinc dust, 1400 lb. casks, per 100 lb., small lots $9.50—9.75; large $7.50—8.50

EASTERN METAL MARKETS.
(By wire from New York.)

NEW YORK, August 21.—The copper market remained strong, but with little buying reported. Reports from the large porphyry properties show heavy stocks on hand and in transit. The continuance of the strike in the Lake Superior district has had no appreciable effect on the general market. The lead and spelter markets are strong and active. St. Francois county strike has had no effect on lead. Cable from London quotes spot copper at £69 2s. 6d. and futures £69 3s. 6d. Lead is steady at £20 7s. 6d. Spelter £20 12s. 6d.

Little improvement has been shown in the London mining market, and public interest is at an exceedingly low ebb. While the feeling is general, it is particularly true of Mexican stocks and investments. It is hardly to be expected that mining affairs will take a turn for the better until some order is brought out of the present chaos in that country.

SILVER

Below are given the average New York quotations, in cents per ounce, of fine silver.

Date.		Average week ending	
Aug.	14	July 9	58.29
"	15	" 16	58.43
"	16	" 23	58.79
"	17 Sunday	" 30	59.28
"	18	Aug. 7	59.29
"	19	" 14	59.12
"	20	" 20	59.16

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	56.25	63.01	July	60.67	58.70
Feb.	59.06	61.25	Aug.	61.32	....
Mch.	58.37	57.87	Sept.	62.95	....
Apr.	59.20	59.26	Oct.	63.16	....
May	60.88	60.21	Nov.	62.73	....
June	61.29	59.03	Dec.	63.38	....

Business has been very limited this week, and, as only small orders have been received from China and India, most of the support has come from some special buying, but the daily offerings have again been small. It would appear, however, that the Mexican Government has discontinued the coinage of dollars, shipments of silver from that quarter to London having recommenced. Only a small amount goes to India this week, and London stocks are not far short of £4,000,000, according to Pixley and Abell's (London) circular of August 7.

ZINC

Zinc is quoted as spelter, standard Western brands, St. Louis delivery, in cents per pound.

Date.		Average week ending	
Aug.	14	July 9	5.10
"	15	" 16	5.08
"	16	" 23	5.10
"	17 Sunday	" 30	5.20
"	18	Aug. 6	5.40
"	19	" 13	5.45
"	20	" 20	5.51

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	6.42	6.88	July	7.12	5.11
Feb.	6.50	6.13	Aug.	6.96	....
Mch.	6.57	5.94	Sept.	7.45	....
Apr.	6.63	5.52	Oct.	7.36	....
May	6.68	5.23	Nov.	7.23	....
June	6.88	5.00	Dec.	7.09	....

Figures compiled by C. E. Siebenthal, of the U. S. Geological Survey, from reports by all zinc smelters operating during the first six months of 1913, and from the records of the Bureau of Foreign and Domestic Commerce, show that the production of spelter from domestic ore in that period was 171,135 short tons, and from foreign ore 9078 short tons, a total production of 180,213 tons of primary spelter, compared with 166,496 tons for the first half of 1912 and with 172,310 tons for the last half of 1912. This production for the first half of 1913 is at the rate of over 360,000 tons per year and approximately 20,000 tons greater than the production in 1912. The spelter made in Illinois increased over 9000 tons and that made in Kansas declined 6000 tons, compared with the quantities of spelter made in those states during the last six months of 1912. The apparent consumption for the period was 153,073 tons, as compared with 181,326 tons for the last half of 1912, and 159,046 tons for the first half of 1912. The stock of spelter held at smelters on June 30, 1913, was 21,856 tons, as against 4522 tons at the beginning of the year, an increase of 17,334 tons.

The imports of zinc ore were 19,994 short tons, containing 9304 tons of zinc, as compared with 16,891 tons of ore containing 6339 tons of zinc in the last half of 1912, and 27,049 tons of ore containing 12,228 tons of zinc in the first half of 1912. The exports of domestic zinc ore were 9745 tons, as compared with 9640 tons in the last half of 1912 and 13,709 tons the first half of 1912.

At St. Louis spelter started the year at 7.25c., the maximum price for the first half of the year. For the greater part of January the price held this level, but there followed a long steady decline, broken by a slight recovery during the first half of March, which decline left spelter bringing a shade under 5c. per pound at the middle of June. A slight recovery through the latter half of June brought the price up to 5.15c. at the close of the period. The London price of spelter, on the contrary, was fairly steady through the first four months of the year.

COPPER

Quotations on copper as published in this column represent average wholesale transactions on the New York market and refer to electrolytic copper. Lake copper commands normally from 1-5 to 1-4c. per lb. more. Prices are in cents per pound.

Date.		Average week ending	
Aug.	14	July 9	14.25
"	15	" 16	13.81
"	16	" 23	13.97
"	17 Sunday	" 30	14.58
"	18	Aug. 6	14.92
"	19	" 13	15.53
"	20	Aug. 20	15.59

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	14.09	16.54	July	17.19	14.21
Feb.	14.08	14.93	Aug.	17.49	....
Mch.	14.68	14.72	Sept.	17.56	....
Apr.	15.74	15.22	Oct.	17.32	....
May	16.03	15.42	Nov.	17.31	....
June	17.23	14.71	Dec.	17.37	....

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.		Average week ending	
Aug.	14	July 9	4.33
"	15	" 16	4.33
"	16	" 23	4.34
"	17 Sunday	" 30	4.40
"	18	Aug. 6	4.50
"	19	" 13	4.48
"	20	" 20	4.68

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	4.43	4.28	July	4.71	4.35
Feb.	4.03	4.33	Aug.	4.54	....
Mch.	4.07	4.32	Sept.	5.00	....
Apr.	4.20	4.36	Oct.	5.08	....
May	4.20	4.34	Nov.	4.91	....
June	4.40	4.33	Dec.	4.20	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California, being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending			
July	24	Aug. 7	41
"	31	" 14	41
		" 21	40

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	43.75	39.37	July	43.00	41.00
Feb.	46.00	41.00	Aug.	42.50	....
Mch.	46.00	40.20	Sept.	42.12	....
Apr.	42.25	41.00	Oct.	41.50	....
May	41.75	40.25	Nov.	41.50	....
June	41.30	41.00	Dec.	39.75	....

TIN

New York prices control in the American market for tin, since the metal is almost entirely imported. San Francisco quotations average about 5c. per lb. higher. Below are given average monthly New York quotations, in cents per pound:

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	42.53	50.45	July	44.25	40.70
Feb.	42.96	49.07	Aug.	45.80	....
Mch.	42.58	46.95	Sept.	48.64	....
Apr.	43.92	49.00	Oct.	50.01	....
May	46.05	49.10	Nov.	49.92	....
June	45.76	45.10	Dec.	49.80	....

The Stock Markets

SAN FRANCISCO STOCKS AND BONDS

(San Francisco Stock and Bond Exchange.)

BONDS

Listed.	August 20. Bid	Ask	Unlisted.	August 20. Bid	Ask
Associated Oil 6s	$ 99⅛	101	Natomas Dev. 6s	$ —	100
E. I. du Pont 4½s	83½	—	Pac. Port. Cement 6s	99	—
Natomas Con. 6s	77½	—	Riverside Cement 6s	77	79
Unlisted.			Standard Cement 6s	91½	—
Ass. Oil 1st ref.	77½	—	Santa Cruz Cement 6s	79	—
General Petroleum 6s	56	58½	So. Cal. Cement	—	85

STOCKS

Listed.	August 20. Bid	Ask	Unlisted.	August 20. Bid	Ask
Associated Oil	39⅜	40¼	Mascot Copper	1⅞	2¼
Amalgamated Oil	84	—	Noble Electric Steel	—	3
E. I. du Pont com	—	135	Natomas Consol	5	—
Pac. Coast Borax, pfd.	—	—	Pacific Port. Cement	61	—
do com	—	100	Riverside Cement	45	—
Pacific Crude Oil	20c	35c	Standard Cement	—	17½
Sterling O. & D.	70c	95c	Santa Cruz Cement	28	37½

NEVADA STOCKS

(By courtesy of San Francisco Stock Exchange.)

San Francisco, August 21.

Atlanta	$ .15	Mizpah Extension	$ .43
Belcher	.23	Montana-Tonopah	1.12
Belmont	6.95	Nevada Hills	.90
Big Four	.31	North Star	.82
Cash Boy	.08	Ophir	.25
Florence	.24	Pittsburg Silver Peak	.46
Goldfield Con.	1.70	Round Mountain	.48
Goldfield Oro	.09	Sierra Nevada	.08
Halifax	1.35	Tonopah Extension	2.15
Jim Butler	.61	Tonopah Merger	.70
Jumbo Extension	.13	Tonopah of Nevada	4.55
MacNamara	.12	Union	.13
Mexican	1.17	West End	1.32
Midway	.47	Yellow Jacket	.15

COPPER SHARES—BOSTON

(By courtesy of J. C. Wilson, Mills Building.)

	August 21. Bid	Ask		August 21. Bid	Ask
Adventure	$ 2⅛	2¼	Mohawk	$ 43	44
Allouez	35½	36	North Butte	25½	25½
Calumet & Arizona	62⅛	62½	Old Dominion	49	50
Calumet & Hecla	425	435	Osceola	[illegible]	[illegible]
Centennial	13	14	Quincy	59	59½
Copper Range	39½	39⅝	Shannon	6½	6⅝
East Butte	11⅞	12	Superior & Boston	2⅛	2⅜
Franklin	4½	5	Tamarack	28½	30
Granby	62	63	U. S. Smelting	37½	37½
Greene Cananea	6⅞	7	Utah Con.	9	9⅛
Hancock	17½	18½	Victoria	1	1¼
Isle-Royale	19⅜	19⅞	Winona	1⅛	1⅜
Mass Copper	2⅜	3⅛	Wolverine	44½	45½

NEW YORK QUOTATIONS

(By courtesy of E. F. Hutton & Co., Kohl Building.)

August 21.

	Bid.	Ask.		Bid.	Ask.
Alaska G. M.	18⅛	19	McKinley-Dar.	1¾	1⅞
Braden Copper	6¾	6⅞	Mines Co. Am.	2¼	2½
B. C. Copper	2⅜	2⅝	Nipissing	8¾	8⅞
Davis-Daly	1⅞	2⅛	Ohio Copper	¼	⅜
Dolores	2	4	San Toy	19	22
El Rayo	[illegible]	2	Sioux Con.	1	2
Ely Con.	7	8	So. Utah	⅛	¼
First Nat.	2½	3¼	S. O. Calif.	187	189
Giroux	1	1⅜	Tri Bullion	⅛	¼
Greene Can.	6¾	7	Tuolumne	1¾	1¾
Hollinger	14	15	United Copper	¼	¾
Kerr Lake	3¼	3⅞	Wettlaufer	10	12
La Rose	2⅛	2⅜	Yukon Gold	2	2⅛
Mason Valley	6	7			

LONDON QUOTATIONS

(By cable, through the courtesy of Catlin & Powell Co., New York.)

	August 21. £	s.	d.		August 21. £	s.	d.
Alaska Mexican	1	15	0	Kern River Oilfields	0	6	3
Alaska Treadwell	8	7	6	Mexico Mines	5	5	0
Alaska United	3	17	6	Messina	1	17	6
Arizona	2	0	0	Oroville	0	5	0
California Amalg.	0	2	6	Pacific Oilfields	0	2	6
California Oilfields	4	12	6	Rio Tinto	77	0	0
Camp Bird	0	18	9	Santa Gertrudis	1	1	3
El Oro	0	15	0	Stratton's	0	2	6
Esperanza	1	2	6	Tanganyika	2	8	9
Granville	0	10	0	Tomboy	1	6	3

AUSTRALIAN

	August 21. £	s.	d.		August 21. £	s.	d.
British Broken Hill	1	18	9	Mount Boppy	0	16	9
Broken Hill Prop.	1	18	9	Mount Elliott	5	11	3
Golden Horse-Shoe	2	17	6	Mount Lyell	1	6	3
Great Boulder Prop.	0	12	6	Mount Morgan	3	11	3
Ivanhoe	3	0	0	Waihi	2	6	3
Kalgurli	1	18	9	Waihi Grand Junc.	1	1	3

BORAX PRODUCTION IN 1912

There was a decrease in the production of borate ores in the United States last year, according to Charles G. Yale and Hoyt S. Gale, of the United States Geological Survey. The output of borate ores in 1912 was 42,315 short tons, valued at $1,127,813, as compared with 53,330 tons in 1911, valued at $1,569,151. The quantity stated is that of the crude ore as mined for delivery at the mill or for shipment.

All the borax now produced in this country is derived from ores mined in California; in fact, virtually the entire product is derived from four mines, one in Inyo county, one in Los Angeles county, and two in Ventura county. Formerly borax was obtained from the so-called marsh or dry-lake deposits, which were worked in Nevada, California, and Oregon. The borax and boric acid now produced is derived wholly from deposits of borate of lime, in which colemanite is the entire source of supply.

There is a general impression that colemanite has been found in so many places and in quantities so large in relation to the small demand for borax and boric acid in the present market that there need be no fear of the exhaustion of the deposits. In fact, in nearly all deposits mining has proceeded with great rapidity and possibly in a more or less wasteful way. Mining entries are generally driven ahead somewhat at random, the pockets of ore being 'gutted' and shipped before attention is directed to the blocking out of ore in reserve. If this practice is continued, even the large deposits of colemanite now known will not last indefinitely, and the exhaustion of one after another of the workable deposits is expected. Since the discovery of colemanite in 1882, at least one large district has been worked out and abandoned.

Even should the richer deposits ultimately become exhausted, there are a great many other possible sources of supply, including the marsh deposits formerly worked, to which recourse could again be had. More important than this, a new factor is entering the field of the borax industry with very recent developments. The natural saline deposits of the western desert region have come into prominence as a possible source of potash, carbonate of soda, common salt, and other products, including borax.

SAN FRANCISCO MINT

The total receipts for July were 268,711 oz. of fine gold, valued at $5,554,751.44. Including gold credited to domestic refineries, it is estimated that about $1,500,000 of the total is new gold of California origin.

	Fine ounces.	
Alaska:		
Cape Nome	2.310	
Douglas island	9,967.905	
Balance	976.786	
		10,947.001
Arizona		9,110.424
California		19,970.499
Idaho		23.846
Nevada		3,537.880
Oregon		309.226
Philippine Islands		3,347.840
Washington		1.844
Refineries, Government offices, etc.		218,499.081
Mutilated United States coin		40.161
Foreign gold		125.913
Jewelry		892.364
Central America		23.202
Mexico		1,839.234
South America		42.580
Total		268,711.101

Value of gold, $5,554,751.44.

Company Reports

TALISMAN CONSOLIDATED, LTD.

This Company was formed in 1899 to acquire gold mining property at Karangahake, in the province of Auckland, New Zealand. Since then the adjoining properties of the Woodstock Gold Mining Co., the New Zealand Talisman Gold Mining Co., and the Imperial Gold Mining Co. have been purchased. The report covers the year ended February 28, 1913, and that of the superintendent, H. Stansfield, includes the following:

Development covered 2547 ft. On No. 13 level, which is about 1900 ft. below the top of the mountain, and 200 ft. below the Waitawheta river, at 1754 ft. in the main south drift a cross-cut was driven westward 15 ft., which intersected 3 ft. of ore that averaged $35.16 per ton. In driving southward, ore was exposed averaging $38.94 per ton for a width of 3 ft. 6 in. and for a length of 53 ft. At 1780 ft. south a raise, No. 17, was driven 15 ft. in ore that averaged $46.62 for a width of 2 ft. 8 in. In a winze, No. 17, driven from the same point, the ore averaged for the first 58 ft. $21.14 per ton for a width of 3 ft. 3 in., and

TALISMAN MILL AND VIEW OF KARANGAHAKE, NEW ZEALAND.

from 58 ft. to 84 ft. averaged $1.44 per ton for a width of 2 ft. 6 in. Further work has been discontinued until the No. 14 level south drift reaches this point.

On No. 14 level the south drift has been extended 220 ft., making a total of 1086 ft., sampling as follows: from 866 to 914 ft. the vein averaged 2 ft. 6 in. wide with low metal content; from 914 to 931 ft. it was 4 ft. 6 in., worth $19.64; from 931 to 1024 ft. it averaged 4 ft. wide of low grade; from 1024 to 1059 ft. the average was $15.88 per ton over a width of 4 ft. 6 in.; and from 1059 to 1086 ft. it was 4 ft. wide and again in low-grade material.

The Talisman and Woodstock shafts were sunk a farther 54 and 186 ft. below the river level, respectively, to 562 and 454 ft. depth. The estimated ore reserves are 47,653 tons averaging $29.48 per ton, exclusive of ore below No. 14 level.

The year's results were as follows:

Ore treated, tons	42,980
Bullion recovered, ounces	291,453
Value	$1,162,000
Total revenue	1,200,000
Mining, treatment, construction, etc.	460,000
Balance after all expenditure	690,000
Dividends	624,000
Total dividends	3,783,000
Balance brought forward from 1912	105,000
Depreciation and taxes	100,000
Investments at cost price	230,000

Water in the main shafts and labor troubles hampered operations. The report is accompanied by the examination of Bewick, Moreing & Co., and excellent plans. The accompanying half-tone will give an idea of the country where the property is situated.

CHIEF CONSOLIDATED MINING CO.

The half-yearly report of this Company, operating at Tintic, Utah, contains the following:

Development, feet	4,064
Ore shipments, tons	30,854
Metal content:	
Gold, ounces	2,489
Silver, ounces	632,897
Lead, pounds	245,171
Net return	$206,569
Balance on hand	303,023
Other receipts	9,744
Total	$519,336
Operating costs	122,776
Sundry expenses	27,452
Dividend No. 1	87,645
Balance on hand	281,462

The superintendent, Cecil Fitch, states that plans for the rapid opening of the mine were continued and all the work possible in this line and for mining the ore was done to the limit of the shaft capacity. It is hoped that an opportunity will be found to stop the work long enough, in the next six months, to permit of the completion of the widening of the upper part of the shaft. So far, it has been impossible to do this. When this work can be carried out it will permit of working a second cage and thus nearly doubling the shaft's capacity, and allow of a larger production of ore and also of increasing the amount of development, of which there is a large amount to do.

The cross-cut to the Gemini mine was completed and much benefit is being derived from the better air in the workings, besides furnishing a necessary second outlet through that mine, and also this drift supplies an opening for the carrying on of work in ground promising for ore heretofore not available. The length of the cross-cut is 2135 ft. There has been a large increase of the ore in sight, there will be no difficulty in maintaining the present product, and it is hoped that in the remaining six months of the year the metal content will improve.

SHANNON COPPER COMPANY

The report of this Company for the second quarter of the current year gives the following information:

Ore mined, Shannon group, tons	69,051
Ore mined, other properties, tons	13,367
Copper produced, pounds	3,243,181
Gold, ounces	423
Silver, ounces	21,925
Average price received for copper, cents per pound	15.107
Total cost, cents per pound	14.434
Net profits	$28,720
Cash, copper, and accounts receivable	187,042
Accounts payable	100,256

This shows a decrease in copper production of 406,383 lb. and $47,127 in profit as compared with the March quarter. This is due to lower-grade ore being mined, fluctuations in copper content being frequent at the Shannon. The Shannon-Arizona railway earnings continue to be satisfactory, the net profit, interest deducted, being $6883, against $5956 for the preceding quarter.

CHINO COPPER COMPANY

This Company has issued its quarterly report containing the following: There was removed by steam-shovels a total of 923,708 cu. yd. of material measured in place, an average of 307,903 cu. yd. per month. Of the total amount so removed, 701,865 cu. yd. was stripping, the remainder of the yardage being ore equivalent to 460,751 tons. During the period, additional steam-shovels and locomotives were received, bringing the total equipment at the mine up to 10 shovels and 19 locomotives, thus providing ample equipment to permit of an ordinary percentage of it being out of commission for repairs without interfering with regular and uniform operations. Some scarcity of water supply prevailed during the quarter, owing in part to an unusually dry season. These conditions did not result in any actual

decrease in production, as the mill was able to receive all the tonnage the mines could economically furnish. Steps are now being taken to improve the additional water supply purchased some months ago as a safeguard against excessively dry seasons and to provide for increased tonnages.

Somewhat less than 60% of the quarter's tonnage was produced from the Hearst area, and was of a fair concentrating quality, although containing a considerably higher percentage of iron sulphides than the average of this orebody, and therefore producing a correspondingly lower grade of concentrate. The remainder of the ore came from various portions of the property. A considerable portion of it was partly oxidized ores which had been deposited on stock piles in the earlier periods of the property's operation, and before the mill was completed. The admixture of so large a percentage of the character of ore just described resulted in lower average recoveries than for the previous quarter.

The average copper content was 1.88%, and extraction 64.48 per cent.

Ore treated, tons	492,852
Copper production, pounds	11,990,832
Net profits	$716,757
Dividends paid	$629,790
Copper on hand and in transit, pounds	14,519,877
Cost per pound of copper, cents	8.71

RAY CONSOLIDATED COPPER COMPANY

The following statement shows the results obtained by the Company's operations for the second quarter of the calendar and fiscal year 1913.

The gross production of the copper contained in concentrate was 13,402,394 lb. In addition to the copper contained in concentrate, there was produced 84,294 lb. of copper from ores shipped direct to the smelter without concentration. This added to concentrate contents brings the total production for the quarter to 13,486,688 lb. The total amount of ore milled was 587,877, as compared with 537,205 tons in the first quarter. The average mill recovery was 66.915%, as compared with 66.205% in the previous quarter. The total production of concentrate was 35,937.652 dry tons, containing an average of 18.647% copper. The ratio of concentration was 16.358 tons of ore into 1 ton of concentrate, as compared with 15.86 tons in the previous quarter. Milling cost 45.25c. per ton. Development covered 22,870 feet.

The orebody tributary to No. 1 shaft produced 62.4% of the tonnage; that at No. 2 shaft 35%; and that at No. 3 shaft 2.6%. The active stopes produced 39% of the tonnage; the reserve drawings 51%; and the development work 10%. This indicates a decrease of 4% in the development tonnage, and a corresponding increase in the stoping tonnage over results obtained in the previous quarter. The average grade of the ore was 1.7035% copper, as compared with 1.739% in the previous quarter. Development work from No. 2 shaft is continuing satisfactorily, and during the last half of the present year, stoping operations will have been carried along sufficiently to permit an increase of the percentage of ore obtained from the reserve drawing. This will result not only in an increase of tonnage, but a decrease in costs. The production of the relatively high-grade ore from No. 3 shaft averaged 165 tons per day of a grade containing 4½% copper. This tonnage will increase somewhat more rapidly in the immediate future, as workings have been extended from the shafts so as to permit of commencing stoping operations on two levels. Mining cost 73.92c. per ton.

The average cost per pound of net copper produced, after allowing for smelter deductions and after crediting income from the Ray & Gila Valley railroad against operating costs, but without so applying other miscellaneous income, was 9.558c., as compared with 9.5096c. in the previous quarter. The average cost per pound so derived during the two quarters is 9.5348c. This cost includes all operating and general charges, as well as a charge of 12½c. per ton of ore treated, or approximately 0.56c. per pound on the quarter's production for the extinguishment of the mine development expense. The profits were $726,759.

The payment of dividends was commenced during the quarter at a rate of $1.50 per share per annum, the first quarterly dividend at that rate being distributed on June 30, and amounted to $543,662.

Total amount of copper on hand and in transit (sold and unsold) was 16,833,979 lb., inventoried at an average value of 14.148c. per pound. The average inventory price of the unsold portion of this copper was 13.83c. per pound. At the end of the quarter, no copper due for delivery from the refineries remained unsold.

ISLE ROYALE COPPER COMPANY

This Company, operating in Michigan, reports the following for the first half of the current years:

'Rock' stamped, tons	250,123
Copper produced, pounds	3,326,655
Mining cost, cents per pound	13.46
Construction, etc	0.68
Smelting, etc.	1.47
Total, cents per pound	15.61
Dividend declared	$150,000
Cash at Boston, copper and silver unsold	434,566
Cash, supplies at mine	110,055
Accounts payable	192,869

The showing in stopes and opening on the Isle Royale lode has not been up to the average of last year. The amount of openings has been at the rate of more than 25% greater than that of last year. The development work on the West or Grand Portage lode has given satisfactory results. About 66% of the drills now in use in the mine are of the Leyner-Ingersoll one-man type.

UTAH COPPER COMPANY

The following statement shows the results of operations of this Company for the second quarter of the calendar and fiscal year 1913.

The gross production of total copper contained in concentrate was 31,785,448 lb., against 23,884,467 lb. in the March quarter.

The financial results of the operations for the quarter, as compared with the first quarter of the year, are shown in the following table:

	Second quarter.	First quarter.
Net profits from milling operations	$1,832,071	$1,110,346
Other income, rents, etc., in Utah	11,495	49,829
Nevada Con. Copper Co. dividend	375,187	375,187
Total net profit for the quarter	$2,218,753	$1,535,363
Dividends paid	1,186,627	1,186,627
Net surplus for the quarter	$1,032,126	$348,735

The earnings for the quarter are computed on the basis of 15c. per pound for copper. The total amount of copper on hand and in transit (sold and unsold) at the end of the quarter was 33,620,594 lb., inventoried at an average value of 13.778c. per pound. At the close of the quarter no copper due for delivery from the refinery remained unsold.

During the quarter there was removed a total of 1,225,343 cu. yd. of capping, as compared with 822,246 cu. yd. removed during the first quarter of 1913, being an increase of 403,097 cu. yd. It is expected that the third quarter will show a further improvement.

The operations of the Bingham & Garfield railway were satisfactory. An average of 14,855 tons of ore per day was transported from the mines to the mills, as compared with 10,602 tons per day for the previous quarter. An average of 1928 tons per day of other freight was transported over the line, as compared with 623 tons per day, and passenger train receipts also showed a substantial increase.

There was treated at both plants a total of 1,910,214 tons of ore, as compared with 1,460,707 tons. Of this tonnage, the Magna plant handled about 55% and the Arthur plant about 45%. The average grade of ore was 1.2807% copper, as compared with 1.2495% copper.

Both plants were in continuous operation throughout the term, and treated a larger tonnage than during any previous quarter, averaging practically 21,000 tons per day.

Concentrates

Most of these are in reply to questions received by mail. Our readers are invited to ask questions and give information dealing with the practice of mining, milling, and smelting.

NITROGEN in the guano by the Compania Administradora del Guano, Limitada, on South Chincha island, South America, averaged 9.18% during the fiscal year 1912-13. The production was 24,350 tons.

CONVEYOR BELTS are being installed in the open-cut of the Mt. Morgan mine, Queensland, to carry waste to the passes leading into the mine; also underground to convey waste where at present hand tramming is employed.

A THICK PASTE of flake graphite and oil will prevent spark-plugs from sticking. The graphite will prevent adhesion of the metals and stop leakage as well. This mixture is also useful on bolts which are subjected to considerable heat.

ORE BROKEN per miner and shoveler per shift in the Mt. Morgan mine, in 1912, was 2.72 tons, and ore broken delivered per underground employee per shift was 1.32 tons. The contract miners earned $4.16, and contract shovelers $3.10 per shift, and the cost of breaking ore from face to chutes, including explosives, was $1.22 per ton.

EXPLOSIVES in the flues of the Tooele and Midvale smelters, in Utah, caused quite a lot of damage and are extraordinary. At these plants the Dwight-Lloyd sintering process is used for agglomerating ores. The trouble is caused by the presence of finely divided sulphur in the gases from these roasting machines, and at a favorable moment an explosion occurs.

SANITATION is the practical application of knowledge and science to the preservation of health, and health is man's credit at the Bank of Life. The successful operation of mines largely depends on the health of employees, which is only maintained by adequate ventilation, lessened risk from various accidents, and comfortable change houses. A contented man will show high efficiency in mines and mills if his surroundings are decent.

UNDER an act passed by the state legislature in 1895, citizens of Nevada may send ores and minerals to the State University, at Reno, and have them analyzed and assayed without cost. These samples must be taken from within the boundaries of the state of Nevada. While results are given to those interested, a record, open for inspection, is kept of such results, together with the history and district from where the samples came.

COSTS at the Associated mine, Kalgoolie, during its past fiscal year were as follows: development, 75c., equal to $14.96 per ft.; mining, $1.78; treatment, $2.56; bullion account, 3c.; general, 18c.; and insurance, 5c. per ton. The power cost was $1.06 per ton. Mill extraction averaged 93%. The mine is opened to 2200 ft., and the mill consists of a Gates crusher, 4 Krupp ball-mills, 4 Edwards roasting furnaces, 20 grinding pans, 6 A. Z. agitators, 8 Dehne filter-presses and pumps.

IT HAS BEEN ANNOUNCED by the Decimal Association that the Standards Department of the Board of Trade has decided to adopt 200 mg. as the standard of the British carat, for weighing jewelry, precious stones, pearls, etc., and it is believed that an order to that effect will be issued probably before the end of the year. The metric carat of 200 mg. is 0.00643 and the present British carat in use 0.00660 ounce troy. Though the British carat hitherto in force, of which 151½ equal a troy ounce, is at present, so far as the precious metals are concerned, only applicable to retail business such as that of jewelers, this step toward unification with the almost universal metric system is interesting. Last year a committee was formed to promulgate the passage of a law making the metric carat effective throughout the United States of America.

THE greatest long-distance power transmission in southern Asia is in the native state of Mysore, power being transmitted from the Cauvery falls to the Kolar goldfields, 92 miles away, and to the cities of Mysore and Bangalore, about 40 and 86 miles away, respectively, for electric lighting and power purposes. Nearly all of the hydro-electric installation for this great enterprise was made in Schenectady, New York, and the only imports connected with this work not from the United States were water-wheels imported from Switzerland. An important extension for this great enterprise has recently been started, and the contract for all machinery except water-wheels has gone to the United States. Power is sold to the mining companies at $48 per horse-power year.

CONTRARY to the usual practice, no regularity in depth of holes was possible at the Mt. Royal tunnel, Canada, due to the character of the rock. A long round of six or seven feet, at times alternated with a short round of four or five feet, and great credit is due to the men for the judgment used in the number and depth of holes required for each round. Usually six rounds were drilled and shot each 24 hours. Forcite dynamite of 60% strength was used and exploded by No. 8 electric exploders, comparing in strength to Canal Specials, and the round was fired from the wires used for lighting the heading, at a switch generally kept at about 700 ft. from the face, and on the opposite side of the heading from the lighting system. The amount of dynamite used in each round varied, and it was found necessary to blast the cut twice before it broke to the bottom. Occasionally the relief holes were shot with the second shot in the cut, but quite often the old holes left in the cut were loaded the third time and shot with the relief holes.

FIRST-AID work is studied by many miners and millmen at Kalgoorlie, there being regular lectures given by local doctors, and examinations are held for proficiency. The mines are all equipped with up-to-date ambulances and hospitals, and victims of accidents receive prompt attention. On Labor Day, June 18, competitions in first-aid were held, the following giving an idea of the work done. The test given was a severe and comprehensive one, occupying 1¼ hours, and was divided into the following parts: (1) treatment of compound fracture of right leg and fractured lower jaw; (2) treatment of broken right fore-arm, arterial hemorrhage, dislocated left ankle; (3) treatment of severe burns on right leg and left foot and left side of face and head; (4) carry man forward by two-handed seat, then apply artificial respiration (Schaefer method), return by three-handed seat and treat for shock; (5) fireman's lift forward, place on stretcher, and carry over obstacle. A keen contest ended in favor of the Great Boulder mine No. 2 team, which won the Miners' Union's valuable trophy; with Penman's Boulder team a good second, and the Great Boulder mine No. 1 team only a point behind.

A DRILL CARRIAGE for mounting heavy drills was used in driving the Mt. Royal tunnel in Canada. The one designed by S. P. Brown had an arm carrying the cross-bar and drills, which may be advanced about 20 ft. ahead of the frame; also a belt-conveyor supported on a movable frame, which may be advanced eight or ten feet ahead of the frame proper, so that the end of the conveyor belt may be kept close to the rock pile. After each shot is fired the shovelers go ahead of the machine and throw the rock off the track, which is riveted to a steel plate until the machine gets close enough to the heading to place the bar carrying the drills, the heading being drilled from one position of the bar. From December 1, 1912, until May 1, 1913, a period of 5 months, the average monthly advance was 344.2 ft., the advance for the month of April being 351.4 ft. (without carriage). During May the 10 by 12½-ft. heading was advanced 510 ft. in 27 working days; in itself no mean record. This was done in extremely hard rock, and the waste was all removed as soon as, if not before, the drilling was finished. There has been no delay due to this machine since its installation, which is a remarkable performance for a new machine for tunnel work.

The Leadville Drill Column Hoist

The utility of such a hoist is now so generally recognized by mining operators that it is hardly necessary to describe the applications and advantages of this compact and ingenuous piece of machinery. The manufacturer's aim has been to develop a simple and powerful compressed-air hoist to be mounted on a drill column for winze and stope work.

The absence of rods, levers, exposed gears, etc., as compared to other similar devices, is to be noted. The weight is easily balanced. There are no overhanging parts to be damaged in handling. The gears, where necessary, are provided with gear guards. The motor is entirely enclosed and reversible. The frame, for strength and lightness, is a rolled steel channel section. The hoist is mounted centrally on this to avoid any overhang or unbalanced condition in handling or operation. Securely riveted to the frame is a 4½-in. standard air drill clamp. When so desired this can be furnished with interchangeable bushings for 3½-in. columns.

The motor is a reversible, 2-hp., square-piston, air-engine, which has been in use for the past fifteen years, and has proved rugged and dependable. The enclosed construction, the absence of connecting rods, and exposed moving parts make this motor an ideal one for the purpose. The drum is mounted directly on the engine shaft. The hubs are bronze bushed. Convenient spring covered oil openings are provided. The drum can be instantly released for lowering by sliding the driving pinion out of mesh, although in many cases operators prefer to lower by reversing the motor. The main gear is cut phosphor bronze, bolted to the drum and shielded from the operator by the projecting brake rim. Both pinions are steel forgings, machine cut. The end of the drum shaft is carried in a phosphor bronze casting, forming at the same time a gear guard for the intermediate gear and pinion. The fly-wheel carries the sliding pinion for releasing the drum. A spring ball catch holds it in either position. The brake band is lined with genuine Gandy belt. A forged lever with quadrant teeth is conveniently placed for the operator. The brake band is provided with adjustment for wear. The hoist is manufactured by the Hendrie & Bolthoff Mfg. & Supply Co., of Denver, Colorado.

Portable Electric Lamp

The United States Bureau of Mines has recently issued Technical Paper 47, by H. H. Clark, entitled, 'Portable Electric Mine Lamps.' The paper states that the safety of mining operations will be largely increased by the abandonment of flame lamps, except for gas testing, and the substitution of portable electric lamps. The locked safety lamp is the only portable lamp now used underground that is comparable as regards safety with a well constructed portable electric lamp. Although an electric lamp cannot be regarded as a safety lamp, if the latter be defined as a lamp that detects the presence of gas without igniting it, still if the presence of gas is known, a well constructed portable electric lamp, even without special safety devices, would seem to be quite as safe as a safety lamp, because while either may possibly ignite gas as the result of an accident, an unbroken safety lamp may cause disaster if its parts are improperly arranged. In Europe the hand lamp is used almost exclusively, but the sentiment in the United States seems to favor the cap lamp, probably because there are so many open light mines in this country. The author summarizes as follows the more important considerations in the design of portable electric lamp equipment: After safety, the next consideration is the production of a proper amount of light for approximately ten hours on one charge. The next is reliability of service, which is followed by lightness and durability. Convenience in handling and charging is an important characteristic. The outfit should not leak or spill electrolyte, and it should not be necessary for the users to exercise care to prevent such leakage. The battery should hold its charge during long periods of idleness. The Bureau of Mines is at present engaged in an investigation of all the patterns of portable electric mine lamps that, as far as the Bureau is aware, are manufactured in the United States. Any manufacturer of portable electric mine lamps may have his equipment included in this investigation by applying to the director of the Bureau for permission to submit equipment for test. Upon receipt of such a request the director will inform the applicants how many outfits and spare parts will be needed and where and to whom the equipment should be shipped.

Recent Publications

SECTIONS OF THE SYDNEY COALFIELDS, CAPE BRETON. By Joseph G. S. Hudson. Special edition for the International Geological Congress. P. 6. Tables, maps, and 15 colored plates. Department of Mines, Ottawa, 1913. These fields were first opened in a small way in 1672, and in 1912 the production was 5,197,601 tons.

MANUAL FOR ENGINEERS, published by the University of Tennessee. This manual is a small hand-book of interesting and valuable data compiled for the engineer's use by Charles E. Ferris, professor of mechanical engineering at the university. Copies will be delivered on receipt of 50c. by Charles E. Ferris, University of Tennessee, Knoxville.

United States Geological Survey publications, Washington, 1913:

SURFACE WATER-SUPPLY OF THE UNITED STATES, 1911. Part VIII. Western Gulf of Mexico. By W. W. Follett, W. B. Freeman, and G. K. Larrison. Water-Supply Paper 308. P. 117. Ill., map, index.

Advance chapters from 'Mineral Resources of the United States, 1912':

THE POTTERY INDUSTRY. By Jefferson Middleton. P. 16.

PRODUCTION OF MINERAL PAINTS. By James M. Hill. P. 26.

PRODUCTION OF BAUXITE AND ALUMINUM. By W. C. Phalen. P. 16.

PRODUCTION OF SAND AND GRAVEL. By Ralph W. Stone. P. 18.

PRODUCTION OF TALC AND SOAPSTONE. By J. S. Diller. P. 32. Maps.

Catalogues Received

NATIONAL TUBE CO., Pittsburgh, Pennsylvania. Booklet, 'The Whole Kewanee Family.' 48 pages. Illustrated. 5½ by 8 inches.

HENDRYX CYANIDE MACHINERY CO., 107 William street, New York. Catalogue No. 8. 24 pages. Illustrated. 6 by 9 inches.

ALBANY LUBRICATING CO., 708 Washington street, New York. 'The Bearing' for August. 12 pages. Illustrated. 4 by 6 inches.

SPRAGUE ELECTRIC WORKS, 527 West 34th street, New York. Bulletin No. 246, 'Motor-driven Exhaust Fan Outfits.' 12 pages. Illustrated. 8 by 10 inches.

INGERSOLL-RAND CO., 11 Broadway, New York. Catalog Form 9107. 140 pages. Illustrated. 6 by 9 inches. Covering entire line of this company, with dimension and capacity tables.

PITTSBURGH TESTING LABORATORY, Pittsburgh, Pennsylvania. Booklet C, 'Standard Specifications for Cement, Reinforcement Bars, and Concrete.' 40 pages. Illustrated. 4 by 7 inches.

CHICAGO PNEUMATIC TOOL CO., Fisher Bdg., Chicago. Bulletin No. 34-R, 'Class L-SS and L-SB Compressors.' Catalogue No. 43, 'Rockford Railway Motor Cars.' Both illustrated. 6 by 9 inches.

The GENERAL ENGINEERING CO., of Salt Lake City, Utah, having completed exhaustive tests on the ores of the National Copper Mining Co. of Wallace, Idaho, has been employed to design and erect a 500-ton plant. J. M. Callow is now on the ground with a corps of draughtsmen. Construction work under direction of Karl Bernson, of the General Engineering Co., will start immediately, and the mill is expected to be under cover before snow flies.

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EDITORIAL

LAKE SUPERIOR engineers are holding one of their periodical field gatherings in connection with the meeting of the Lake Superior Mining Institute, August 26 to 30, inclusive, while in the first week in September Mr. C. K. Leith will guide a party of visiting geologists to the points of chief interest on the ranges.

REJECTION by the directors of the American Institute of Mining Engineers of the plan of affiliation with the Mining and Metallurgical Society of America, worked out by a joint committee of members of the two institutions, was announced at Butte. We believe that the directors of the Institute made a grave mistake in taking this action and we shall discuss the matter at length later.

IT seems to be a question in the minds of some farmers whether irrigation and alfalfa is as profitable as barren desert and smelter fume. With the experimental work which is now being conducted on smelter fume and with every prospect of success, it is gratifying to know that the day of the 'smoke-farmer,' as recorded in Mr. Herbert Lang's article in the current issue, is almost a matter of history.

THE strength of the present copper market is reflected in the advance of copper shares. In a period of less than three months there has been an appreciation of over $100,000,000 in the value of thirty representative copper properties. The steady advance in copper since the middle of June, when it was selling at 14⅜ cents, to almost 16 cents at the present, has had a most beneficent effect upon the industry, and those who, two months ago, were fortunate enough to foresee the flood tide coming in the affairs of copper, are reaping the results of their investment. It is significant to note in this connection that the Lake Superior shares have kept pace with the general advance, regardless of the labor troubles in that district.

SHUSHANNA continues to be the mecca of prospectors in Alaska, and men are coming out with excellent reports. Supplies are reported still to be scarce, but as the McCarthy trail has been put into condition for use, ample food and material for the winter's work will doubtless be on the ground soon. The discoveries are really on the Chisina, a tributary to the Tanana that might well be considered the upper Tanana itself. Rich gravel has undoubtedly been found. Whether there are present the old gravels that gave stability to other Alaskan placer districts has not yet been announced. It is possible,

too, that glaciation may have interfered with the extent of the district, but information available is too indefinite as yet to warrant a positive opinion, and we may hope that the misnamed Shushanna is really another of the great placer districts such as have brought romance and industry to the Far North.

PERSISTENCE or non-persistence of ore deposits in depth is a subject of unceasing interest to geologists and mining engineers. One of the most interesting sessions of the International Geological Congress recently held at Toronto was devoted to the discussion of this topic and related phases of ore deposition. Papers were presented by Messrs. J. F. Kemp, Malcolm Maclaren, W. H. Emmons, Paul Krusch, L. L. Fermor, and Paul F. Fanning. Among those participating in the discussion were Messrs. G. F. Becker, Waldemar Lindgren, A. C. Lawson, F. L. Ransome, A. C. Lane, H. V. Winchell, T. T. Read, J. A. Udden, and many others. Considerable difference of opinion developed, particularly in regard to the limitations of secondary enrichment. As Mr. Lindgren noted, Mr. Krusch and Mr. L. C. Graton have come to diametrically opposed conclusions as regards the secondary origin of bornite, and it is evident that a complete consensus of opinion lies still far in the future. We print this week a brief discussion of the general topic, prepared by Mr. H. V. Winchell, but not presented, Mr. Winchell preferring to speak instead, which he did, clearly and forcibly. In later numbers we shall present abstracts of the formal papers presented, as they tie on well to the discussion that has been running in the *Mining and Scientific Press* in the last two years especially.

LODE MINING in the interior of Alaska has made slow progress, which is not especially surprising when account is taken of the lack of transportation and other difficulties incident to pioneer work. Just what these are, and how they are being overcome, may be judged from the account of the Willow Creek district, written by Mr. Sumner S. Smith. Well informed Alaskans look upon this as one of the most promising areas for lode development in the North. It is a region in which the great mass of quartz diorite cuts through the later sedimentaries, and, as suggested by experience in California and southeastern Alaska, the conditions are especially favorable for development of large orebodies. So far only the small high-grade veins have attracted attention. It is to be hoped that with improved conditions mining on a larger scale may prove possible. One announcement of the summer bears upon this directly. It will be remembered that the Alaska Central railroad extending northward from Seward to Turnagain Arm is hampered by heavy grades and curvature which have been recognized as a serious obstacle to converting it into the proposed trunk line to the interior. When it was built, the advantages of Seward as a harbor and townsite and the supposed prohibitive cost of tunneling at Portage pass, influenced the location of the line. Re-examination of the pass this summer has shown that it affords a feasible route for a railway, and that a much shorter tunnel than was anticipated is all that will be necessary. Details of the survey have not been published, but it is known that an entirely new face is put upon the matter and that a short workable line to the Susitna valley is possible. Sentiment in favor of government building of Alaskan railways seems to be consolidating rapidly, and when Congress can be induced to act, a large and valuable country will be opened to mining.

SLAG LOSSES in copper smelting have been a fruitful theme for discussion, the question as to whether the copper was present in the slag as mechanically entrained matte, or had been oxidized, thus forming a true if undesired component of the slag, having important bearing on practice. Mechanically held matte particles may be caused to settle, while the copper which has been oxidized is practically beyond recovery. Mr. Lewis T. Wright has contributed valuable evidence and a more recent study of Mr. Thomas Kiddie gives confirmatory results. Where care is taken to give the matte ample opportunity to settle from a not too viscous slag the amount of copper present as sulphide is found to be small, any increase in copper content being due to the presence of an increased amount of oxidized copper. If this rule holds good with converter slag, as there is reason to believe it does, the practice at many plants of returning fluid converter slag to the reverberatory furnaces partakes of the nature of a solemn futility, and the growing tendency toward pouring converter slag directly into the settler of the blast-furnace is in the right line of progress. The settler retrieves the mechanically held matte and the blast-furnace slag so dilutes the content in oxidized copper that the feelings of the management will not be injured at the thought of its going over the slag dump. As a matter of fact there is no economic difference between rejecting a large quantity of slag of an apparently low average and a small quantity of comparatively high content.

The Passing of La Lucette

Mines, like Hamlet's dog, have their day; which comes to an end at last in pinched-out veins, lower grade of ore, influx of water, or one or several of the thousand and one ills which may cut down a promising prospect in its adolescence or write *finis* to the record of production of a well known mine. So closes the day of La Lucette, which though a comparatively small mine, was yet one of the most notable of them all. Since 1889 it has been the leading producer of antimony, and in 1910 was reported to yield one-quarter of the world's production. Curiously enough, the mine was worked for antimony for nearly fifteen years before the presence of gold was discovered. During recent years, of the gross output, about $800,000 per annum, about two-thirds of the value has been derived from gold and one-third from the antimony produced.

The mine La Lucette is at Genest, about eight miles from Laval, France, in the department of Mayenne. Here steeply inclined veins occur in a region of quartzites and slates, of upper Silurian and lower Devonian age. The veins consist of rather wide bodies of quartz in which occur narrow rich streaks of stibnite and pyrite. The mining concession, which

covers 841 hectares, was obtained in 1889 by La Société anonyme des Mines de la Lucette, and for many years the sulphide streaks were mined and the antimony recovered, the quartz which was broken incidental to mining the sulphides having been used for road metal and other industrial purposes. In 1903, M. Strap, now general manager of the prosperous gold mine, La Bellière, at St. Pierre-Montlimard, Main et Loire, discovered the presence of gold in the quartz, and a new company, with a capital of 3,150,000 francs, was formed in 1904 to undertake the recovery of gold, its operations meeting with such success that in 1909 dividends of nearly 45 per cent upon the issued capital were paid. Two veins were worked, the larger of these being an example of that beau ideal of the prospector, a vein which grows larger and wider in depth. Unfortunately this condition was not persistent, and recent work discloses the fact that at about 700 feet in depth the vein passes out of the more brittle rocks into shales and quickly disappears in a network of stringers. The shale is of great thickness, and the possibility of finding the vein again on the farther side is remote in the extreme. The mine has some years of life, until the veins are exhausted down to the shale horizon, but its final end is definitely in sight. France still has notable gold mines, such as La Bellière, Le Chatelêt, and others, but the passing of La Lucette is much to be regretted. Incidentally, a large producer of antimony will cease to yield, and a larger demand for the output of the numerous other producers will result. But from antimony regulus to babbitt metal is a long step, and it is not to be expected that axles, the world around, will squeak in lamentation.

Prospecting by the Government

Finding new mines is becoming increasingly difficult as the shoots which outcrop at the surface are located and mined. The world needs and will continue to need additional metal, and there can be no doubt that the crust of the earth contains enough metal to supply the needs of mankind, but how to find it is a problem. Doubtless much remains to be done in the prospecting of additional territory by old methods, but also new methods must be developed. On another page the problem is discussed thoughtfully by Mr. Albert Burch, whose extended experience through the West and the identification of whose interest with the West, makes his proposals especially significant. We think well of the plan he outlines, though we recognize the many difficulties in the way of its adoption. For the United States Geological Survey to begin prospecting the public lands would be but the natural extension of its present duty to classify the public lands. We have long felt that the next great task for the Geological Survey was to develop the methods of scientific prospecting, and unless it attempts, and at least in part succeeds in pointing the way here, it will miss a great opportunity and fail to meet a legitimate task. The application of the methods may be by public or private agency, or by the two in competition, as Mr. Burch suggests. That is a distinct problem to be solved on its merits, but the time is rapidly approaching when, in the United States at least, it will not be possible to meet the demand for metal by relying on the efforts of the man, however hardworking, who has merely a 'hunch.' Administration of any such system as Mr. Burch proposes would be full of difficulties and would call for talent of a high order, but it is not an impossible task. As illustrating the difficulties to be met, the situation in the Wyoming oilfields at present may be cited. Prospecting here is under way at the same time that a party is in the field for the Survey, classifying the land. Friction, intense enough to have generated some heat, has resulted. It is clearly impossible for the Department to announce in advance of the investigation what lands will be withdrawn, and the officials have been reluctant to issue a general blanket order and so stop all prospecting. As a result, the oil men do not know where to turn. To start for a district means but to attract the attention of the geologists to it and place a premium on its withdrawal. Here, as in other matters of controversy in regard to the public lands, the element of uncertainty is one which promotes much ill feeling. It is not possible to avoid all of this until Congress, acting for the whole people, adopts a definite policy, but it is possible to have a policy that is definite and sharp and under which rights may be certain.

As to the form that government aid to mining should take, there is much room for difference of opinion, and we think it would be helpful to have further discussion of Mr. Burch's proposals, which have the merit of being concrete as well as thoughtful. We believe that Western miners would not object to a small royalty if they could be certain of value received in return. If the Government can really aid in finding a mine, the man who works it is not going to refuse to pay a moderate return. In most instances he does that now, only he often pays to one who has contributed no real service. It must be recognized that much prospecting, however scientific, will prove of no avail, and that many campaigns will result in loss. The experience of the Ontario Bureau of Mines is a case in point. No one familiar with the excellent work of Mr. W. G. Miller and his associates, can question the high quality of their skill. When the Provincial mine was reserved, opinion was unanimous as to its value. Indeed, there were loud protests at the reservation of the tract. When the mine proved of less value than was anticipated, the outsiders protested that it was the natural result of 'inefficient' governmental work. When it was thrown open to lease, it was bid off at a price that, in the light of later events, proved much too high. To this day no satisfactory answer has been given the question of why the Cobalt veins are not found in the area to the south, where, by all the apparent rules of geology, they should be present. Failure, therefore, must be anticipated in many cases, however careful the preparation for success. Failure, however, stares us in the face along the road we now travel. The world needs and must have more metal. Sooner or later the wise men of the profession must point the way to its finding. The men of the Geological Survey have the best chance to lead in this great work. Will they accept the responsibility?

Persistence of Ore Deposits in Depth

By Horace V. Winchell

Like every question whose answer depends on the definition of a term that is relative, the impulsive reply to this one will reflect the temperament of the individual conducting the discussion. A person of sanguine temperament, just about to invest in the development of a mining prospect or with a nicely engraved stock certificate in his strong box, will have visions of an ever-widening vein of precious metal ore extending downward indefinitely and becoming constantly richer as it approaches the centre of the earth. Men of much experience, having perhaps tried for years to find an ore deposit that does 'persist' far enough to make a mine, will declare with emphasis that there are none such. Many geologists even, not accustomed to carry on researches beneath the surface of the ground, and without much consideration of this question, are likely to entertain the idea that, since it is necessary to dig in the earth for ores, they may extend downward as far as digging operations can be conducted. And, on the other hand, the geologist who broadly compares the depth of mines with the thickness of the earth, and who has greater familiarity underground, will perhaps say that ore deposits do not and cannot persist. And it must be admitted that all of these opinions, contradictory as they are, have a certain amount of truth, depending on the point of view.

Depth of Ore

Ore deposits do persist; but there are depths below which they do not and cannot extend. Some of them are bonanzas, increasing in size and richness (down for long distances) as depth is gained; mining operations are in some instances being conducted at the depth of more than one mile from the surface, and the bottom is not yet. Still, it is unquestionably true that numerically the majority of ore deposits do not carry 'pay ore' below the depth of 1000 ft., and a very large percentage, numerically, are worked out before attaining the depth of 500 ft. The western half of this continent is dotted all over with holes in the ground where ore was found and mined near the surface, and where great hopes were aroused and extensive preparations made for large mining operations, but where the ore did not persist. On the other hand, some veins are still productive at 3500 or even 5000 feet.

No profound thought is needed to suggest that the behavior of ore deposits as to persistence depends largely on their origin. It is an undoubted fact that there is a class of ores which have been formed through the agency of surface waters. It is perfectly obvious that such ore deposits cannot persist below the depth to which surface waters can penetrate and still be active. In general, therefore, deposits of oxides, carbonates, and chlorides do not persist below the vadose zone or belt of free circulation of ground-water.

It has further come to be admitted that many sulphide ores are formed by the reactions which take place between descending solutions carrying oxidized products from the upper portions of veins and the unaltered sulphide minerals situated at greater depth. It is even true that the richest portions of many ore deposits, and often the only parts rich enough to be worked profitably, are the portions thus secondarily enriched. And it is perfectly obvious that such mines can persist no deeper than the agents which induced the secondary enrichment.

Oxidized Minerals and Secondary Sulphides

The depth to which oxidized minerals and secondary sulphides can be carried and deposited depends on a number of factors, such as time, character of the enclosing or overlying rocks, and their porosity or permeability, climatic conditions, underground temperature, and the chemical activity conditioned thereby. Thus, where, as in the Lake Superior region, the rocks have been exposed to weathering and decay for geologic ages, enormous deposits of iron ores may be formed, the oxidation reaching downward for many hundreds of feet. And no one knows how much has been removed by glacial erosion. Here the time element has been paramount. But in this same extensive glaciated region, where a relatively cool climate has prevailed for ages, and where the rocks have not been so rapidly and deeply rotted, there are few important deposits of secondary sulphide ores. Such ores are indeed present, but occur very near the surface. South of the border of the continental ice sheet, however, where the rocks are rotted to greater depths, and where chemical activity is more intense, important deposits of secondary ores, formed in much shorter periods of time than have been available in the Lake Superior region, are found.

Influence of Climate

In regions of rapid erosion and youthful topography, oxidation and secondary sulphide enrichment do not extend so deep as in the vicinity of the arid plains and plateaus. Of course, the possibility of changes in climate, drainage, and many other geological conditions must always be kept in mind; but it is true as a general fact that there are fewer secondary ore deposits, whether sulphides or oxidation compounds, in those regions north of the margin of the continental ice sheet, and that their depth is not so great as in all the country farther south, extending far down into Mexico. It is also true that secondary ores play a less important rôle on the western slope of the Cascades and Sierra Nevadas (where rain and snow fall are heavy and erosion more rapid than oxidation) than upon the drier eastern slopes and foothills. The actual depth of such secondary ore deposition may vary from a few inches to two thousand feet; and under exceptional conditions, where faulting has been extensive and recent, or the rocks broadly uplifted and fissured, may be even deeper.

The factors which determine the persistence of primary ore deposits are not so easily determined.

Such ores are believed to have been formed by magmatic agency and to represent either actual magmas or chemical precipitates from vapors and solutions expressed out of the magmas.

As for the first category, ore magmas, although they may be expected to vary widely and rapidly in size, shape, position, and richness, there is no reason to anticipate their discontinuance short of the stock from which they were originally derived. Such ores are seldom sufficiently concentrated to be of commercial value, and except for certain iron and nickel ore deposits, are not likely to be found often in actual practice.

Conditions for Ore Deposition

The conditions which govern the maximum depth at which primary ores may be deposited by ascending waters, vapors, and gases are physical and chemical. There must be some way for the passage of the aqueous and gaseous solutions, and chemical reactions must transpire. Various estimates have been made as to the lowest point at which the smallest openings may exist in the rocks. It is reasonable to suppose that there is a limit below which the rocks are so dense as to be practically impermeable, but as yet sufficient data are not available to determine the effect of such enormous pressure and high temperatures. Whatever it may be, it is quite safe to assume that no large and valuable mines will ever be found there, because in the first place, of the physical impossibility of working to any such depth, and in the second place, because of the scarcity of ore at the initial points of its assemblage.

It is known that the solvent power of solutions rises with the increase of temperature and pressure, and that mere supersaturation compels precipitation. It is readily understood that if a saturated solution starts on its way toward the surface from the depth of 30,000 ft., it will be under less pressure and at a lower temperature at the depth of 20,000 ft.; and it is practically certain that at various points on its upward course it will become progressively supersaturated and thus obliged to part with a portion of its burden of mineral, the less soluble substances perhaps being deposited in the order of their solubility. Thus are found zones of minerals in the veins of certain districts, gold to a certain depth, copper beneath the gold, and zinc under the copper. At what depth these various chemical reactions take place because of supersaturation is not known. And if it were known, there are so many other factors involved, and so much unknown subsequent erosion that it would be impossible to make practical application in any given instance.

Precipitation

While supersaturation alone may bring about precipitation, it may also be induced by chemical reaction or the interchange of molecules between the solutions and the rocks through which they are passing. In this way the ores are formed by metasomatic replacement. But, here, too, the physical conditions must be such as to permit the passage of the solutions, otherwise there can be no chemical interaction. Stationary solutions soon reach a state of chemical equilibrium and may remain unchanged for ages. It is only moving solutions that deposit ores. And again one is confronted by the presumption that below some such depth as six or ten miles, solutions, even if they exist and regardless of their nature, cannot and do not migrate.

Theorize about it as one may, when he comes right down to the consideration of concrete cases, it is found that no two mining districts have had precisely the same antecedents; nowhere have precisely the same factors contributed to the final result; hardly any two mines, even in the same district, are the same in all respects. There may be a general similarity of mineralization; but, even so, the gold and silver ratios will differ in different mines or different veins, or even in different ore-shoots in the same vein. Or there will be noticed in a single mining camp, minerals in one vein which occur much less abundantly, or not at all, in another. Or certain veins will be continuously mineralized while other veins, not only within the same district, but even within the same few acres of ground, will carry their ore only in lenses or shoots. The outcrop of one vein may still be covered by Tertiary lavas, while adjacent veins of similar mineralization may have been exposed to weathering, erosion, and secondary enrichment since the Triassic. Of one vein there may have been carried away by erosion a thousand feet or more. In another the ore may not come to the surface at any point, and there may never have been any of it removed by erosion.

What is really 'depth' for one vein or ore deposit as it is found today, may be nearly brought to the surface by erosion and earth movements; and there may be no way to compare it with other deposits of the same region but much more recent or different origin.

Relation of Depth to Value

Such considerations impel caution against the ever-imminent danger of generalization. And yet, it must be possible to generalize to some extent. Some experience has been had, some mines have been studied; it is known whether, as a matter of fact, ore deposits resemble wedges with the narrow edge up (or down). And candor compels us to admit that on the whole, mines are usually of lower grade and less productive in depth, almost without exception and without reference to their genesis (magmatic segregations alone excepted). It is not possible to specify closely the depth at which impoverishment begins, nor to predict the point of serious decline or ultimate demise of a mine. But this is because of our lack of understanding of its origin and history. I fully believe that the day will come when such forecasts can be made with a fair degree of confidence, although they will always be subject to correction by the possibility of faulting and duplication of ore or its enrichment through fissures which occur at greater depth and have not been developed at the time of examination.

In general, veins do become smaller and tighter with depth; mines are surely exhausted and worked out; old mining districts are abandoned and new ones discovered. Ores become baser, more complex, and less valuable. Free-milling ores, oxides, carbonates, and chlorides are conspicuous by their general absence below the depth of 2000 ft.; and although it

is possible to imagine their formation and to write the chemical equations expressing the theoretical mode of their formation in the deep, yet they are not found in minable quantity. That individual who, or mining company which goes on prospecting to much greater depth after the ore has, for a series of years, declined in value and quantity until it is too poor to pay, is in most cases throwing money away.

The future mining industry will consist more in the treatment of lower grade ores by more refined and economical methods and in the opening of ore deposits whose presence was not conspicuous on the surface and whose existence was consequently overlooked, than through the pursuit of veins by improved mechanical devices to much greater depths than are now attained. And in my humble opinion, the all-sufficient reason is because the great preponderance of ores is to be found within 3000 or 4000 ft. of the surface, with occasional instances of exceptionally large and strong fissures and intense and long continued and repeated mineralization, reaching downward to much greater depth.

Selective Flotation at Broken Hill

Owing mainly to the state of the metal markets, there has been manifest of late, in many ways a decided weakness in Broken Hill, New South Wales, stocks, but that weakness has not been nearly so pronounced as it would have been had it not become slowly recognized that the field was likely to benefit largely by the putting into operation of certain new treatment processes whereby the slime heaps that are so marked a feature of the district are to be made capable of remunerative treatment. The Zinc Corporation already has made complete trial of these new processes with most satisfactory results, there being as a consequence a considerable greater profit made than was made previously.

What, then, are the new processes? Their object is well described by a writer in the *Australian Mining Standard* who puts the position thus:

Minerals Separation

It was recognized that the Minerals Separation, and perhaps other processes, would recover the lead, zinc, and silver from the slime, leaving a clean worthless gangue, but it has been almost an impossibility to separate the lead and zinc slime concentrate into marketable products. The method used for attempting this is wet concentration of the mixed concentrate float on tables and vanners, taking advantage of the difference in specific gravity of galena and blende, the operation being known as 'de-leading.' By this means an imperfect separation is effected, and the products, though in themselves probably not very suitable for smelting, can be mixed with the higher grade products obtained in the wet mill and zinc tailing mills, to form a marketable product. That this method does not give entire satisfaction is evidenced by the fact that all the mines along the line of lode have been experimenting with a view to finding a process to separate the lead and zinc in the slime concentrate more effectively. The processes that are being evolved to effect this have been called selective or preferential flotation processes. One of them is already well known as Horwood's process, and consists in subjecting the concentrate to a sulphatizing roast by which the galena particles are coated with sulphate of lead, while the blende particles are unaffected. After roasting, the material is refloated, the unaltered blende floating and the coated galena remaining behind.

Method of Control

The other processes—for there are several now under trial—seem to depend upon the control of the character of the flotation by the control of the aeration of the pulp, and the chemical composition of the solutions. How imperfect the slime treatment has hitherto been is shown by the fact that the Central (Sulphide Corporation), and the Broken Hill Proprietary had to cease the attempt to deal with the old slime dump with the plants they had erected for the purpose. Now there are several companies treating the current slime from the mills, and the results should soon be obvious. Selective flotation will effect a revolution in Broken Hill practice, making it advisable to create slime instead of to avoid sliming, because by this treatment the lead is recovered from the slime and the zinc is recovered in the form of a high-grade concentrate. On average slime this should be worth $5 per ton. The South mine, with about 300,000 tons of accumulated slime, should benefit particularly, and the North will also, though in a lesser degree, find the advantage of the new methods, though this mine and the British have sold their old dumps to the Junction North. The directorate of this last-named Company has shown great foresight in the purchasing of the old dumps despite the Company's poor financial circumstances, and its plant will be available with but little alteration. The Proprietary company and the Amalgamated Zinc are busy stacking slime, and the latter Company will reap good profits. It is estimated that the net value of all Broken Hill ores will advance from 50c. to $1 per ton on account of the wet mill slime alone. If so, the added value to the mines should be from $5,000,000 to $10,000,000, and also many low-grade ores will be made profitable to work.

Chromic iron ore produced and sold in the United States was nearly 70% greater in 1912 than in 1911, according to J. S. Diller, of the U. S. Geological Survey. The total output marketed was 201 long tons, valued at $2753, compared with 120 tons valued at $1629 in 1911. California is the only producing state, and the output comes from three separate deposits. Two new mines were opened, one near Livermore, in Alameda county, and the other near Piedra, in Fresno county.

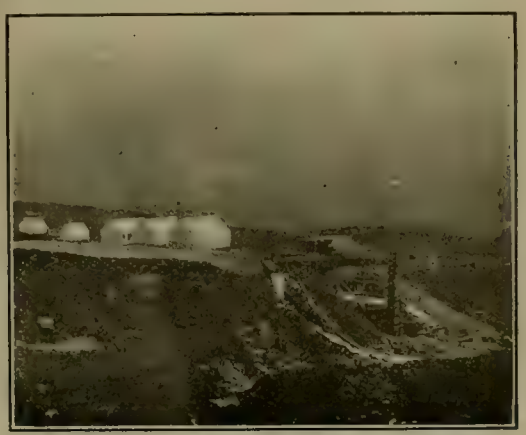
The total production of lime in the United States in 1912 was 3,529,462 short tons, valued at $13,970,114, as compared with 3,392,915 short tons, valued at $13,689,054, in 1911, an increase of 136,547 short tons in quantity and $281,060 in value. The total number of plants operating in 1912 was 1018, as compared with 1139 in 1911.

Lode Mining in the Willow Creek District

By Sumner S. Smith

The history of the Willow Creek district dates from the discovery of placer gold on Willow creek in 1898 and on Grubstake gulch, a small tributary, in 1899. As the source of the placer gold was shown to be the small lenses and veinlets in the schist which formed the major portion of the stream valleys, and as but little attention was given to lode mining at that date, the quartz veins were not discovered until 1905, when locations were made on the divide between Fishook, a small tributary of the Little Susitna river and Willow creek, since which time the limits of the district have been constantly expanding.

KNIK, ALASKA.



ALASKA FREE GOLD MINING CO.

Situation of Mines

The district is about 35 miles northeast of Knik by wagon-road, and the mines which up to the present time have been proved profitable are situated on the divides between Craigie, a tributary of Willow, and Willow, and between Willow and Fishook, a creek which flows southeast into the Little Susitna river. The sides of these valleys, which have been eroded by glacial action, are steep and precipitous and the bottoms covered with detritus and glacial wash. These conditions have led the prospectors to seek the upper slopes where the outcrops have been comparatively easy to trace and to avoid the lower levels, so the majority of properties discovered are high above timber line, the ore being sent over aerial trams several thousand feet to the mills in the valleys below.

Length of Season

There are practically two working seasons, the winter when the roads are covered with snow and in good condition for sleding, and the summer when the snow has melted. During the spring and fall the roads are almost impassable, and the snow blocks the trams and hinders the work at the mines. The actual season of mining and milling at the present time does not exceed four or five months and covers a period from some time in May till the latter part of September or October. At some future date, when the mines have been developed to a point where conditions warrant the installation of a hydro-electric, a steam, or gas-producer plant in the lower valleys, it may be possible to double this period or even operate the entire year. The rainfall is not excessive and the summer climate most enjoyable.

Freight

The steamship companies have a sliding scale for the freight rates, but an average of $16 per ton is charged from Seattle to Knik anchorage, $6 from the anchorage to Knik, and $1 wharfage. From Knik to the mines the present winter contract price is 4c. per pound, and in the summer double that figure. Probably these figures could be cut down a little now, as the Alaska Road Commission has constructed a first-class wagon-road to the centre of the district. There is comparatively little grade from Knik to where the road crosses the Little Susitna river at Mile 28, from which point there is a continual ascent to the mines, with one hard pull of about a half mile. The road is excellent for hauling in winter and summer, but, as mentioned before, almost impassable in the spring and fall.

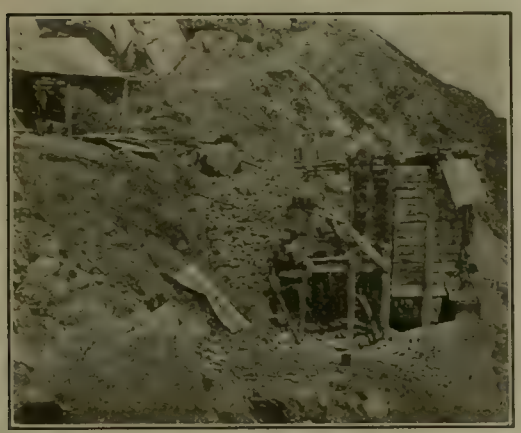
Labor

Miners are paid at the rate of $3.50 per day and board, an estimated cost of $1.50 per day for board being made by the mine operators where the crew averages 20 to 30 men. The shortness of the season and the fact that this time of the year is the most favorable for prospecting, make it hard to assemble an efficient force of men. Living conditions are severe. Hurried tent camps are erected in the spring which give but little protection from the mosquitoes and moose flies, and are disagreeable in wet weather. This condition should change rapidly as the mines develop, but at the present time it is but little inducement for a man to pack his blankets 35 miles for a job.

Systems of Veins

The country rock is a quartz diorite intrusive in a

mica schist and there are three sets or systems of veins: (1) those in the diorite striking almost at right angles to the schist-diorite contact; (2) those apparently parallel to the contact but in the diorite; and (3) those in the schist striking at right angles to the contact. The present mines of proved value are in the first class, though some excellent prospects have been opened on the second and third types. The diorite is blocky and the fissures seem to traverse it for great lengths, with small cross-fissures coming in from both hanging and foot-walls. The quartz is usually accompanied with a small amount of gouge on both walls, and is from white to a bluish tinge, with reddish streaks due to the oxidation of the iron minerals. While many specimens show free gold the greater portion of the gold seems to be finely divided and not visible in the ordinary hand specimen, though it is rare to find a piece that will not 'pan' colors. The veins in the diorite vary from a few inches to a few feet in width, strike northwest and southeast, and dip toward southwest.



TRAM TERMINAL, ALASKA GOLD QUARTZ MINING CO.

ALASKA GOLD QUARTZ MINING CO.

Mines

At the property of the Alaska Free Gold Mining Co., on Fishook creek the main vein has been traced the length of several claims by open cuts and on the northeastern portion of the outcrop a drift is being driven that will give approximately 150 ft. of 'backs'. At this point an aerial jigback tram has been erected which carries the ore 1100 ft. in a single span to an intermediate ore-bin from which point it is carried by a similar tram 2500 ft. to the mill, the total drop from mine to mill being 800 ft. A third tram with a 2250-ft. span has been installed from an open cut on the southern portion of the property to the mill. Two 500-lb. buckets are operated on these trams, the loaded pulling the empty back. Track cables are ⅝ in. diameter with ¼-in. haulage cables. At the mill the ore is crushed by a jaw crusher to one inch when it is fed automatically to a Lane slow speed mill 10 ft. in diameter making 8 revolutions per minute. No screens are used, the size of the product being governed by the height of the discharge which is kept about 6½ in. above the die and the amount of water fed to the mill. Inside amalgamation is practised with excellent results. From the mill the tailing is split over two sets of plates and is passed to two Wilfley tables, being finally impounded for future treatment. Power for the plant is furnished by a 10-in. turbine under a 30-ft. head, though a 35-hp. boiler and 25-hp. engine have been brought to the camp to supplement this when the water is low.

Alaska Gold Quartz Mining Co.

On the property of the Alaska Gold Quartz Mining Co., which joins the Alaska Free Gold on the north, two veins, the Independence and the Granite Mountain, have been opened. Both strike northwest. The former averages 2½ ft. in width and dips 38 to 42° southwest, while the latter averages 18 inches wide with a parallel strike, but a lower dip, about 16 to 17° southwest. On the lower vein a drift has been driven about 350 ft. and stopes alternate with pillars. On the upper vein 110 ft. above the lower level a drift has been driven 100 ft., opening an intermediate level, and 90 ft. above a cross-cut has been made and raises driven to the vein. From these openings 236 tons was sent to the mill in 1911, and 680 in 1912. The ore is conveyed from the mine to the mill over an aerial jigback tram, ⅝-in. cable being used for the track, and ¼-in. for the haulage. From the jaw crusher the ore is fed to three 350-lb. stamps and one Nissen stamp. The small stamps drop 7 inches 104 times per minute and crush to a 40 mesh. The Nissen stamp drops 6 inches 96 times per minute and crushes to a 40 mesh. From the stamps the pulp flows over plates to the concentrating tables, after which the tailing is impounded for future treatment. Power for the plant is furnished by a Pelton wheel under a 110-ft. head. One ton of concentrate with an approximate value of $450 is obtained from 75 to 100 tons of ore.

The Gold Bullion Mine

The Gold Bullion mine, which was discovered about a year after the two former properties, is situated near the top of the divide between Craigie and Willow creeks, and shows outcrops on both sides of the mountain. The property has a record of production of over $130,000 since 1910, though but little work has been done toward its development as a mine. At several points where rich outcrops were opened, cuts were run or stopes driven to get out the

easy ore which stoped about two feet in width. In 1907 a 2-stamp mill was erected, and in 1911 five stamps were added to this. The ore is transferred from the mine by two aerial jigback trams, the distance from the mine to the transfer bin being 1300 ft., and from the transfer bin to the mill 3800 ft. The drop between the mine and mill is approximately 1500 ft. In the mill, the ore is crushed to 50 mesh, the pulp going over plates to a Wilfley table. The property has recently been taken over by new interests and work started to determine the amount of ore available for the mill, which will be rebuilt at a later date.

Available Power and Timber

As the mines are all well above timberline, and as the melting snow furnishes power for only a short time in the summer, the question of timber and power is a serious one. Lignite coal outcrops on the south bank of the Little Susitna directly opposite the mouth of Fishook creek, and a better grade could be obtained from the Matanuska field with an additional transmission line of about fifteen miles. This would offer a supply of power that would be available the entire year, or a hydro-electric plant could be installed on the Little Susitna which would furnish all the power necessary in the district. Excellent timber for all mine timbers or lumber can be obtained in the valley of the Little Susitna, though the expense of getting it to the mines will always be heavy.

Conclusions

As the mines of this dictrict were discovered and opened by comparatively poor men, they have been forced to pay their own way, and if some of the mining has been crude it has been due to the fact that the properties had to be producers from the start rather than to the desire of the men who operated them. The veins are small but high-grade, and the ores easy to treat. The fissures have been traced on the surface for considerable distances and the shoots proved at least several hundred feet in length. Lack of any secondary enrichment in the present openings suggests that the ores will retain their value to the depth of profitable mining. From the known properties now in operation and the prospects under development, it would seem that with additional capital available for increased development, with permanent camps established so work may be advanced throughout the year, and with increased power facilities for mining and milling, the district should be assured of a steady growth and a substantial future.

Petroleum in the Philippines

*The existence of petroleum seeps on Bondoc peninsula, Tayabas Province, became generally known soon after the American occupation of the Philippines, although no mention of petroleum in Tayabas appears in the geological and mining publications of the former Spanish government. Within the past few years a number of companies have been organized and claims have been located far and wide throughout the region, but development has not gone further than the drilling of two shallow wells. Each of these developed oil, but neither yields a quantity great enough to class it as successful. However, the wells are close together and neither is more than 325 ft. deep. This vicinity might be made to yield oil in commercial quantities under proper treatment, although it probably could not be considered the most favorable from a geological standpoint. That the wells were not successful therefore, fails as evidence upon which to condemn the whole field.

Over the southern half of the oilfield the land rises from the coast to a relatively high, level, or rolling plateau with deeply-incised narrow valleys. The highest member of the geologic formation is a thick bedded to massive limestone. A provisional scheme of the stratigraphy of the Bondoc peninsula is as follows:

Character of formation.	Thickness in metres.
Clay, sand, and gravel	0 to 10
Raised coral reefs, beaches, etc	0 " 15
Coralline to sandy limestone	20 " 50
Bedded sandstone, calcareous, yellow to brown, and locally concretionary	150 " 300
Limestone with coarse quartz, sand, and pebbles	0 " 15
Blue to gray, massive, clayey sandstone	50 " 100
Volcanic agglomerate (not generally distributed in the district, and occurring at two different horizons)	?
Massive bluish to brownish black shale (Bacau)	50 to 100
Gray, yellow, and brown, thin bedded sandy shale and sandstone (Vigo)	1000 + base not exposed

The oil horizon is in the two latter formations.

Bondoc Peninsula

The presence of petroleum on Bondoc peninsula is indicated by seeps of gas and oil at widely separated points throughout the region. The seeps occur invariably near the crests of anticlinal folds and always at about the horizon of the Bacau shale. In several instances the oil oozes directly from the Bacau shale, but in at least one case it appears to come from the upper Vigo shale. Gas, unaccompanied by oil, is emitted at a number of places. No discoloration of the strata by the escaping petroleum can be detected, but the odor of light oil is noticeable in the neighborhood of a petroleum seep. The wells which have been drilled obtained their oil from the Bacau shale. The petroleum contains an unusually large percentage of light oils. Its specific gravity averages 0.832, and distillation gave 30.4% gasoline, 50.9% kerosene, 15.1% heavy oil, these by volume, and 3.6% residue by weight.

The existence of petroleum on Bondoc peninsula is established, although the quantity which may be available is undetermined. If no petroleum exists other than the small quantity which occurs in the Bacau shale, commercial production is not likely to develop, but if the unexposed lower Vigo strata also contain oil, the prospect is bright. The character of the Vigo shale (alternating shale and sandstone) is favorable for the accumulation of any oil that may be present.

Under the circumstances Bondoc peninsula must be classed as an unproved oilfield where there is a good chance of obtaining petroleum economically.

*Abstract from Press Bulletin No. 17, Bureau of Science, Government of the Philippine Islands.

Diamond-Drilling at the Poderosa Mine

By C. L. Severy

The Poderosa mine is among the rounded peaks that rise above and bound the western edge of the great Bolivian plateau, and lies only a few miles from the international boundary between Chile and Bolivia. The elevation at the collar of the main shaft is 15,400 ft. above the level of the sea. In any other country but South America this would be considered a mine of extreme altitude, but in this country of high elevations it calls for no particular comment outside of the fact that until quite recently the highest railroad in the world was the branch line to this mine.

The Ore Deposits

The ore deposit is copper of extreme richness, carrying from 6 to 8 oz. of silver throughout. The copper content runs from 8 to 65% over considerable widths. The vein is a true fissure vein in a massive dacite with a diorite dike as the hanging wall. In places this dike forms the hanging wall of the vein, but not throughout its full length. The vein is divided into two parts, the Poderosa, or principal part, and the San Carlos. The San Carlos is separated from the Poderosa by a fault with a vertical thrust of 150 ft., and a side thrust of from 50 ft. on the upper levels to 100 ft. on the lowest level. No indications of the veins in this district are visible upon the surface, most of which is covered with sharp angular gravel to depths varying from a few feet to over sixty feet. There are numerous side branches and parallel veins from the main vein, and it was to prospect for the continuance of these and to find the main vein at depth that diamond-drilling was started here in November 1910.

Three drills were put to work underground, an electric, an air machine, and a hand-power drill. The two former were made by the Sullivan Machinery Co., and the last by an English firm. The capacities were 500, 800, and 100 ft., respectively. '*E*' rods were used in all, making a 7/8-in. core. In setting the bits here it was found best to use the method of setting 'kickers,' due to the rough character of the ground. Six stones were set in the face of the bit, three inside and three outside. The outside stones were set close into the side of the bit, and below these were set two smaller stones or large sized chips, called 'kickers,' directly opposite each other, to carry the gauge of the hole. This lessened the work on the large outside stones and gave less chance for breakage or pulling out a stone in a caving hole.

Conditions Attending Drilling

The conditions attending diamond-drilling here were difficult. The ground was bad for drilling, being broken and caving, and in places extremely hard but always remaining badly fissured. The veins were in a soft gangue material, for the most part, and would only give core with a double-tube core-barrel, and anyone familiar with diamond-drilling knows what a frail piece of apparatus is an '*E*' double tube. Thus great care had to be taken in using it. Cementing and casing the holes had invariably to be resorted to, which is not only expensive but causes much delay.

Another difficulty and inconvenience was experienced from breakdowns. Any break of a serious nature had to be repaired on the coast, a distance of 465 kilometres, and took from a month to six weeks before the drill was working again. Besides, the work done was of an inferior character.

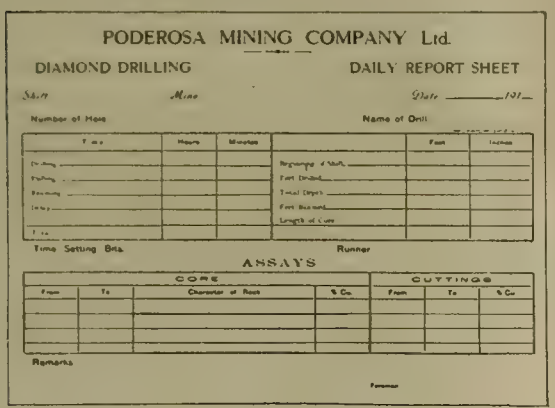
During the calendar year of 1911 sixteen holes were drilled, two of which were unfinished. The deepest of these was 301 ft., and with the exception of six, all were flat holes prospecting laterally. The total combined footage of the sixteen holes for the year was 2444 ft., three-fourths of which was run with the electric drill. At no time were all three drills working at the same time, due to the shortage of runners. Native helpers, after a year's apprenticeship, were tried as runners, but they were a failure. They could learn the routine work, but when it came to knowing what kind of ground they were running through, and what the drill was doing, from the sound of the rods, or whether the bit was water-blocked, they failed to learn, which often resulted in heavy breakage of stones. Of the sixteen holes, one was an inclined surface hole and afforded more difficulties than any other. Near the surface the rock was even more broken and contained more waterways, so that the hole was continually losing its water and had to be cemented.

Cost of Operation

In any work of this kind, one of the most valuable and interesting points to engineers is the cost. In comparing these costs with other diamond-drilling figures, one must bear in mind the extra expense incurred in traveling expenses, high cost of supplies and labor, and all the other elements that have to be contended with in a country difficult to live and work in and so far from the base of supplies. Even considering all these items, the cost compares favorably with diamond-drilling in some parts of the United States. Like a great many other costs, especially in mining, they have to be taken with a great deal of consideration and weighed for what they are worth, before any comparison can be made with similar work elsewhere. Conditions are so variable and the personal element so great that any actual comparisons are difficult, to say the least.

The causes of the high costs may be summed up as follows. First, the higher salaries paid to skilled runners and setters operating in a foreign field, and their traveling expenses to and from the States, which amounted to an average of $600 gold for each round trip per man. Second, poor diamonds. Of course there is a great deal of luck in buying black diamonds, as some look good and wear poorly, while others appear to be poor and wear amazingly well. And being a long way from the market, one has to accept what is sent him and do the best he can with them. Third, the abnormal cost of power. At so

high an altitude the combustion of fuels is poorer and the compression of air is a difficult and expensive problem, due to the light air. Also the fuel to produce the power is high, coal varying in price from $25 to $35 per ton placed at the mine. Fourth, delays are an important item. One can readily see the expense incurred by a delay caused by a part of a machine breaking which has to be cast at a foundry some three hundred miles away, and which takes at least a month to manufacture and about twice to three times that long to get from stock in the States, even when cabled for. Such delays are not only expensive, but aggravating in the extreme. Fifth, the poor inefficient native labor for helpers. Sixth, a formation which is extremely difficult for the operation of diamond-drills, namely, a hard fragmented wall rock and veins of ore either quite friable or in a soft gangue material. This means a heavy loss in diamonds while drilling through the rock and a poor representation of what is being passed through when in a vein.


PODEROSA MINING COMPANY Ltd.

DIAMOND DRILLING DAILY REPORT SHEET

Shift Mine Date _____ 191_

Number of Hole Name of Drill

	Hours	Minutes		Feet	Inches
Drilling			Beginning of Shift		
Drilling			Feet Drilled		
Reaming			Total Depth		
Lost			Feet Reamed		
Total			Length of Core		

Time Setting Bits Runner

ASSAYS

CORE				CUTTINGS		
From	To	Character of Rock	% Cu.	From	To	% Cu.

Remarks

Foreman

The average cost per foot in American gold taken over a period of a year for all three machines was $9.05. During this time the electric drill made the best showing, due in part to the greater footage drilled, but only in part, as electric power costs less to generate than compressed air. The average cost for the electric power was $8.63 per foot, for the hand power $9.40, and for the compressed air $11.40. The lowest cost per foot of drilling was $3.40 on a flat hole with the electric drill, and the most expensive was on an angle hole from the surface of 39° dip, also with the electric drill, which cost $13.65 per foot. Accurate check was kept on the loss of diamonds for each hole, and the diamonds were all weighed at the end of each month for the monthly cost sheets.

Report Forms

For keeping a record of the holes there was devised a system of report blanks, which vary in some particulars from others, but it is better to arrange one's own reports to suit the immediate conditions. The illustration shows the form of daily report for each shift. This sheet gives the time consumed in the various operations of drilling, the delay, time setting bits, feet drilled, feet reamed, length of core, besides the various changes in the character of the rock, assays of the core, if in ore, and of the cuttings. From the daily data the monthly sheets were compiled and also those for each hole were segregated.

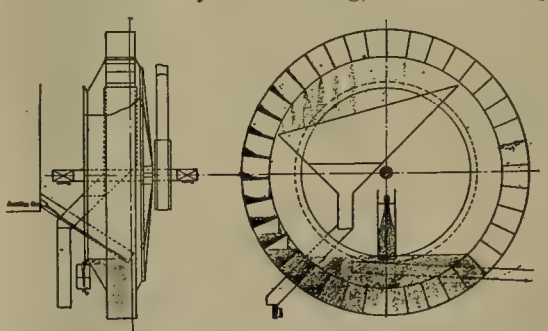
Cuttings were taken of every five feet of hole, except where it was positively known that the region was barren rock. In the vicinity of veins or while passing through them, cuttings were taken every foot, and a sample was cut at any time where the return water or action of the rods indicated a change of formation. Samples of the cuttings were taken by letting the water from the hole run into a settling box. One could generally count on the cutting assays being a little high on account of some of the lighter material not settling and being carried over into the sump.

All the ground drilled on this property was of such a broken character that a high percentage of core was impossible with any reasonable amount of speed. In the soft vein materials on the lower levels a double-tube core-barrel had to be used to save any core at all. An average of 52% of core was saved, which is admittedly quite low.

The average speed of actual drilling taken from the records over a period of a year, not counting time consumed in pulling rods, was 1.14 ft. per hour, and the loss in diamonds amounted to one-thirty-second of a carat per foot. This last statement indicates the difficult ground drilled during the operations in this district better than any other information which I might give.

A Dewatering Wheel for Pulp

*At the Winona stamp-mill, Michigan, it was necessary to re-use the water, and the tailing had therefore to be separated from it. This led to the development of the 12-ft. diameter wheel now in use. As shown by the drawing, the dewatering


ELEVATIONS OF DEWATERING WHEEL.

wheel consists of a sheet steel water-tight wheel with radial partitions along the periphery forming pockets in which the sand is caught and lifted out of the water and discharged at the top of the wheel over an apron upon the belt conveyor. The sand is run from settling tanks through spigots into the bottom of the wheel. The water overflowing from the wheel is carried to the settling tanks and reused.

A refinery consisting of about 30 stills, 20 of which will produce motor spirit, is being erected at Casper, Wyoming, by the Standard Oil Co. The plant will probably be ready for work early in 1914.

*Abstract from a paper, 'Winona Stamp-Mill,' by R. B. Seeber, prepared for Lake Superior Mining Institute.

An Electric Mine-Signal System

By E. A. Colburn, Jr.

Every mine doing a large amount of hoisting through a shaft should be equipped with some system of signaling and station lighting other than the old fashioned bell-pulls and candles. Electricity has been developed to such a point that its use in this service has resulted in many safe, efficient, and reliable installations, one of which, at the Ajax mine, Victor, Colorado, is worthy of description.

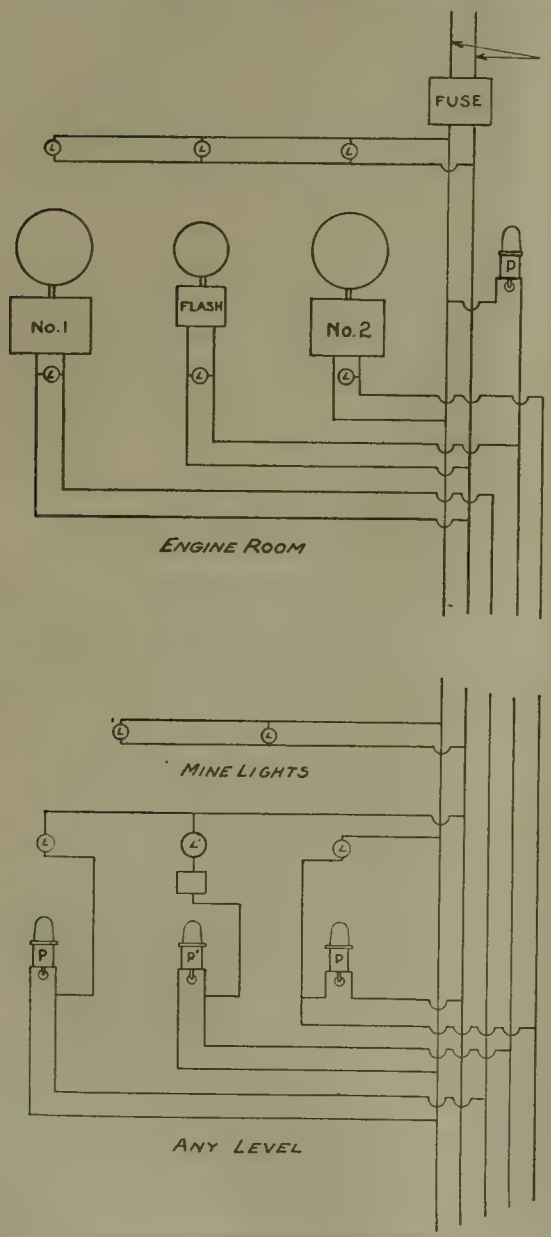


DIAGRAM SHOWING METHOD OF WIRING.

The mine is opened by a 3-compartment shaft 1200 ft. deep, and at certain seasons of the year is exceedingly wet, due entirely to surface drainage. As this surface water is acid, after passing the first or second level, a great deal of trouble is experienced with any metal work placed in the shaft. Lag screws in the guides, nails in ladders, and turnsheets on the stations are eaten away in a few months.

When electric signals and lights were first installed in the mine the separate wire system was used. This system caused so much trouble from short circuits and wires being eaten entirely through by the acid mine water, that a cable made especially for the purpose and containing five wires, two for power and three for signaling, was substituted. Since that time little trouble has been experienced except on the stations where the wires are exposed to the drip from the timbers.

The cable is cut at each level and run into a junction-box placed at a convenient point on the station, and is protected from moisture as much as possible, decay usually starting at the bend caused by bringing the cable into the level. From the junction-box the wires are run to their respective lights and switches.

Station Lights

Each station is lighted by four or more 60-watt carbon lamps screwed into waterproof sockets and is equipped with three pull-switches, one for each compartment and one for the skip tender's signal or flash. The pull-switches, at each shaft compartment, ring their respective bells on the engineer's platform, but the skip-tender's pull-switch operates the buzzers on every level in the mine and one on the surface within hearing of the hoistman.

This signal is for the purpose of notifying the skip-tender when any level is without empty cars or when some one wishes to move from level to level. A pull-switch attached to this circuit is also within reach of the hoisting engineer for use in calling for repeat signals, etc. Bells were originally used on all the levels on this circuit, but were later abandoned on account of their large first cost and frequent repair due to the presence of so much water. Small buzzers are now used in series with 100-watt carbon lamps and are giving good service.

Although the pull-switches are constructed especially for this class of work and are made as nearly water-tight as possible, a little trouble has been experienced on account of water being drawn by capillary attraction up the stem of the switch and corroding the interior. The bells used on the hoisting circuits are large single-stroke gongs using 110 to 120-volt alternating current, the same as the rest of the system, and have been in use about ten years without giving any trouble. In case the power should be interrupted, ordinary bell cords, hung in the hoisting compartments, are used; as is also the case when examining the shaft between levels. By reference to the diagram, furnished by C. A. Bliley, mine electrician, connections may be readily understood.

The total production of coal in Oklahoma in 1912, according to E. W. Parker, of the U. S. Geological Survey, was 3,675,418 short tons, having a value at the mines of $7,867,331. These statistics have been compiled in coöperation with the State Geological Survey.

Coal used in Pittsburgh amounts to 22,700,000 tons per year.

Common Sense of the Fume Question

By Herbert Lang

In spite of all that has been said and written during recent years concerning the cause and effects of smelter fume, it does not appear that correct ideas of the matter have yet pervaded the popular mind, which remains very much in need of enlightenment. On every side it is asked, "Why don't the smelting people do something to prevent damage by their smoke?" It is also common to hear apparently intelligent persons proclaim the great rewards that would accrue to the man who first solves the smelter-smoke problem. Inventors, too, in great numbers, continually put forth plans to abate an evil whose character and extent they have yet to learn. Proposals for the abatement of the nuisance are without number, although for the most part they are merely repetitions of what has been suggested ever since the time when furnaces first came into existence. The commonest proposal is the oft-recurring scheme of drenching the smoke with water, a plan which, for aught I know, may have originated in the time of the Pharaohs. It is surprising indeed that a scheme so frequently tried and so inadequate should not have been finally dropped long ago. It is, therefore, worth while to repeat what has been said a thousand times before as to the nature of smelter smoke, so as to get an idea of the problem to be solved, and then discuss it in the simplest language, so that there may be no excuse for the ignorance which impels men and newspapers to misstate facts, and legislators, like simpletons, to father bills requiring the impossible to be done.

Harmful Gases

In the first place, nineteen-twentieths of the gaseous material of smelter smoke is like that from an ordinary fire, and quite harmless. The remaining one-twentieth may consist wholly or partly of gases that under some circumstances, but not by any means all, may do harm to vegetation, and perhaps to animals. The really injurious gas, and practically the only part of the smoke which need be considered in any ordinary discussion of the question, is SO_2, the gas which is produced by the burning of a sulphur match or a piece of brimstone. This is derived from the sulphide minerals treated in practically all smelting and roasting operations having to do with the extraction of copper and lead, as well as of gold and silver. This gas, as well as many others of a less noxious character, has to be allowed to pass off into the air in nearly every case, for reasons which will later appear. Although there are other solid substances in the fume, such as lead and various compounds of arsenic, which might be supposed to be injurious to organic life, they are for the most part withdrawn from the smoke and retained within the works by well known and universally employed apparatus, such as dust-chambers, bag-filters, and the like, with which all modern smelting plants are provided. Some of these are too valuable to be allowed to escape, and while some damage might be caused by their presence in the atmosphere the harm actually caused is negligible in almost every case. The flue-dust, which is normally present in furnace gases of all kinds, is regularly caught, and therefore no harm need be apprehended from it, whatever its composition may be.

Sulphur Trioxide

Another gas, sulphur trioxide, SO_3, closely related to the first, is disguised. It quickly takes up moisture from the atmosphere and becomes sulphuric acid, the destructive effects of which upon organic matter are well known. Since sulphur dioxide is also, to some degree, converted by natural processes into sulphuric acid by the action of free oxygen, the effects of the two oxides cannot well be differentiated, nor need they be in this connection. However, since the acid can be effectually removed from the air in which it is suspended, it presents some points of difference in its behavior from the dioxide, which is practically impossible to condense on any great scale, such as would be demanded by an attempt to purify the smoke of an ordinary smelting plant. A number of recent inventions fully adapted to the disposal of the recoverable part of the fume, especially of the sulphur trioxide, have been installed at the more modern plants. Unfortunately these improvements have been put forward in some cases as cure-alls for all the evils, though it is natural enough that emphasis should be laid upon successful work in this line, while the failure of attempts to render the really troublesome part, the dioxide, harmless, have been ignored so far as possible. But the public on its part is even more blameworthy. Noting the helpless condition of the smelters, a class of despicable blackmailers has grown up, who levy tribute on the industry, assisted by undiscriminating laws, and the profession of smoke-farming has attained quite a vogue.

Smoke-Farmers

A smoke-farmer is an agriculturist who makes two spears of grass grow in place of one, so that if they providentially wither he may get paid for both. By tying a sick horse in the path of smelter smoke he makes the price of two good horses when the poor beast expires. A barren ranch in the region of smoke is worth more than a fertile one in any other locality. Smelter smoke is the stock in trade of this sort of farmer, but any kind of smoke is a good excuse for extortion. The emanations of oil-refineries, gas works, or any other factory, so long as it rises in the region of smelters, answers the purpose so long as ignorant jurors can be convinced of the fearful effects of the flue gases. That these evils are enormously exaggerated there is no doubt. It is so common to hear tales of the desolation wrought by smelter smoke that the general public looks upon it as a matter of course that smelters almost ruin the country. If half a dozen trees and a clump of worthless brush can be shown to have been blighted, the greatest cry goes up and threats of suits and in-

junctions are heard. Litigation out of all proportion to the damage done takes place and heavy costs are incurred. One company alone in California has expended, in fighting suits for smoke damage, more than the actual provable damage by smelter smoke since the industry first began on the Pacific coast. Considering the kind of country where the smelters are generally situated, the character of the vegetation and the sparseness of the population, the conclusion is inevitable that most allegations of damage are all but baseless; and that in more distinctly agricultural regions the damage might be justly assessed at moderate sums. But it is useless to talk of justice or moderation. Public sentiment is, without sufficient reason, opposed to smelters, and jurors and court officers are only too ready to mulct them heavily whenever there is opportunity. They are looked upon almost as public enemies, and their operations are regarded as a public nuisance.

Unpleasant Nature of the Fume

Besides the foregoing consideration, there is another of some moment, which is rarely mentioned, even in the complaints of the smoke-farmers. This is the unpleasant nature of smelter fume, the smell of which is objectionable to many, though not at all poisonous. Residents of the neighborhood may well complain of this feature, which may render life less desirable. Sulphur oxides affect the breathing apparatus more or less, according to the degree of their dilution. Asthmatic people are apt to suffer from comparatively mild fumes, but healthy individuals, like the workers around furnaces, may enjoy robust health continuously, though exposed to much stronger sulphur emanations. It is found that the system, becoming habituated to such fumes, can tolerate, after a time, a gas which it would be difficult to breathe at first. It is rare indeed that smelter employees are heard to express objection to the atmosphere which their employment compels them oftentimes to breathe. Having settled that sulphur dioxide is the really objectionable component of smelter smoke, the source, as it were, of the woes both of those who make and those who breathe the fumes, it will be proper at this point to describe this body, tell its effects upon organic life, and explain the reasons why attempts to prevent or control it have been and must always be unsuccessful.

Sulphur Dioxide

Sulphur dioxide, as is well known, is a colorless and invisible gas, much heavier than air, that mixes with and diffuses itself in air readily, so that the fumes progressively grow weaker after they leave the smokestack and enter the surrounding air. The dioxide consequently becomes more dilute, but covers a greater space—two facts that must be kept in mind in this consideration. The mischief caused depends upon the strength of the gas and upon the time of exposure to its action. Gases containing not more than one-thousandth part of the dioxide may be breathed by man and are not greatly harmful to plants, and not by any means to all plants, since some are more susceptible to its influence than others. Again, when the air-currents move fitfully, now in one direction, now in another, those plants which are affected may recover when the winds change their direction. I have seen bushes lose their leaves as many as three times in a season, putting forth fresh foliage whenever the smoke took a different course. But if the fumes persist over an area for a prolonged period, several months, for example, the plants are unable to recover, in many cases. This condition is not, however, so common as may be thought. In reality, but comparatively few of the trees and grasses within reach of smelter smoke are completely killed, and of those which expire, the character is such that little actual loss accrues. The native scrub growth within the smoke area of, for example, Shasta county in this state, is of extremely small value, except possibly in connection with the retention of the rainfall. It is certainly not worthy of governmental interference for its protection.

Smoke Dispersion

Very dilute fume, made so by the dispersion of the smoke by the trade winds, affects the crops little or not at all. In the natural course of things the volume of smoke broadens out as it drifts along, and while remaining suspended in the air troubles no one. The most favorable condition of things exists when the furnaces are situated on large plains. In this case smoke dispersion is unimpeded, but as most smelters are found in mountainous districts, where local air-currents, or still worse, stagnant patches of air exist, the smoke may have to take a definite direction and may be for some time protected from diffusion, and considerable damage may result. In fact, the greatest damage occurs in just such wind-bound areas; the more so as the fume becomes cooled nearly to the temperature of the surrounding land and hence is prevented from rising above the plant growth. It should be said that the initial heat of the gases, which adds to their ascensive force, is a factor. It will, therefore, readily be seen that in order to escape the fume difficulty, the smoke should be hot when it leaves the stack, and that the works should preferably be situated on a plain. If in a hilly country, the smoke should be conducted through culverts of sufficient lengths to the top of some eminence, where the general oceanic breezes may have free access. This has not been the practice, the custom being to place the plant, not where it will do the least hurt, but where it will do the most good.

Manufacture of Sulphuric Acid

The most obvious means by which the smelter-smoke nuisance is to be prevented is by retaining the dioxide within the works. This has been done, but so far only by turning it into sulphuric acid; a process which involves great expense, and is only admissible where a market exists for the acid. As a general thing, it would cost, aside from the value of the sulphur, $6 to $8 per ton to manufacture the acid (66°B.), corresponding to a cost of about 1c. per pound of sulphur in the ore. As applied to the prevailing copper ore of the Shasta belt, for instance, the average expense would be perhaps $7 per ton, which is decidedly prohibitive. Few

copper ores could stand such a charge, and smelters are consequently debarred from the employment of this means of getting rid of their sulphur. But where a market can be found for the acid, the presence of the sulphur, otherwise a detriment, becomes beneficial, and sometimes highly profitable. It is in this manner, by the use of sulphur-bearing ores of various metals, especially of iron, that a large part of the acid of commerce is manufactured. In nearly all of the mining districts of this country, however, there is no market whatever for the acid, and even in so large a community as Butte the smelters have never had any encouragement to go into its manufacture. A small proportion of the sulphide ores of California are utilized in this way, and the greater part of the local output of acid, which reaches some 200 tons per day, requiring one-third that weight of sulphur, is made in this way.

Utilization of Sulphur

But the amount of sulphide smelted is so large that the sulphur contained in them is vastly greater than that needed for the acid manufacture. Indeed, it is probable that, taking one year with another, not more than one-fourth of the sulphur in California ores is utilized. The rest escapes into the air, furnishing the basis of what is called the fume nuisance. No one regrets this waste more than do the smelters, and they are fully alive to the desirability of conserving all valuable material and of abolishing the nuisance. But the situation, as it stands now, is clearly beyond them, and will remain so until either the excess of sulphide ores is used up, or population and manufactures overtake the mining business, producing a market capable of taking care of the vast quantity of acid which would have to be made. This, in a nutshell, has been the reason for the existence of the fume question. Since sulphur in the form of brimstone is worth in the centres of commerce about $20 per ton, and in the form of pyrite about $12, there is ample incentive on the part of the miners and smelters to do their best to improve conditions. The public should realize, what they do not seem to have grasped as yet, that the matter is a most difficult one, without the easy solution that the uninitiated appear to believe in. There are other methods of solving the question than acid production, but they have not yet passed beyond the experimental stage. What they are, I will briefly recount.

Methods of Recovery

The methods in general use are two. In the one, it is proposed to preserve the sulphur from oxidation during the treatment, causing it to pass off, sublimed and invisible, to be condensed farther on into flowers of sulphur, a merchantable commodity. This implies the simultaneous oxidation of the combined metals in the sulphides, which is a necessary part of the process. In the second method, the sulphur, oxidized in the process, as is the associated metal, is subjected to deoxidation after it has passed off, and is thus converted into the elemental form, settling likewise in the flues beyond. The Hall process, previously described in these columns, deals with the sulphides in roasting apparatus, and consists in effecting their decomposition there by means of gases containing a paucity of oxygen; in short, enough to unite only with the iron, which thereby rejects its sulphur, which, at the heat prevailing there (some 1700°F.) is sublimed and passes over into condensing apparatus of no special kind. Thus the oxidized metals are procured, and with them, not the sulphur dioxide which is the universal concomitant of ordinary roasting, but elemental sulphur instead. The reactions are assisted by steam, which, as I have pointed out,* has the effect, at comparatively high temperatures, of decomposing metallic sulphides, with the evolution of hydrogen sulphide. This gas is by an easy decomposition the source of elemental sulphur, since by its interaction with sulphur dioxide that substance, together with water, is directly produced. The Hall process is about to be introduced on a working scale at the Balaklala mine, in Shasta county, in this state.

Separation of Elemental Sulphur

The idea of expelling the sulphur from metallic sulphides in the uncombined form is quite as applicable in smelting as in roasting. The underlying idea is the oxidation of the iron without that of the sulphur, which necessitates a selective action of the oxygen present. The oxygen, one would suppose, must be free, as in blast-furnace smelting; but this does not agree fully with the views of the proponents of the Hall process, who place reliance upon that combined with matters which, at the temperatures judged advisable, would give it up to the iron. Evidently there must be a sharp control of the gaseous matters, both before and after the oxidation. I designed and partly constructed, some eight years since, a plant to operate upon what I call ultra-pyritic principles, having in view the expulsion of the sulphur in the elemental form. In order to confine the oxidation to the heavy metals (almost exclusively iron) in the charge, I arranged for a very strong blast of five pounds per square inch, to be heated to a higher temperature (1000 to 1200°F.) than has ever been used in pyritic work. This I assume to be necessary to provide sufficient heat in the zone of fusion to carry on the reactions properly, not calling upon the sulphur for any increment of heat. This selective action of the oxygen under some circumstances is a common phenomenon, as may be seen in the quantities of sublimed sulphur accumulating upon roast heaps, and further, is seen in blowing converter charges when a good deal of sulphur is sublimed as such. In the ordinary pyritic process, much is also given off. We are apt to ascribe these appearances to the excess of sulphur in the mineral pyrite; but pyrrhotite, which contains no excess, produces also a volatilization of sulphur under the same circumstances. There is no doubt a great deal of promise in this direction, although it will probably be somewhat difficult to control the work so as always to get the best results. The combination of oxidation with distillation, which these methods practically are, must inevitably introduce complications hitherto unsuspected. I believe, though, that the principles

*'Metallurgy,' Vol. I, pp. 172-174.

are well worth following up. It would be surprising, indeed, if pyritic smelting were to advance another step beyond what we have always considered its ultimate, the production of matte and sulphur dioxide. It is perhaps too much to hope that the whole of the sulphur beyond that needed for matte production should be evolved in the elementary form, thus removing entirely the fume nuisance: there must doubtless be a portion that would become oxidized; but if any considerable percentage can be so recovered, it will be a distinct triumph for metallurgists, and will add greatly to the profits of smelting. The conditions, however, for the recovery and sale of the sublimed material must be favorable, from which we must argue that such an improved method will be of comparatively restricted application. It would hardly be expected that all the sulphur should be recovered by either of these processes; but should the percentage of the dioxide be made to go below that found destructive to plant growth, the chief end will have been attained. There are, in fact, two points of view to be taken: the removal of the fume nuisance, and the recovery of the valuable element, which are coincident.

Other Dioxide Methods

The other methods deal with the dioxide as it issues from the furnace. It is proposed by some to decompose the gas by means of carbonaceous fuel (petroleum or coke) in the flues. A fire is kept burning there, the excess of carbon taking up the oxygen of the dioxide as it passes through, which is thereby reduced to the elemental form, settling beyond in the form of powder. This method is undergoing experimentation at Campo Seco. In such a process, more than an incomplete recovery of the contained sulphur could not be expected. A very common but always unsuccessful proposal is to remove the dioxide itself from the smoke by means of water, which dissolves it to a small extent. Innumerable suggestions and inventions have been made with this end in view. It is quite possible to abstract the dioxide in this way, but as it is only soluble to a limited extent, the process is balked by lack of water and by the great size and cost of the necessary apparatus, added to which there is no practicable means of getting rid of the charged liquid, which in itself would constitute a nuisance even greater than that it is proposed to obviate. The bad effects upon the streams thus polluted with so active a gas need no emphasis. All fish and other animal life would perish, and the farms along the banks would be affected at least as injuriously as if the smoke were allowed to escape at once into the atmosphere. It would probably be worse, as the tendency of the gas to escape slowly from solution would carry the SO_2 to quite remote and probably inhabited localities. As only about 1% of the gas by weight is taken up by ordinary exposure to ample water, the quantity of solution would be tremendous, considering the immense output of smoke from large works, and no river of less size than the Amazon would be sufficient to cope with it. Any such use of streams would be immediately enjoined, of course. As a whole, the proposal is entirely impracticable, and only deserves mention here in order to show the mistaken ideas of the many inventors who are constantly re-introducing this scheme in a new or, often, in an old form.

Washing the Gases

Although the wholesale removal of the dioxide and the suppression of the smoke evil by washing the gases is impracticable and visionary, a certain modification of this method has achieved technical and, in a limited way, commercial success. In this the practice is to absorb the gas in water dripping downward through coke-filled or other towers, whereby a solution is obtained containing about 1% of dioxide by weight. This is filtered to free it from the flue-dust and other solids, and then is heated in closed vessels, whereby the gas, which is less soluble in hot than in cold water, is driven off, caught in other apparatus free from air, and is then compressed by machinery until it assumes the liquid form. It is then an article of commerce, although of very limited application. The only works engaged in this manufacture, to my knowledge, prepares about 1000 tons of the liquid dioxide each year, a quantity which could be made from 500 tons of sulphur, or from two to three times that weight of heavy sulphide ore like that of Shasta. The manufacture, therefore, cuts no figure in a discussion of the fume question, and is only pertinent as showing what could be done were the demand for the liquid dioxide much greater than it is now or is ever likely to be. It appears finally that unless some unlooked-for change takes place in the industrial world, whereby much larger quantities of sulphur or its products are demanded, things must go on practically as they now are, the smoke being discharged into the atmosphere, but with a gradually increasing utilization of the sulphur according to the growth of the population and the demand for sulphuric acid. Conservation of the sulphur, however desirable, is impracticable under most conditions, since its conservation demands that the ore deposits lie idle until that element can be better utilized. It is not to be expected that owners of mines will suffer them to lie idle in order to conserve a substance of only problematic value when they are in position to realize on the more immediately valuable metals which they possess. Meantime, the smelters are awake to the desirability of improvement and are making many costly and strenuous efforts to obviate the fume nuisance. So far as I can see, their best hope will be to improve conditions by the use of very extended flues and culverts by which the smoke may be conveyed to points where it can do little or no damage. It is very desirable now to do the utmost toward building up a public sentiment which will look with tolerance upon their efforts, and will be more disposed to await their outcome. I must say the whole outlook is not very hopeful.

Stamp-duty at the Talisman mill, New Zealand, averaged 4.27 tons per stamp day in 1912. The cyanide plant produced 52,589 oz. fine gold and 223,652 oz. fine silver, the recovery being 95.1 and 72%, respectively. Treatment costs averaged $3.42 per ton.

Emerald Fields of Colombia

By F. P. Gamba

The adjoining sketch map shows the geographical position of the emerald deposits of Colombia. Of these deposits, those at Muzo are the most important, not only for the size of the workings, but also for the quality of the stones found.

I believe that Somondoco was the first emerald mine to be worked by the Spaniards. Shortly after operations were commenced here Muzo was discovered and the Somondoco mines were abandoned and not reopened until recently.

The Muzo emerald is remarkable for its color and water. Emeralds from other mines, although as perfect as those from Muzo, always have a yellow nuance and a glassy lustre, while the Muzo emerald, in the finest varieties, is blue nuanced, and in its lustre is *gota de aceite* (drop of oil) as described locally. The geological formation of the Colombian emerald deposits is different from that of the emer-

SKETCH MAP OF EMERALD FIELDS.

ald deposits of other countries and furthermore the Muzo formation is quite different from the Somondoco, Guazeque, and others in Colombia.

The Muzo Deposits

I will summarize in a few words the most prominent features of the emerald mines of Muzo. The country rock is a black dolomitic schist, probably of the Jurassic age. The emerald-bearing formation is a network of stringers of quartz and calcite carrying some iron pyrite. Beautiful collection specimens are obtained from these veinlets.

The emeralds are found in pockets in the stringers in a matrix called *guarrucero* which is interesting in itself. This *guarrucero* is a powdery material, gray in color, and spotted with green composed of a mixture of the carbonates of calcium, cerium, and lithium. The stones are loose in the matrix.

Emeralds are found in the *guarrucero* in all sizes, qualities, and shapes, and in some cases they are found in a green viscous material which is called by the miners *esmeralda tierna* (child emerald). The principal associate of the emerald is the parisite.

While this is the most common manner of occurrence the stones are also found intermixed with quartz and calcite in the veinlets and here they are adherent to the gangue material. In many cases they are found as incrustations in the black schist of the country rock.

Classification of Emeralds

The emerald was evidently the last deposited of the vein materials. I have seen splendid stones completely enclosing crystals of pyrite. The color of the gem ranges from white to the typical blue nuanced green and in lustre from that of quartz to the oily lustre which is characteristic of the Muzo emerald. The specific gravity of the stone is a function of the color. The emeralds at the mines are classified according to color, water (limpidity), lustre, and form. It is impossible to imagine the beauty of the crystals which are to be found in the deposits of Muzo and is to be regretted that the Colombian government has not established a special department in the National Museum in Bogotá for a collection of these minerals.

Open-cut methods are used in mining. The emerald formation is under a bed of barren material more than 100 metres thick. This barren material is hand-drilled and loosened by explosives. The loosened material is then washed away by water under pressure. Water for this purpose is stored in large reservoirs constructed at higher elevations than the workings in order to afford the necessary head. When a good formation is discovered special workers begin the work, first the cleaning and afterward the hand-picking of the stones, precautions being taken to guard against robbery. The stones are sorted and weighed at the mine and again in Bogotá before being packed for shipment to Europe. The only authentic information about the production of the mines of Muzo is to be found in a report by E. Lloyd Owen, published in the *Diario Oficial* (No. 12,330) in 1905.

A production covering eight months, under favorable operating conditions, was as follows: First class emeralds, 262,548 carats; second class, 467,600; third class, 22,700; and fourth class, 16,000. The value of this production was over $768,920.

Governmental Control

The Colombian government controls all of the emerald deposits in the country, which is an important measure, for were it otherwise over-production would result and the value of the gem would depreciate. It has also proved good policy to destroy all of the low-grade emeralds produced. Plans have been completed for improving the equipment at Muzo which includes the fitting of the mines with drilling and shoveling machinery. I have concluded that all the emeralds found by the conquerors in Peru, Ecuador, and other Latin-American countries came from Colombia.

The quantity of coal shipped by rail and water to Pittsburgh and through Pittsburgh to points west in 1912 was 43,801,134 short tons, an increase of 4,160,226 tons over 1911.

Power-Plant at the Associated Mine, Kalgoorlie

By M. W. von Bernewitz

The Associated plant includes six Babcock & Wilcox boilers and six Davey-Paxman water-tube boilers of 1299 and 1255 sq. ft. heating surface respectively, with a working pressure of 140 lb. Salmon gum, gimlet, black butt, oak, and mulga wood are used as fuel, and 3.5 lb. of water is evaporated per pound of fuel, at and from 212°F. The boilers are fed by

MIXED PRESSURE TURBINE.

a vertical compound weir feed pump, which is an extremely simple and efficient type.

Hoisting Plants

At Tetley's shaft there is an electric hoist with a fly-wheel generator, of the well known Ilgner system. The geared hoist consists of two conical drums, driven by a 215-b.hp. direct-current motor, which uses about 70-kw. on an ordinary load. Foot and air brakes are attached. The fly-wheel set consists of a 6.5-kw. exciter, 65-b.hp. motor, and 9-ton cast steel fly-wheel, and a 130-kw. generator, all on one shaft, and in the order given, revolving at 720 r.p.m. This set was devised for the purpose of equalizing the power consumed during hoisting, by the energy stored in the wheel. At the No. 3, 6, and 15 levels in the main, or Judd's shaft, ore-bins have been excavated, and at other levels temporary chutes have been fixed for filling the skips, which hold two tons of ore. The steam hoist at this shaft was installed some 13 years ago, and has been in commission ever since. The cylinders are 20 by 60 in. The pistons have tail-rods. There are foot-brakes on the discs, also post-brakes, and steam reversing and clutch gear. The engine hoists 3 tons from 3000 feet.

The Engine-Room Equipment

The main air-compressor is a cross-compound, air and steam engine. The steam cylinders are 33 and 57 in. diam., and the air cylinders have diameters of 29 and 48 in., with a 60-in. stroke. The maximum speed is 40 r.p.m. The ordinary Corliss valve-gear is attached. The fly-wheel is 20 ft. diam. and weighs 22 tons. The working load is about 500 hp. for the mine and mill, but the plant is capable of developing 1000 hp. As an auxiliary, there is a Rand duplex air-compressor, with steam and air cylinders, 13 and 22 in. diam. This engine is rarely used. For driving four No. 8 and six No. 5 Krupp mills with conveyors and elevators, there is a horizontal cross-compound engine of 500-hp. capacity, but with an average load of 350 hp. The cylinders are 18 and 35 in. diam., with a 48-in. stroke. The fly-wheel is 18 ft. diam. and weighs 19 tons. It has 14 grooves for the driving ropes, and a speed of 60 r.p.m. There is an auxiliary lighting set, consisting of a vertical compound engine of 135 hp. with forced lubrication, running at 350 r.p.m., and driving, by a flexible coupling, a 3-phase, 25-cycle, 550-volt generator of 85-kw. capacity, with an exciter on the same shaft. This set supplies power for the electric hoist and is used to drive 12 motors in the plant, but its use will soon be discontinued. The condensing plant consists of a large surface condenser containing 33,000 ft. of ¾-in. tubing, through which the circulating water is pumped by a 16-in. centrifugal pump driven at 450 r.p.m. by a vertical compound engine of 40 hp. The water is pumped to a cooling tower. The air-pump consists of a vertical 3-cylinder engine running at 115 r.p.m. The average vacuum is 25 in. The exhaust steam from all the engines is passed into oil-separators, and then to the low-pressure turbine.

The Turbo-Generator

The turbo-generator may be described as a mixed-pressure turbine, as live steam may be used if there is not enough exhaust from the other engines. It is a horizontal type turbine direct connected to a 750-kw., 3-phase, 50-cycle, 550-volt generator, with a speed of 3000 r.p.m. The whole machine is mounted on a single bed-plate, and is entirely automatic in its action. If there is more exhaust steam than is necessary to drive the turbine, the excess passes by an automatic valve to the condenser; if there is not sufficient exhaust steam, live steam is admitted at 140 lb. pressure by six automatic valves. The low-pressure steam averages from one to two pounds, and the vacuum 25 in. Forced lubrication, at 45 lb. pressure, is essential for the successful running of the machine. The governor and valveless oil-pump are worked by means of worm-gearing, the former of the ball and spring type, operating in oil, as seen in the foreground, and if there is not sufficient low-pressure steam, the speed is reduced, and the governor admits more steam in the following manner. The governor has an arm connected by a rod to a small piston valve, which admits oil at 45 lb. pressure, to a rotary valve, which is connected to a cam-shaft.

This shaft is geared to an arm which fully opens the main low-pressure steam valve, when the oil pressure causes the cam-shaft to revolve, and the high-pressure valves are opened, one at a time, as steam is needed. If the low-pressure supply is entirely cut off, the high-pressure valves open, according to the load. It will be seen that the oil does all this work, besides lubricating the three main bearings. In case the turbine goes too fast, there is an emergency governor. This operates when the speed is at 3360 r.p.m. Fitted to the turbine shaft is a weighted eccentric on the inside of the bearing casing, with a spring at the back, and when the above speed is reached the eccentric flies out somewhat and hits a trigger, which in turn, by a system of rods and weights, immediately shuts off both high and low-pressure steam, the exhaust steam then going to the condensor by a by-pass, and the turbine slows down. As packing could not be used on the shaft at such a high speed, a water-seal is fitted at both ends of the turbine.

The switchboard is automatic in action. There are eight panels of enameled slate, five of which are connected by leads to the various groups of motors throughout the plant. One panel contains the generator and exciter switches, and the various meters; another has the Tirrill voltage regulator mounted; while the last panel is for the lighting. The current for the latter is passed through a 50-kw., 3-phase, oil-cooled transformer, which steps down the current from 550 to 110 volts. The method of driving everything by motors is quite satisfactory, and several long lines of shafting which required much attention have been dispensed with along with the services of fifteen men. Power costs average $1 per ton of ore treated. There are 41 motors about the surface plant, and the following table gives details of them, and their duty:

No. of motors.....	Capacity of each, hp.	Speed, r.p.m.....	Operation.	Power absorbed by each motor, hp..
1	85	720	No. 7½ Gates crusher.....	16 to 60
1	20	720	Incline belt conveyor, 110 ft. long...	12
1	10	950	Horizontal belt conveyor, 75 ft. long	5½
1	10	950	Fan for ball-mills	6
2	7½	950	Feed conveyors for furnaces.....	4
4	10	950	Four Edwards roasting furnaces...	6½
1	7½	950	Furnace discharge conveyor	4
1	10	950	Hot water pump for furnaces.....	7
1	7½	950	Assay office sample room.....	...
2	25	720	Hot ore conveyors, elevators, mixers.	12
5	40	720	Twenty grinding pans	20
1	10	950	Clean-up barrel and pan.....	...
1	20	720	Fitting shop machines.....	...
1	7½	950	Plate-rolls, shears, and punch.....	...
2	25	720	Centrifugal pumps, 5-in. delivery...	12
3	25	720	Six A. Z. agitators.....	16
1	40	720	Filter-press filling pump	24
1	20	720	Filter-press washing pump	15
1	10	950	Pumping gold solution to clarifier..	8
1	10	950	Residue mixer of vortex type.....	6
2	25	720	Residue belt conveyor to mixer.....	12
1	20	720	Residue pump from mixer to pond..	12

Besides the above, there are several other motors on intermittent work.

Fineness of Gold at Fairbanks, Alaska

Placer gold is generally believed to increase in fineness the farther it is removed from its source or parent vein, an assumption based on field evidence. According to Philip S. Smith, in *Economic Geology*, interesting data on this subject has been supplied by Frank W. Hawkins, formerly of Fairbanks, Alaska. The placer gold having the highest fineness in this district assays 950 per 1000 parts, and is found on claims in the central part of the valley of Big Eldorado, a tributary of Goldstream. The lowest fineness recorded for any considerable amount of placer gold is 800, from claims near the head of Ester creek and on St. Patrick creek. L. M. Prindle and F. J. Katz have reported a fineness of 792.5 from Ready Bullion creek. The average of 167 determinations at Fairbanks is 880 fine, but the mean of two averages, according to the amounts of gold of each fineness, is 868.5 fine. The average silver is 127 fine. A comparison of the fineness of the bullion from the individual placer claims in the district indicates that, on the whole, the gold becomes progressively finer downstream. This fact is well illustrated by the bullion from Twin and Pedro creeks, for, at the farthest claim upstream it is 861 fine and becomes progressively finer downstream until at the junction of Pedro and Gilmore creeks it is 906 fine. No lodes are being developed in the Pedro Creek basin, but disseminated mineralization undoubtedly occurs there, so that the placer gold in this basin probably did not come solely from the lode deposits noted on the upper part of Twin creek and Skoogy gulch. This condition also prevails in all the other valleys. The data therefore do not warrant computations based on the assumption that all the gold is derived from the same source.

Influence of Surface Processes

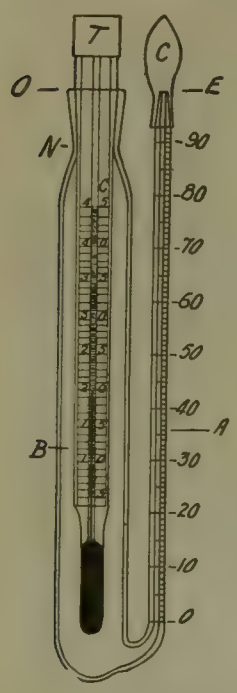
The fineness of the gold probably increases even in deposits which are not being transported; in other words, probably the longer gold is subjected to surface processes, other conditions being constant, the finer it becomes. Therefore, in two deposits alike in all features except those due to difference in age, the older contains gold of the higher fineness. Search among the records of the fineness of gold from Fairbanks for detailed evidence in support of this belief so far has proved unsuccessful.

Twenty-four determinations of the fineness of the lode gold from different parts of the Fairbanks region were obtained. The highest fineness is 843, the lowest is 780.5, and the average of the 24 determinations is 817, which is equivalent to a gold value of $16.89 per ounce. The average lode gold is therefore 63 parts per 1000 lower than the average placer gold reported in this paper or 40 parts per 1000 lower than the fineness reported by Prindle and Katz. The amount of silver was determined in five of the assays of the lode gold bullion and ranged from 149 to 180 parts in 1000 parts of bullion, the average being 167.5. The average silver content of the bullion from all the lodes computed as the remainder obtained by subtracting the fineness of the gold from 990, is 174.5.

Combination Specific Gravity Bottle and Dilatometer

By C. A. Browne

*The sketch shows a specific gravity bottle and dilatometer, consisting of a narrow tubular body *B*, holding about 30 c.c., connected at the bottom with a graduated capillary tube *A*, and contracted at the top to an opening at *O*. The latter is made slightly funnel shaped and is carefully ground on its inner surface so as to receive the thermometer *T*, which is also ground above its scale so as to fit perfectly tight after insertion. The displacement of the thermometer is about 7 c.c., which leaves a capacity of about 23 c.c. for the instrument after stoppering.



The end of the capillary tube at *E* is ground and fitted to a small cap *C*. The scale, upon which the changes of volume are measured, is graduated so that 1 division equals 0.001 c.c.; by means of a magnifying glass, readings can be made to 0.0001 c.c. Capillary tubing is manufactured of uniform calibre, so that the graduation can be made with accuracy.

A few weighings of the instrument, after filling with air-free distilled water to different points of the scale at different temperatures, are sufficient for constructing a table of water constants for each scale division and temperature. The ground-glass surfaces should be lightly coated with vaseline to prevent all possibility of loss from evaporation. The instrument, when filled with water and stoppered, should show no loss in weight after a week's standing. In making weighings the bottle may be placed in a support, or it may be attached to the hook of the balance beam by means of a loop of wire wound about the neck at *N*.

For determining specific gravities, the method of operation is the same as with an ordinary pyknometer. If it is desired to determine the specific gravities of a solution at different temperatures, one filling of the instrument and one weighing only are required. After filling the apparatus the meniscus in the capillary tube is adjusted by means of a thin, tightly-wound strip of filter-paper to a convenient position upon the scale, and the whole is weighed. The instrument is then placed in a constant-temperature chamber (such as an incubator) and as soon as the thermometer and meniscus readings remain constant the observations are noted. By raising or lowering the temperature and noting the changes in position of the meniscus, the specific gravities and coefficients of expansion or contraction may be readily calculated. The position of the meniscus is easily affected by very slight changes in temperature, so that the instrument is best handled by placing it in a stoppered glass cylinder.

*From the *Journal* of the American Chemical Society.

Recovery of Quicksilver From Ores

During the last two years inquries have been made by the United States Geological Survey relative to methods of recovery, and quantitative data on the subject have become available for the first time. These data show the insignificant total output from retorts, although a large number of retorts usually are in operation.

Quicksilver retort furnaces are of two types: the pipe retort and the D retort. Both work on the principle of distilling off the mercury from the ore separately from the gases of combustion and conveying the volatilized metal through short outside condensing pipes to a trough in which the mercury is collected. The retorts are built over fire-boxes and are filled and discharged horizontally from the same doors and from the furnace floor, the D retort by means of iron pans resting on the flat bottom and the pipe retort by semicircular shovels and hoes. Retort plants contain from 1 to 15 retorts, 12 being the usual number for a pipe-retort plant, and are inexpensive to build and operate. It has been estimated that a 12-pipe plant costs from $1000 to $1500, depending upon local conditions. The pipes themselves cost $25 to $35, whereas the D retorts about $250 each. The D retort, however, increases capacity and decreases space. Recovery is probably 75% of metal in the ore as charged. Retort plants serve useful purposes at small mines or in prospecting or early development, but are best used perhaps for treatment of rich ore and concentrate or furnace soot. Unless carefully operated they menace the health of workmen by causing salivation; and when in operation at new mines the temptation is to gouge out rich ore for them and possibly quickly to sacrifice a property that otherwise might be remunerative.

The great bulk of present domestic output is from shaft furnaces, in which, as is well known, the descending ore meets the upward furnace flames and gases, and the volatilized metal passes with the gases and impurities of combustion into a series of condenser chambers, usually of brick, in which the metal is collected and from which it is drawn off. The gases pass from the final chamber to the stack, usually through an inclined flue. The modern tendency is toward the increased use of the Hüttner tile furnace perfected by Robert Scott, formerly of the New Almaden mine, which is adapted to both medium and fine ore. All the furnaces in Texas and Nevada are of this type. At New Idria, also, are the coarse ore furnaces designed by B. M. Newcombe, and at the Guadalupe are the Davey modified Litchfield furnaces. Some thought and experimentation have recently been given to the application of rotary furnaces for quicksilver ores. It has been estimated that a Scott furnace can be built, under favorable local conditions, at about $1000 per ton of capacity. According to this the common 10-ton furnace should cost about $10,000.

Discussion

Readers of the MINING AND SCIENTIFIC PRESS are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment. Insertion of any contribution is determined by its probable interest to the readers of this journal.

Under-Estimating the Cost of Milling Plants

The Editor:

Sir—Under-estimating the cost of milling plants is the rule rather than the exception, and I have read with great interest Mr. Additon's diagnosis of the case. I cannot agree with all of his conclusions, however, and as it would appear futile to call attention to an ill without proposing a remedy, the following suggestions may prove of interest. The blame for under-estimating costs lies primarily with the buyer, who is, as a rule, aided and abetted in fooling himself by his mine superintendent. The latter is presumably a mining engineer, and is not unnaturally interested in holding his job. Therefore, when the question of building a mill arises, he will profess his ability to perform the duties of metallurgical engineer in devising a method of treatment, mechanical engineer in designing the plant, and engineering contractor in constructing it. It is truly a wise man who knows his own limitations, and a great man who has the courage to confess them. A mining engineer may know intimately everything from the collar of the shaft down; he may be able to call every rock known to geology by its first name, and yet be unable to calculate whether the chords of a roof truss should be 4 by 6 or 8 by 12. I have seen more atrocities in the form of mill plans submitted by mine superintendents than have emanated from any other source, and this is simply due to their efforts to *save* their employer's money by undertaking work for which they have had no special training. This lack of training along lines that are highly specialized becomes even more pronounced when the time arrives for the erection and construction of the plant. This work should under no circumstances be undertaken by the mine superintendent, but should be contracted for as a whole with a reputable contractor. I could cite countless instances within my own experience where mining companies have undertaken to do their own construction work in order to *save* the contractor's profit, with the result that their plants cost from 25 to 75% more than the contractor's bid, to say nothing of having taken a proportionately longer time to build. If a man who is his own lawyer has a fool for a client, what is the man who undertakes work that calls for the specialized knowledge of four different kinds of engineers? If you are ill, send for a doctor; if prison stares you in the face (save the mark!) send for a lawyer. If you desire to develop a mining property, send for a mining engineer. When you are ready for a reduction works, let a metallurgical engineer devise your treatment and a mechanical engineer design your plant. When you are ready to build, you have only to whistle, and the contractors will swarm around you by the score. This method of procedure has many advantages, chief of which is a knowledge of the cost of your plant before it is built, rather than after. Men are human and prone to err, and engineers, like other men, make mistakes. But of all the engineering professions, the engineering contractor is the only one who pays for his. Remember this, and when you see an engineering contractor on the street, don't speak roughly to him. He is human like the rest of us. One word more. I quote: "Visiting in the city by the manager, superintendent, or engineer at company expense, discussing the proposed plant, and *lunching with machinery dealers is a source of expense* which could be eliminated." The italics are mine. I would like to ask, *en passant*, if when lunching with a machinery dealer Mr. Additon was ever so careless as to pay for his own lunch.

Josh Billings, one of the pioneers in the art of simplified spelling, once said, "Sum peepls branes is located in their heds." This may be true enough, but it is the common experience of machinery houses that the only direct route to a buyer's affections is by way of his stomach. I do not pretend to say that a 'mess of pottage' is the only factor that influences sales, but it would be indeed difficult to negotiate a sale without it. The mine superintendent is given to calling the machinery salesman a peddler in public, but is glad to consult with him in private. As a matter of fact, the machinery houses have for years made practically all of the mine superintendents' estimates for them gratis. Not only that, but this practice is often extended into supplying engineering data entirely outside of any possible chance for securing an order for machinery. Personally, I should like to see all machinery dealers shut down on this sort of thing. It could be done by mutual agreement. All reputable manufacturers would a thousand times rather figure from intelligently prepared drawings and specifications than make the extraordinary efforts they do at present to get at the buyer's requirements before selling machinery to meet them.

CHAS. T. HUTCHINSON.

San Francisco, August 16.

Prospecting by the Government

The Editor:

Sir—While traveling from one Nevada mining camp to another, a few days ago, I stopped at a spring, where I found a typical old-time prospector camped for the night. His equipment of tools, camp utensils, and food was good, and his four burros were grazing nearby. Everything was well cared for, and he gave one the impression of being a man who was in earnest and understood his business.

With all that, he told of having spent months in a southern range where the chances of finding mineral were almost hopeless; and he was then on his way to the north to search for a legendary vein of high-grade ore that had been found and later lost by his brother prospectors in the misty past.

He belongs to a class that is rapidly becoming extinct, and many reasons have been given for his disappearance from the hills; such as the establishment of forest reserves, the difficulty of interesting capital in mining, etc. It is my belief, however, that the real cause is the lack of incentive because

of the increasing difficulty of finding good mines. The veins which disclosed their presence by bold outcrops were located long ago, and more obscure veins in their immediate vicinity were soon added to the list of producing mines. Later, such districts as Tonopah, with only about 300 linear feet of outcrop for the entire district, and Goldfield with very little more, were discovered and developed. Their discovery caused an influx of 'prospectors' of all classes and degrees of experience, and Nevada was overrun by grocery clerks, schoolteachers, doctors, lawyers, miners, and a few prospectors. Some were searching the hills for bonanzas; some were watching the searchers, that they might be ready to stake a convenient townsite; and some, also, were lying by shady springs consuming their grubstakes.

The result of a decade of this kind of prospecting in Nevada has been the discovery of few first-class mines and the expenditure of a great deal of money on prospects, of varying merit, that have not made mines. On the whole, it has probably not resulted in finding enough profitable mines to repay 20% of its cost; and in this respect Nevada is in no worse position than the other mining states of the West. The chances for success in prospecting have been steadily diminishing for years, and herein lies the secret of the true prospector's withdrawal from the field. They have not all died, nor have they all become rich enough to retire.

It is a well known fact that Tonopah, one of the most important mining districts found in recent years in the United States, was discovered by accident; and, no doubt, similar accidents will occur in the future; but why leave such things largely to chance? The mining of precious metals in this country is an important industry, and a decline in the mining of the money metals must affect all other industries, but the decline must come unless new mines are found to take the place of those which are becoming exhausted.

Most of the land in which it is possible to find new mines is still a part of the public domain, and owned by the people as a whole. It is therefore suggested that it would be a proper function of the Government to systematically search its own lands for mineral-bearing veins, using all the knowledge gained from science and from the experience of trained prospectors.

Such work could be very properly performed under the direction of the Geological Survey, though only a comparatively small number of the force employed need be trained field geologists. Good prospectors are close observers, and with a good field geologist to aid in the interpretation of their observations, much good could probably be accomplished in the way of finding ore deposits whose existence might never be suspected by the average prospector, because of obscure outcrops or none at all. It would also be possible to eliminate much effort which is now expended in the exploration of geologically impossible regions.

Assuming the discovery of promising prospects by the government explorers, the question of what to do next with such discoveries is another problem. I am not one of those who believe that the Government should engage in mining or in any other business that can be better handled by private capital; nor do I believe that the mines discovered by the use of public funds should be donated to individuals. However, the policy of leasing public lands, both mineral and non-mineral, seems to be growing in popular favor, and a system of leasing partly developed prospects could doubtless be devised.

One plan would be for the Government to first do enough development to show that certain prospects had merit. It could then publish a list of prospects with a brief description of each and call for bids; a long-time lease to be given to the responsible bidder who offers the highest royalty. Forfeiture should be provided in the event that the lessee should violate rules intended to safeguard the Government's interests, but no attempt will be made in this letter to formulate such rules.

As an objection to this plan, it might be urged that a salaried prospector would not have the same incentive to spur him to action as the prospector of the past, and this is doubtless true, notwithstanding the fact that excellent work is done by the employees of such Government departments as the Geological Survey, Bureau of Mines, Reclamation Service, and others. To attract and keep good men, it might be proper for the Government to offer its prospectors, in addition to moderate salaries, preference rights to lease at a low fixed royalty any promising ground found by them, or to participate in royalties received by the Government from others. This in effect would make the Government a colossal grubstaker on its own domain; but it would be grubstaking trained men instead of amateurs, and the results should be correspondingly better.

This plan need not exclude private individuals from exploring the public lands in search of minerals except that certain sections should be temporarily withdrawn from entry while being examined by the Government men.

Possibly the ideas outlined above will be of sufficient interest to others of your readers to induce criticism.

ALBERT BURCH.

San Francisco, July 10.

Drill Efficiency at Buckeye Belmont Mine

The following table is from the report of the superintendent, Letson Balliet:

Class of work.	Time, minutes.	Cost.	Time, per cent.
Setting up machines	82	$0.82	17
Shifting machines	66	0.66	14
Changing steel	75	0.75	15
Morning and noon starting	24	0.24	5
Oiling and cleaning	15	0.15	3
Getting steel and water	15	0.15	3
Tearing down and blasting	45	0.45	9
Actual time drilling	158	4.80	34
Total, 8 hours, or	480	$8.02	100

The gold belt in the James River basin, Virginia, covers an area of 700 square miles in Fluvanna, Goochland, Buckingham, Cumberland, Powhatan, and Amelia counties.

Special Correspondence

NEW YORK

THE COPPER SITUATION.—NEW SMELTER TO BE BUILT AT GLOBE.—RECOVERIES OF COPPER IN MIAMI, CHINO, AND RAY MILLS.—CAMP BIRD AND SANTA GERTRUDIS.—NEW DOMINION COPPER COMPANY.

The expectations of large profits from the upward movement of copper and copper shares seems to have been a trifle premature. Shares in copper mines have indeed advanced on the basis of increased earnings resulting from a higher price for copper, but the selling price of the metal exhibits a certain degree of balkiness that scarcely seems to presage any 'runaway market.' There are loud assertions that copper has sold at 16c. all during the week, but as a matter of fact very little has been sold, and the truth of the situation seems to be that with Mexico boiling over, the tariff still unsettled, and the outcome of banking and currency legislation still in the lap of fate, manufacturers have cut their buying orders down low and are pushing the selling end of their business so as to face the situation with as large cash assets as possible. European buyers continue to take copper in large quantities, exports for August being estimated as 80,000,000 lb. This is nearly 10,000,000 lb. in excess of the monthly average for this year, which is itself about 10,000,000 lb. greater than the monthly average of the past two years.

The foreign statistics continue to show decreases in the stocks of copper abroad. Consumers point to these two facts and intimate that, taken in connection with the fact that the financial situation in Europe has at times been worse than in this country, there are indications of trouble ahead. It has even been stated that the Amalgamated is shipping copper from foreign warehouses back to this

CHINO CONCENTRATOR.

country. It is evident that the domestic consumer is disposed to stand pat, in the belief that when he needs copper he will be able to get it at reasonable prices. When the official job of tinkering at Washington is at last completed, there is every reason to believe that business will at once pick up again. The new tariff will make necessary a good deal of readjustment, and it is but natural that trade should meet such a crisis on a conservative rather than an extended basis.

The building of a new copper smelter at Globe, by the International Smelting & Refining Co., prophesied in this column many months ago, has been confirmed by the officials of the International company. Work will begin in time to have the smelter ready to handle the concentrate from the Inspiration mill, and the Miami concentrate will be diverted to the same plant. Since the Amalgamated owns nearly half of the International shares, this new venture will increase its hold on the copper-smelting industry by nearly 90,000,000 lb. per year. J. Parke Channing was recently in New York, and in discussing the situation at Miami referred to the fact that the tailing losses in copper at the Miami mill are 0.8% copper. As a matter of fact they were somewhat less than this during 1912, according to the annual report, which shows a recovery of 69.39% of the copper in a mill feed averaging 2.393% copper. As far as percentage goes, this compares well with such plants as Chino and Ray, where recoveries of 70% and 68.25% are being made. However, the Ray tailing only contains 0.5% copper, and the extra 6 lb. of copper in the Miami tailing represents nearly $1 worth of metal per ton that escapes from the mill. It is stated that a 20-ton leaching plant will be constructed in the hope of recovering about 12 lb. copper per ton from the tailing. It will indeed be interesting to see the outcome of the experimental study of the two most promising methods for the reduction of tailing losses. The Inspiration will soon have a 600-ton oil-flotation plant at work, and comparison of the results there attained with the success of wet concentration followed by leaching at Miami will be of great importance in determining the lines along which milling will advance in the future. The Miami mill is now treating about 3000 tons per day, the mine output having been brought back to normal.

The Camp Bird, which like a hale old man, refuses to yield to the decay of old age, has been showing remarkable vitality lately. The Santa Gertrudis ore reserves on June 30 were estimated at 778,000 tons, worth $3,740,000, as compared with 586,000 tons, worth $4,390,000, the year before, and the shares went down in sympathy. But recent reports from London show that the July operating profit at the Santa Gertrudis was $91,500, or at the rate of nearly 20% on the Gertrudis shares, and state that the cross-cut on No. 20 level has cut the vein, showing 5 ft. of ore worth $20 per metric ton. Since in the estimates of ore reserves only 26,000 tons out of 269,000 was allowed as probable ore below No. 19 level, the discovery markedly improves the position of Santa Gertrudis, which is so closely allied with Camp Bird that the two move in sympathy. At the Esperanza, Ltd., 17,572 tons of ore and 34,229 tons of tailing was treated in April, May, and June, with a gross yield of $333,590 and a net profit of $83,339.

The New Dominion Copper Co., which is controlled by the British Columbia Copper Co., is about to make a peculiar payment. The Company started out as the Montreal & Boston Mining Co., and, after some troubles, was taken over by the Dominion Copper Co., Ltd., with a capital of $5,000,000 and a bond issue, which was sold at 90, with an accompanying bonus of $200 in stock. Three years later it was taken over for $348,000 by the New Dominion company with $1,250,000 in issued capital and $500,000 in 6% convertible bonds. For the first time in its existence, the Company operated at a profit last year, with a net profit of $119,000. It is now proposed to pay coupon No. 4 of the bond interest, due the first of next month. This is provided that the holders will be willing to forego payment on coupons No. 1, 2, and 3. Though not entirely out of the woods yet, the Company is certainly on the uphill road and deserves all the success it attains.

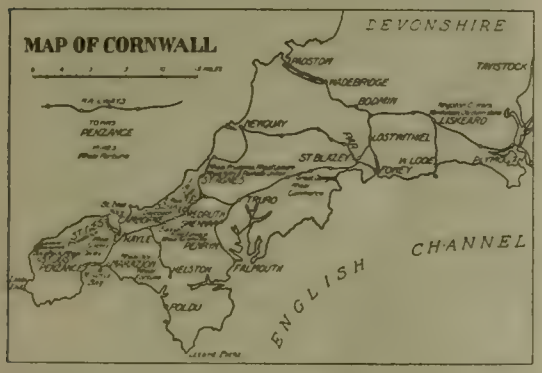
LONDON

CORNISH MINING AND DEVELOPMENTS AT THE DOLCOATH AND LEVANT.—RE-TREATING OLD TIN-ORE TAILING AND FURTHER EXTENSIVE DEVELOPMENT CERTAIN IN THIS INTERESTING WORK.

Cornish mining has been again to the fore in city circles during the last week or two. Attention has been attracted by the keen inquiry in Cornwall for Dolcoath shares, and the press and the public have been endeavoring to ascertain the cause. It is unfortunately, both in America and in England, a habit among most of the directorates of mining companies to refrain from issuing either good or bad news. In spite of the strenuous pleas put forward by *The Mining Magazine* and by the daily and weekly press, the shareholders continue to be left in the dark with regard to new discoveries and proposed modifications of policy. The Dolcoath coterie is not noted for communicativeness, and the public has to do a good deal of guessing when movements take place in the shares. As far as can be ascertained—and this is only hearsay—the improvement in the situation at Dolcoath is due to the intersection of the north lode at 1260 ft. depth, and the discovery there of rich deposits of tin ore. It is generally forgotten that

the Dolcoath area contains a series of lodes of which only one, called the Main lode, has been developed at all extensively during late years. The Main lode has been in poor ground recently at the bottom level, 3000 ft. below the surface, and it was deemed advisable to investigate the other resources of the property. The cross-cut was started over six months ago, and is much deeper than any previous workings in this part of the property, as recorded in the old plans. No doubt, at the forthcoming meeting of shareholders, some information will be given.

Another old Cornish company, the Levant, near Land's End, has attracted attention owing to the possibility of the present company having to relinquish possession at the expiration of the lease a year or so hence. This mine is famous owing to its workings penetrating a long way under the sea. It is also notable because it is the last of the big Cornish mines to be worked under the old cost-book system. Francis Oats, chairman of the De Beers Diamond Co., is the largest shareholder at present, and he is in fact the controller of its fortunes. The 'lords'



are demanding onerous terms for the renewal of the lease, asking for an increased royalty and requiring a large amount of money to be spent on development. One wonders whether it is the fact of a man connected with a mighty industry like the De Beers being in control at Levant that gives the 'lords' the opportunity of squeezing their lessees. Moreover, they state that other people are ready to come forward and accede to the new terms. Mr. Oats is unmoved by all these threats, and says he will not renew except on the old terms. For the last year or two he and the board have adopted the policy of accumulating a reserve fund with the object of embarking on a vigorous policy of development directly the renewal of the lease is agreed. If, however, the lease passes to other hands, this fund will be distributed, and the assets, such as plant, realized.

The re-treatment of old tailing is the most profitable business in Cornwall at present. The present vogue was set three years ago, when the Anglo-Australian group, of which J. T. Lempriere and W. L. Baillieu are leading spirits, purchased over a million tons of dump from the Carn Brea & Tincroft company. The average content of these dumps is nearly 20 lb. metallic tin per ton. The material is reground and re-treated on tables and buddles according to standard methods, but the recovery is only 40%. The reasons for this poor result, and similar results at other mines in the neighborhood, are being investigated by several engineers and metallurgists. The subject has been discussed in detail in *The Mining Magazine*. The Company is investigating several chemical processes for treatment of the material with a view to securing an adequate recovery, one of the processes being that invented by the manager, Arthur Richards. The same group has recently turned its attention to the accumulation of cassiterite in the sand of the Carnon river, one of the tributaries of Falmouth harbor, and coming down from the mining districts of Chasewater and St. Day. The stream itself is a small one and runs down the middle of a tidal estuary. Here natural concentration has been going on for ages. Many people have tried to treat this sand, but hitherto to no profit. The new owners have formed a company called Carnon Valley (Cornwall), Limited, of which Theodore J. Hoover is chairman. Tests have been made, and above high tide 1,900,000 tons of material averaging 12½ lb. tin per ton has been proved. In the tidal portion there are also large amounts of material worth treating, but as the engineering problem is not easy, their exploitation will be left for a time.

Another sand deposit that promises well is on the Gwithian beach at the mouth of the Red river, which comes down from the Camborne district. Here, David Stephens has made a decent living for a generation by regrinding and reconcentrating. The Cornish Tin Sands Co., of which Oliver Wethered is the leading spirit, has acquired the property and has erected a large regrinding and dressing plant. This should be in operation within two months.

HOUGHTON, MICHIGAN

THE STRIKE SITUATION IN THE COPPER DISTRICTS, GENERAL FEELING, AND THE ATTITUDE OF CERTAIN FOREIGN WORKMEN.

There is not much change in the strike situation here, although additional men are going to work every day and the mines are producing a little copper 'rock.' The socialistic element continues to dominate the situation, covertly under direction of prominent politicians who are trying to make capital out of conditions, and who are encouraging the strikers and officials of the Western Federation of Miners. This element seems to have pronounced influence with some of the politicians in high places, so much so that there is great indignation at the action. In fact, the independent business men of the copper country are now convinced that the strike would be over and the mines working normally if it were not for the moral support given the strikers and their leaders by the investigators and mediators sent here. This applies both to the state and federal governments.

There is no doubt that the majority of the workingmen of this district never wanted the strike, and did not countenance it when it was called. At the present time, a large majority desire to return to work and several thousand have already returned. But it has required a great deal of nerve and courage to go to work under existing circumstances. The situation now is, that practically all of the English and Scotch miners have resumed work. A large number of the Italian miners have signified their intention of returning to work during the week ended August 23. They claim that the situation was misrepresented to them, that they have not received strike benefits as promised, and that they can see nothing to be gained by remaining away from their employment any longer.

The two classes which are holding out for the Western Federation and a continuance of the strike, are the Finns and the Austrians. Most of them are rank socialists, particularly the former. The spirit of unrest and opposition to any organized government is born and bred in the Finn. It comes with him from his native land, and when he gets a home and a job in this country it is difficult for him to distinguish between license and liberty. The Finn socialist is against the government, no matter what the government may be. They are just as naturally opposed to authority, restraint, or power, and it does not matter much where that government or authority originates. There are two Finnish daily and several weekly newspapers here. One of the dailies is avowedly socialistic, and its editors, managers, and employees are the leaders in this strike movement. The other Finnish daily has recently come out in favor of the strike, and that position has added to the general antagonism toward the Finns as a class, upon the part of the public that generally is hopeful for a return to normal conditions. In the recent dock strike in Duluth, operated by the Industrial Workers of the World, the Finns took a leading part, and orders have gone forth that henceforth no Finns are to be taken on the Duluth ore-docks. The general belief here is that, when this difficulty is ended, the number of Finns employed in the mines of Houghton county will be largely reduced.

To date the strike here has cost the workingmen more than a million dollars in loss of wages. In some instances it has cost them their jobs, as the mining companies in resuming operations are diligently weeding out the more rabid of the agitators and socialists and refusing to take them back on any terms. They are showing preference for the better class of labor and are securing promises from all the men who return to work that they are going to keep away from affiliation with the Western Federation of Labor. These facts are becoming pretty well known throughout the country, and a general influx is anticipated in a short time. In fact, quite a few of the miners from the lead district of Missouri, where the Federation recently called a strike, have already arrived here and applied for work. A good number from this district, who went to Detroit to take jobs in the automobile factories, are inquiring about positions in the copper country again, as they anticipate a strike outbreak instigated by the Industrial Workers of the World in a short time.

DEADWOOD, SOUTH DAKOTA

NEW MILL FOR THE MOGUL MINING CO.—HEIDELBERG CLAIMS TO BE DEVELOPED BY DEADWOOD BUSINESS CLUB.—MINING AND MILLING AT THE TITANIC, IRONSIDES, NEW RELIANCE, BISMARCK, AND GOLDEN GATE.

Favorable progress is being made by the Mogul Mining Co. in the construction of its new plant in Nevada gulch, and it is hoped that the mill will be crushing ore by the end of the year. For over a year the Mogul has been without milling facilities, a fire having so severely damaged the plant at Pluma in March 1912 that the Company took no steps to rebuild on that site. After considerable research work, it was decided to rebuild at a point more convenient to the mine, and that near the Snowstorm mine was selected as the most convenient and suitable. A plant at this point will be able economically to handle a large tonnage of low-grade ore which could not profitably be shipped to Pluma. From the Pluma plant will be salvaged practically all of the crushing and grinding machinery necessary for the erection of the new plant, which will have a capacity of 150 to 200 tons per day. The Pluma plant also contains a number of vats which can be utilized, and the warehouse and machine-shop, which were not damaged by the fire, contain much valuable machinery, repair parts, supplies, and the usual layout of tools found in a small machine-shop. With all of these accessories at hand, the engineers of the Company estimate that the plant as outlined will cost $46,000. It is also planned to expend $8500 in mine development and equipment in order to make the mine workings convenient to the mill. The trustees for the bondholders have in hand $73,280 of insurance collected on the fire of the old mill, and have agreed that the present expenditures may be made from this money. Ore supplies for the new plant will be drawn from the North lode, Carstreet, and Black Moon, which are stated to have 48,000 tons in sight at the present time, the Mark Twain, Sunnyside No. 1, Ben Hur, White Pine, Hardscrabble, and others. The new plant will use gyratory crushers, rolls, Chilean mills, Dorr classifiers, and the continuous decantation and counter-current system of slime treatment, using Dorr thickeners, and eliminating the filter-plant as used in the old mill. As the first plant in the Black Hills to use this process with a filter, its operations will be closely watched.

Promotion of a mine has been undertaken by the Deadwood Business Club, a committee of which spent over two months examining numerous properties. Upon the final report of the committee it was almost unanimously decided, at a general meeting of the members, to accept the proposition offered by the owners of the Heidelberg group, which was to give to the club a one-half interest in the property if the club would raise $5000 for further development. This amount was quickly raised, from fifty men who agreed to advance $100 each in monthly payments. The idea was not to raise the money among a few men, but to give a goodly number an opportunity to contribute, and have a good list of boosters for the enterprise. Work will commence September 1 and continue throughout the winter. The property is regarded as one of the best prospects in the Black Hills, showing a most encouraging face of ore in the meagre developments which have thus far been made. Sampling of this by numerous parties shows it to be of excellent milling grade, while some of it would pay well to ship to smelters. It is the intention of the club to develop the mine to a point where it can readily be sold, and it is believed that this can be done in six months time. The property is in a rough part of the country, and the first work will be the construction of a wagon-road, expected to cost about $700.

OPEN-CUT MINING AT THE WASP NO. 2. PROPERTY.

Toward this work the county commissioners have appropriated $250. The property consists of 185 acres, which includes a good territory of splendid timber, a good mill-site, and is traversed by Two Bit creek, which carries enough water to supply a large cyanide plant. Administration of the affairs will be left to a board of five trustees, of which the owners, John Treber and A. T. Roos, will be members. The club will select two members, and these four will select the fifth man. Should this venture prove successful, the club will take up other properties and handle them in a similar manner.

A steam hoist is being installed at the Titantic property, at Carbonate, which, with the air-compressor, will be run by steam from the Iron Hill plant, 150 ft. distant. The Titantic shaft is 100 ft. deep, and water has commenced to show in the shaft. It is proposed to dewater the Iron Hill shaft to the 300-ft. level, believing that this will drain the Titanic workings, and as soon as a skip is completed and coal delivered this will be commenced.

Lessees on the Ironsides property, in Squaw creek, are preparing for an all-winter siege in the snows of that locality, and about the most important work under way is the construction of ore-bins in which the ore excavated during the winter will be stored. This work will be completed before the snow comes, and in the meantime shipments will continue until the roads are impassable. Three cars of smelting ore, the poorest of which was worth $30, has been shipped in the past month, and two cars of milling grade are now being loaded for shipment to the Golden Reward mill at Deadwood.

Wasp No. 2 paid its regular dividend of 1 cent per share on August 14. The mine is operating regularly at

full capacity, 500 tons per day, and a good surplus fund is being built up in addition to the distribution of profits. It is estimated that there is a supply of ore sufficient to operate at present capacity for six years now in sight in the quartzite deposits alone.

New Reliance is dropping 30 stamps and handling a satisfactory tonnage of good grade ore. The ore is quite hard, and is crushed fine, so that the daily capacity is a little under 100 tons. Diaphragm pumps have been installed lately to replace the air-lifts for moving pulp from tank to tank in the continuous-decantation process. Mr. Bowman, the manager, states that this change resulted in a fair saving of electric power. The pumps require less supervision than the air-lifts, and the management is well pleased with the change. The ore-supply is at present being drawn from workings near the top of the hill, and will come from there until cold weather sets in, when the scene of operations will be changed to the tunnel workings directly at the rear of the mill.

The Bismarck mill, at Flatiron, is operating successfully at full capacity, 300 tons per day, and is showing a profit on operations. The ore is mined by glory-hole and trammed to the mill, where, after coarse crushing, the entire product is leached with cyanide solutions. So economically has the work been laid out that during the past month total cost of mining and milling, including general expenses, was only 95c. per ton. This figure did not include many items of repairs, which will be higher as the mill gets older, but on the other hand, some economies may be effected which will offset them; for instance, a mechanical haulage system, eliminating horses, to handle the ore between mine and mill, would result in a saving. On the basis of present operations, the property is earning a good profit.

The Golden Gate property, at the head of Blacktail gulch, is being thoroughly sampled by W. T. Boley, who represents the Chicago owners. The old workings have been dewatered and carefully sampled. Mr. Boley is also making a thorough examination of a bed of quartzite which outcrops on the south end of the ground, believing that it will be possible to handle it satisfactorily on a large scale. The bed is nearly 20 ft. thick. Preparations are being made to take a sample of several hundred tons in order to get a reliable sample of the whole bed. This amount will be removed and shipped to some local plant where it can be crushed and quartered for assay and treatment. In addition to this deposit, there are a number of smaller shoots of ore of good value, and altogether it is quite probable that a mill will be built.

Exploratory work at the Elliptic, which is under bond to the Strattan Venture Corporation, headed by Frank S. Strattan, consists of reaming out the diamond-drill hole which is claimed to have produced high-grade cores in the past. The hole was drilled to a depth of nearly 800 ft. from the bottom of a 600-ft. shaft, and it was near the bottom of the hole that ore was found and good cores were produced. At the present time the reaming has been completed to a point a little more than 600 ft. below the collar of the hole, progress having been slower than was anticipated, but within the next two weeks it is expected that the bottom will be reached.

On August 15 the Homestake Mining Co. declared monthly dividend No. 416, constituting a record in the annals of gold mining. Starting its divended disbursements in October 1878, they have been regular each month with the exception of two short periods, when from extraneous causes the mine was closed. With next month, September, the Company will have completed 35 years of dividend payments. It is interesting to note that the present dividend is one of the biggest ever declared, amounting to 65c. per share on 251,160 shares issued. It means the distribution of $163,254 among the stockholders. And the end is not yet. The Homestake probably has more ore reserves than any other gold mine in the world. They approximate 30,000,000 tons, or enough to operate at present capacity for twenty years. And all of this at the shallow depth of 1900 ft., with a large ore-shoot still going down and producing from the lowest levels some of the richest ore ever found in the mine.

The First National Gold Mining Co. has been organized by Detroit people, taking over the Forest City property near Hill City, Pennington county. The officers are W. J. Blake, president and manager; John B. Sheffiett, vice-president; Henry J. Guthard, secretary and treasurer, and George P. Good, consulting engineer. The property consists of 20 acres, on which a shaft 110 ft. and lateral workings disclose a shoot of high-grade free-milling ore. A contract has been let to sink the shaft an additional 200 ft., and work will probably start by the first of September. A 10-stamp mill was erected last fall, which is described as a neat plant of its kind. It is equipped with Pierce amalgamators and Wilfley tables. It is probable that a cyanide annex will be added.

The Black Hills Tungsten Co. is employing a number of men in both mining and milling construction. The property is near Hill City and is to be equipped with a small concentrating plant as quickly as the work can be completed.

TORONTO, CANADA

CROWN RESERVE MINE AND THE SHARE MARKET.—DEVELOPMENT AT THE BEAVER, YORK ONTARIO, AND LUMSDEN.—LA ROSE PRODUCTION.

The principal feature of mining interest this week has been the passing of the bonus on Crown Reserve stock, as announced by the directors on August 11. The Company, in addition to the regular monthly dividend of 2%, has been paying a bonus of 3% to stockholders. The latter has been discontinued, the reason assigned being the pinching out of the Carson vein, the leading producer in the mine. For some days previous to the announcement the stock of the Crown Reserve had been steadily falling on account of large blocks having been thrown on the market. The passing of the bonus was followed by a further slump, the stock dropping to $1.70, the lowest price since 1908. Reports alleged that the directors, taking advantage of inside information, had sold stock heavily before the general public was made aware of the conditions, but all statements to that effect have been emphatically denied by Mr. Carson, the president, and his fellow-directors. Nevertheless, it is clear that some extensive stockholders must have had an inkling of how matters stood, and the affair has done much to weaken public confidence in mining ventures. The future of the Company now appears to be entirely dependent on the success of the project to drain Kerr lake in the hope of increasing the ore reserves. The Beaver, which is now cutting a station at the 800-ft. level, has attained the deepest point of any mine in the Cobalt area. Preparations are being made to cross-cut east for the main or No. 5 vein, which at 700 ft. shows a continuous ore-shoot, warranting exploration at the lower depth. Development work on the other levels has been satisfactory. A stringer from No. 5 has been picked up at 460 and 530 ft., showing 2 in. of 5000-oz. ore. The production of La Rose for July was 226,626 oz., the total revenue being $136,815, and the profit $81,413. The cash surplus at the end of the month was $1,418,404, and the value of outstanding shipments and ore ready for shipment, $299,411. At the York Ontario, formerly the King Edward, a rich ore-shoot, showing from one to three inches of high-grade ore, has been cut and found continuous for 20 ft. The Company is preparing to ship two cars of concentrate and high-grade ore. The Lumsden, situated near the Temiskaming and Beaver properties, now appears on the list of shippers, having sent out 20 tons of high-grade ore which had been accumulating for some time. Short shoots of rich ore have been found from time to time, mostly in the 250 and 300-ft. levels, in the Keewatin formation. Three drills are at work.

During July the Nipissing high and low-grade mills treated 177 and 7268 tons of ore, respectively, the product being worth $314,115. Hydraulic prospecting and underground work was satisfactory.

On August 20 the Nipissing company shipped to England 212 bars of bullion valued at $152,524, which is claimed to be a record shipment. The Buffalo company also sent out 141 bars worth $82,837.

General Mining News

ALASKA

According to Alfred H. Brooks, in an advance chapter from 'Mineral Resources of the United States in 1912,' metalliferous mining in this territory made important advances during 1912. The production was as follows:

Gold, ounces	829,435	valued at $17,145,951
Silver, ounces	515,186	valued at 316,839
Copper, pounds	29,230,491	valued at 4,823,031
Total value		$22,285,821

Fairbanks

During the third week of July there was a good fall of rain in the district, and there is plenty of water available. In spite of the shortage of water on Goldstream, operations on No. 17 have not had to be suspended or curtailed, this being due to the fact that the owners of the property are also the owners of the Goldstream ditch, and this still provides a full sluice head. It is expected that a large crew will be kept steadily at work for the balance of the season, when in all likelihood the claim will have been exhausted. This property is worked under lease by Peterson, Craig & Johnson, who are taking out 11,000 ft. of bedrock weekly. The ground is low grade, but profitable. The dredge of the Alaska Exploration Co. is to be overhauled and work probably started on No. 7 and 8 above, Fairbanks creek. At the Newsboy mine there are fifteen men employed. The manager, Louis Golden, states that there is six months' ore-supply on the 150-ft. level, where the vein is from 8 to 12 ft. wide. On the 200-ft. level the vein was cut 225 ft. from the shaft. It is 18 in. wide, but of no value. On the east end of this level, 25 ft. from the shaft, the vein is 30 in. wide, worth from $15 to $20 per ton, while there is 42 inches in a raise of about the same value. The 5-stamp Joshua Hendy mill works one shift. The *Fairbanks Weekly Times* suggests that the new placer district in Alaska be called Shusana, instead of Shushanna, Chusana, and Chisana, the first being the nearest to the Indian pronunciation. The trail, says W. H. Newton, a well known trader, is dry and well defined as far as Tanana crossing. Beyond Tetlin, he says, it would be prudent to hire Indian guides. From Tanana crossing to the Chisana, and far up the Chisana, the water is so 'slack' that the wind will blow a boat upstream. The total distance from Fairbanks is 335 miles, taking about 12 to 13 days.

Juneau

The following are the July returns of the mines on Douglas island:

	Alaska Mexican.	Alaska Treadwell.	Alaska United.
Stamps working	120	540	240
Ore crushed, tons	17,493	77,973	36,680
Concentrate saved, tons	394	1,449	.....
Gold by amalgamation	$18,573	$101,984	$49,324
Gold by cyanidation	18,867	92,394	43,063
Realizable value	37,066	192,435	91,464
Operating expenses	22,171	90,510	52,808
Construction	4,971	14,760	4,972
Net profit	9,923	87,164	33,684
Development, feet	80	474	.....
Broken ore decrease, tons	4,846	2,808	.....

On August 28 the Alaska Mexican, Alaska Treadwell, and Alaska United companies paid dividends of 30c., $1, and 50c. per share, respectively.

Another group of coal claims in the Bering River field, the Chezum, has been rejected by the Land Office at Juneau. The decision is similar to the Cunningham case, and is based upon the point that the claimants failed to show that they had opened a mine on the ground. All charges of fraud were, however, dismissed.

Nome

The most important gold find in the vicinity of Nome since the discovery of the third beach-line was made on Golden Cow claim, as reported by telegraph. Twenty dump-car loads produced $150 worth of gold. Rich placers have been found on Manila creek.

ARIZONA

Cochise County

It is reported that the United States Circuit Court of Appeals at San Francisco has handed down its decision in the case of Synnott and others *v.* Tombstone Consolidated Mines Co., Ltd., and others, which judgment affirms a decision previously made by Judge Sloan of the United States District Court at Phoenix, which latter decision in turn affirmed the ruling of the referee in bankruptcy, Daniel McFarland, at Tombstone. The referee, in his decision, held that the holders of the bonds of the Tombstone company, being a total issue of $3,000,000, were not entitled to prove their claim in bankruptcy. When the bondholders attempted to prove their bonds, they were objected to by the general creditors and by A. L. Grow, trustee in bankruptcy. The unsecured claims which have been proved and allowed amount to upward of $2,500,000. While the text of the decision of the Circuit Court of Appeals has not been received, it will probably have the effect of terminating the pending litigation between the bondholders and the general creditors. Disposal of this litigation will doubtless bring about the resumption of operations in the mines of the Company at Tombstone.

According to Charles E. Knox, president of the Montana-Tonopah Mining Co., Nevada, the Commonwealth mine, owned by that Company, is proving to be a much larger property than was anticipated when it was purchased. On one level a stope 90 ft. wide is being opened, and the ore for a width of 18 ft. will average from $11 to $15 per ton, and the remainder profitable milling ore. On other levels large bodies are being opened, and there is fully 100% more ore in sight than when the mine was purchased. The new mill will be ready early in September.

Gila County

(Special Correspondence.)—The test of the electric smelting of copper ores at Globe resulted in an extraction of 98% of the copper content. The salient feature of the test was the fact that about 3500 kw. per ton charge was required for smelting. From this may be estimated the economical practicability of the furnace. The added features of absence of water-jackets and lightness of parts make the furnace peculiarly adaptable to carbonate deposits in high and inaccessible places, provided electric current can be supplied at a rate sufficiently low to make operation of the furnace an economical success.

Sultan & Wayne are reported to have abandoned their lease on the Gibson, where recently they were reported to have made successful tests of jigging the sulphide ores. It is also reported that the owners of the Gibson are negotiating with the Minerals Separation Co. for installation of a small flotation plant at the property, the chalcopyrite ores of the Gibson being favorable for that manner of recovery. The Iron Cap is mining more high-grade ore above the point in the east 650-ft. level drift where the vein widened so suddenly. The stope there is known as No. 3 and is being driven west to connect with No. 2 stope and driven east along the vein. The whole face of the main east drift on the 650-ft. level is in copper ore varying in daily average from 10 to 15% copper. The point where the vein widened on the 650-ft. level is about 494 ft. east from the shaft, and the face of the 800-ft. drift east is now about 210 ft. in the same direction, leaving about 285 ft. to be traversed before the shoot is found on the lower level, if the enlarged portion of the vein proves nearly vertical.

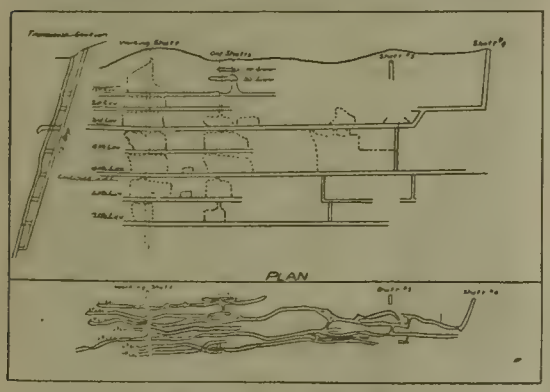
Miami, August 20.

It is reported that a successful attempt was made to smelt ore in an electric furnace at Globe on August 14. The test was made there at the instance of H. S. Paul, of Pittsburgh, who purchased the furnace from the Pittsburgh company, and had it shipped to Globe and set up on the ground of the Globe Light & Power Co., which supplied the current used for the trial run, Mr. Paul defraying the entire cost. The test was made on ore from the Copper Reef mine, 13 miles south of San Carlos. The ore contained 68% silica and 5.44% copper. The furnace is known as the

electric-resistance type, and has a capacity of 15 tons of ore per 24 hours. The furnace has a steel shell and an 18-in. lining of Grecian magnesite brick. A stationary electrode passes through the base of the furnace, about half an inch above the bottom of the brick lining, and a second electrode 4½ ft. long and 4 in. diam. is suspended in the furnace and is raised and lowered by means of a wire cable attached to a small winch. The slag was thin and contained only a trace of copper. The copper produced was of higher grade than that from a blast-furnace, and there were no dust losses.

MOHAVE COUNTY

The Midnight mine has shipped a carload of concentrate to the Copper Queen smelter. The Copper Giant shaft is down 275 ft., and 5 ft. of $35 ore is being opened. The Gold Road yielded $18,000 from a six days' run of the mill,



TOM REED MINE WORKINGS.

while the Tom Reed produced $88,000 in July. Outside mining properties are being purchased and developed by the Company, so that other sources of ore-supply will be available should anything occur to cut off the reserves of the main property. Some of the new mines are said to be developing satisfactorily.

PIMA COUNTY

(Special Correspondence.)—The Calumet & Arizona Copper Co. will make a preliminary survey for a railroad to be constructed from Tucson to its properties at Ajo, 80 miles southwest.

Tucson, August 21.

PINAL COUNTY

(Special Correspondence.)—In the Pioneer district, popularly known as the Superior district, the general tone is constantly improving. The Magma continues its shipments of high-grade ore *via* Florence to El Paso, and it is known that its drilling operations have revealed considerable high-grade copper ore at a depth of several hundred feet below the lowest present workings. It is still uncertain when the power-transmission line from the Roosevelt dam *via* Miami will be completed to Superior, but probably it will be early in 1914. The Calumet & Arizona, Reymert, and Ajax properties are being actively developed. At the point in the Ajax where the workings left the vein it had 15 ft. of ore assaying well in lead, zinc, copper, and some silver and gold. Indications are favorable for development of copper at the property, as both chalcocite and chalcopyrite are showing in the vein.

Florence, August 20.

(Special Correspondence.)—Certain mining districts in this county are being examined by C. E. Knox and E. A. Cowan of the Montana-Tonopah, Nevada, and Commonwealth, Arizona, companies, respectively.

Florence, August 21.

YUMA COUNTY

(Special Correspondence.)—Two tons of $80 lead-silver ore has been shipped to the Selby smelter by George Norton. This came from the Eureka district, about 60 miles up the Colorado river, and was brought down by boat.

Yuma, August 21.

CALIFORNIA

Statistics of the oil-producing counties are as follows:

	Barrels.
Stocks, June 30	46,389,663
Production in July	8,573,906
	54,963,575
Consumption in July	8,325,402
Stocks, July 31	46,638,173

There were 48 rigs completed during the month, 337 wells drilling, 67 completed, 5 abandoned, and 6035 producing. Dividends amounted to $734,771.

AMADOR COUNTY

The Kennedy Extension Gold Mining Co. is being sued for $30,000 by John A. Gubson for injuries received while working in the Company's shaft.

MARIPOSA COUNTY

A 5-stamp mill, of 1000 lb. stamps, has been shipped to the Studhorse Flat mine, at Bagby, by John T. Carroll.

NEVADA COUNTY

A good deal of interest is being taken by Grass Valley people in a promising vein opened in a garage in the town.

SAN DIEGO COUNTY

About $100,000 has been spent in developing the Montezuma gold mine, situated 11 miles from Warner's Hot Springs, by Pasadena men, headed by E. W. Knowlton, of Crown City. The company owns 18 claims in the San Ysidro range, and 15 gold-bearing veins have been opened. Present operations are confined to the Morning Star and Eureka claims, where the vein has been developed to 200 ft. depth, exposing good ore. From 12 to 18 men are employed, and further development is planned on the 250-ft. level when it is reached.

SISKIYOU COUNTY

(Special Correspondence.)—The Keables Mining Co. is working the Pine Grove placers, near Walker, with a dragline excavator. The Company has completed an extensive line of flumes and the gravel scooped out by the excavator is discharged into the sluices and washed as in ordinary practice. It is said that prospects are good. San Francisco people are interested. Most of the placer mines in the Walker and Oak Bar districts have stopped work for the season, owing to scarcity of water. Drifts from No. 2 adit of the Cub Bear mine have entered the orebody, which yielded good grade quartz in the upper level. The shoot is small, and only the specimen grade quartz is being shipped. The Cub Bear is situated 16 miles from Etna and is operated by the Siskiyou Syndicate. A force of 12 men is employed on development work at the Dakin copper mine, near Fort Jones. Three shifts are worked. It is rumored that Eastern people are considering the acquisition of the property, Oakland people being the owners. Work will be resumed at the Bunker Hill placer group next winter. A new pipe-line has been decided on, together with substantial repairs to the flumes.

Fort Jones, August 18.

TUOLUMNE COUNTY

(Special Correspondence.)—An option has been secured by J. N. Lyon and others on several hundred acres of land situated a short distance southwest of Jamestown, through which, it is believed, the rich gravel channel uncovered in Table mountain extends. It is announced that active work will begin soon to develop the property. A number of men are engaged in general repair work at the Jumper, and it is understood that the early resumption of mining operations is assured. The long adit at the Paymaster mine, southeast of Tuolumne, is still being driven, and it is said that the operators are pleased with the present outlook. Work has begun on the Carlin property, near Jamestown, recently bonded to Howard Pollion, of New York. A hoist has been purchased, and when installed the working force will be increased.

Sonora, August 15.

Charles H. Segerstrom reports that the water is being rapidly lowered in the Dutch mine, and since June 1 it

has been reduced from the 800 to the 1400-ft. level. About the end of September the shaft and mine will be drained to 1700 ft. depth. Present operations in the mine are mostly confined to driving and stoping on the 300 and 800-ft. levels, and to reopening and prospecting on the 1000-ft. level. It is stated that C. E. and G. E. C. Boyd are negotiating a sale for the Rawhide and App mines, and it is generally believed that a strong syndicate has been formed for the purpose of not only acquiring these mines, but adjacent promising properties.

TRINITY COUNTY

The Alta Bert Gold Dredging Co. owns over 600 acres of ground along the Trinity river, near Trinity Center,

ALTA BERT DREDGE, NEAR TRINITY CENTER.

and the dredge, with 7½-cu. ft. buckets, has been in operation for about 19 months. A steel spud, weighing about 20 tons, has recently been added to the equipment.

COLORADO

The state mining commissioner, Thomas R. Henahan, has issued a circular containing figures on the mining industry of this state. He states that the mines of Colorado supplied 85½% of all the tonnage originating in this state on the Denver & Rio Grande, Colorado & Southern, Colorado Midland, and Denver & Salt Lake railroads in 1912, leaving only 14½% to be supplied in 1912 by agriculture, manufacturing, and all other industries not associated with mining. In Denver there are about 80,000 people dependent on mining for a living, while in the whole state there are 382,500 people dependent on the industry.

OURAY COUNTY

The annual report of the Mountain Top Mining Co. contains the following information: The exploration work from the adit before cutting the vein where it was of normal width amounted to 108 ft., and the drift north on the vein to 168 ft., making a total length of new workings on July 31 of 2501 ft., of which 2250 ft. was driven since January 1. In the north drift the vein has varied from 2½ to 8 ft. in width, and the main streak from 6 to 22 in., the latter averaging a little over 10 in. for the entire distance and being 18 in. at the present face. The average of 22 samples from the streak was $7.86 gold and 64.4 oz. silver, or a total value of about $46.50, per ton. The flow of water from the adit is 140 gal. per minute. A good millsite has been secured about 5000 ft. from the portal of the adit, and 1000 ft. from the Atlas mill, and is safe from snowslides. The ground between the adit and site is suitable for an aerial tramway.

TELLER COUNTY (CRIPPLE CREEK)

During July, eight of the local mills, the Portland, Stratton's Independence, Colburn-Ajax, Kavanagh-Jo Dandy, Gaylord-Dante, Rex Mining & Milling Co., Wild Horse, and Isabella plants, treated 35,373 tons of ore with a gross value of $85,428. This low-grade ore ranged in value from $1.10 to $2.84 per ton, with a general average value of $2.41 per ton. This tonnage will be increased soon by the addition to the Portland mill and the completion of the Neville and El Oro mills. The Gaylord mill is treating about 75 tons per day, and a clean-up on August 20 resulted in bullion worth $4000.

Two distinct ore-shoots have been opened on the 1600-ft. level of the Portland, and they are producing good ore. No. 2 shaft is dry, and No. 1 is down 1100 ft. at present, and it will be necessary to sink 562 ft. to have the bottom levels of both shafts on the same plane. At 300 ft. in the Gold Bond property, a rich shoot has been opened. The Elkton company has paid a 2c. dividend, amounting to $50,000. The new ore-shoot opened by lessees in the Dexter mine on Bull hill has been opened 50 ft. It averages 3 ft. in width and about $40 per ton, the yield being two cars per week.

NEVADA

CLARK COUNTY

The Yellow Pine mining district, sometimes called the Good Springs district, in the southwestern part of this county, is well described by James M. Hill in Bulletin 540-F. of the U. S. Geological Survey. From 1902 to 1911, inclusive, the production was: gold, $196,515; silver, 101,779 fine ounces; copper, 521,411 lb.; lead, 5,138,247 lb.; and zinc, 15,834,643 lb., with a total value of $1,453,715. The Yellow Pine district has a varied production. Exclusively gold ores are obtained from at least four different mines. There is also some opportunity for the development of prospects which may yield various oxidized copper ores that are said to carry a little gold. By far the most important mines at present are those from which oxidized zinc and lead ores are obtained. These produce three classes of ore, namely, lead ore, zinc ore, and zinc-lead ore, each one of which requires different treatment. All three classes may be taken from a single mine, or they may be found in distinct deposits. Three mills have been built, one for gold ores and two for zinc-lead ores. The Keystone had two 4-ft. Huntington mills. The Yellow Pine mill concentrates an ore averaging 16 to 17.5% lead, 27.8 to 29.8% zinc, and 11 oz. silver.

HUMBOLDT COUNTY

The Causten adit on Nenzel hill, the longest that has been driven at Rochester, cut the vein on August 21 at a depth of 430 ft. The development is the most important recorded in the history of this place, for it demonstrates the much mooted question of the depth of the ore. Another important development was the cutting of 5 ft. of $75 ore in the Stoker adit on the Rochester Weaver property. The development was made at a depth of 125 feet.

NYE COUNTY

Heavy thunderstorms, on August 24, caused considerable damage at Tonopah, Manhattan, and Goldfield, while the transmission lines of the Nevada-California Power Co. were badly damaged, and the sub-station at Palmetto partly destroyed by fire. All power was shut off from many mining districts in Nevada for some time.

During July, 10 mines at Tonopah produced 48,227 tons of ore, yielding 813,385 oz. bullion and 183 tons of concentrate, the gross value of the ore being $961,440. The yield during the week ended August 23 was 12,318 tons, valued at $283,970.

STOREY COUNTY

Bullion tax statements for the second quarter of the year contain the following data:

	Tons.	Yield.	Profit.
Ophir, ore	1363	$37,134	$ 3,484
Ophir, tailing	7640	34,108	22,152
Comstock-Phoenix	1142	21,864	*613
Crown Point	5735	34,064	*486
Yellow Jacket	2536	.....	.....
Belcher	1046	3,697	*7,598
Hale & Norcross lessees	322	3,039	*302

*Loss.

Arrangements have been concluded with the Starrett Pump Co. whereby two of its pumps will be utilized in lowering the water at the north end from the 2500 to the 2700-ft. level at the C. & C. shaft. These pumps will be of 1000-gal. capacity each per minute, and will be low-

ered through the old Consolidated Virginia winze easterly of the C. & C. shaft station at the 2500-ft. level. This winze is in first-class condition, as far as it is possible to determine, and gives assurance that there will be no delay in reaching the 2700-ft. level.

White Pine County

The following are details of the new roaster stack which the Nevada Consolidated company is erecting at the Steptoe plant. The new stack is being erected on the south side of the dust-chamber and about 150 ft. west of the site of the old one. It will be 275 ft. high and is 19 ft. diam. outside. It rests on a concrete foundation 35 ft. diam. set deep in the ground. The lower section of the stack is hexagonal in shape and for 100 ft. it will be constructed of ordinary pressed brick of the best quality, and above 100 ft. the construction will be of stack tile. The stack is now about 80 ft. high and progress will be made at the rate of five feet per day.

On August 19 the first Giroux ore to be mined by steam-shovels went down Robinson cañon in a train of 21 cars. The ore was from the Ora claim and was mined by one of the Nevada Consolidated shovels from the Liberty pit for the purpose of removing the right-of-way to the pit to facilitate Nevada Consolidated operations. More of the ore is being loaded and as the regular production from the Giroux is being made as usual, the output for the week will be materially increased over the average of 1000 tons per day. During July the Nevada Consolidated Copper Co. produced 5,403,919 lb. of copper.

UTAH

Juab County

High temperatures from 90 to 100°F. on the 1000-ft. level of the Tintic Standard have interfered with development, so the Company is changing the 9-in. air-pipe from the shaft to the face of the drift, a distance of about 1200 ft., to a 16-in. line. This is expected to remedy the trouble. A No. 4 rotary blower is sending air down the present pipe. A large low-grade orebody has been opened on the 1000-ft. level of the Victoria. It is probable that the Lower Mammoth will resume shipping zinc ore in September. The new cyanide plant of Griggs, Carter, and Castleton yielded about $1500 from 960 tons of tailing treated. Results are said to confirm the experiments.

Salt Lake County

It is stated that the Yampa smelter has been offered for sale, which effectually settles the question frequently asked in regard to the Yampa Smelting Co.'s intention of resuming smelting operations. The Yampa smelter is at Bingham Canyon. It was constructed in 1904, and enlarged in 1906 to a daily capacity of 1000 tons. The plant for several years was in operation on the low-grade copper ore of the property in Bingham, but upon the negotiation of a smelting contract with the American Smelting & Refining Co. the plant was closed, and it has remained idle to date. At one time the Yampa was one of the largest copper ore producers of the West, but the more recent policy of the Company has been to cease wholesale mining so that a smaller but much more valuable tonnage might be secured at a profit.

Summit County

Ore shipments from Park City during the past week totaled 1628 tons. The Silver King Consolidated has declared a dividend of 25c. per share, amounting to $155,000.

WASHINGTON

Okanogan County

(Special Correspondence.)—Crescent Mining Co., Ltd., has installed a Samson turbine electric plant and sawmill, the latter being for the Company's own use. Temple-Ingersoll 5-C drills will be used to drive a 1600-ft. adit to cross-cut the main vein at the 1300-ft. level. Lumber is being cut for the large compressor and hydro-electric plant which is to be installed next spring, the present plant being a temporary one. The ore consists of chalcopyrite, bornite, pyrite, and quartz.

Twisp, August 23.

Spokane County

The *Spokesman-Review* published the following table showing the dividends paid by mining companies operating in the Coeur d'Alene district, Idaho, Ferry and Stevens counties, Washington, and the Boundary district, British Columbia, during the first half of the current year.

	1912.	1913.
British Columbia Copper	$ 177,512	$ 88,766
Bunker Hill	752,100	523,200
Federal	720,000	360,000
Granby	1,600,000	450,000
Hecla	300,000	220,000
Hedley	360,000	120,000
*Hercules	600,000	280,000
International Coal & Coke Co.	.....	60,000
Knob Hill	5,000	15,000
Le Roi	60,000	43,200
Republic Mines Corporation	85,000	.....
Snowstorm	75,000	89,979
Standard	425,000	400,000
Stewart	.....	123,836
Success	180,000	90,000
United Copper	50,000	.....
Total	$5,389,612	$2,863,971

*Estimated.

CHILE

The report of the Braden Copper Co. for July, stating that the No. 1 Teniente adit had advanced in that period 68 ft. in ore averaging 4.73% copper, indicates that this working has probably again reached the contact. The No. 1 Teniente adit is the most important development in the Braden mine. It has already advanced several thousand feet in ore. The face of the adit is 1400 ft. below the surface and is being driven into virgin ground with no work done either above to the surface or below the adit. Ahead of the adit there are no workings for a distance of 1000 ft. until the Fortuna adit is reached, where ore of a good grade has also been opened.

COSTA RICA

The Abangarez Gold Fields Co. reports as follows for June:

	June.	Half-year.
Ore crushed, tons	6,170	29,186
Tailing leached, tons	689	2,777
Slime treated, tons	4,902	24,112
By amalgamation	$13,655	$ 65,700
By cyanidation	42,516	185,810
Total	$56,171	$251,510
Cost of operation, marketing, and administration (exclusive of betterments)	47,942	290,212
Profit	$ 8,229	*$ 38,702
Betterment expenditure	$5,174	$47,156

*Deficit.

MEXICO

Baja California

The Boleo Copper Co. produced 14,619,920 lb. of copper during the first half of the current year. This is about 1,000,000 lb. more than the corresponding period of last year.

Hidalgo

The report of the Santa Gertrudis company shows the following regarding the ore reserves:

Ore opened and partly developed, tons	778,000
Profit in ore	$3,740,000
Probable ore, tons	269,000
Profit	$1,040,000

The San Rafael y Anexas Mining Co., one of the big concerns of the Pachuca district, has arranged to operate the San Pedro Analco mines in the Hostotipaquillo district of Jalisco on a bond and lease. The San Rafael company is under the management of Edmund Girault. It

owns mines in the Parral district of Chihuahua as well as in the Pachuca district.

JALISCO

A new body of rich ore has been opened in the Mololoa mines in the Hostotipaquillo district of this state, the property of the Mololoa Mining Co., a Makeever enterprise. Much of the ore taken out so far runs 57 kg. silver per ton, and averages 2.5 gm. gold per kilogram of silver. The new body of rich ore is between the old Mololoa mine and the Soledad mine of the Mololoa group, and was opened by a drift on No. 6 level of the Soledad. The addition to the El Favor mill in the Hostotipaquillo district, which is to be used exclusively for the treatment of Mololoa

EL FAVOR MILL.

ores, will be ready for operation within a month. The addition consists of 15 stamps, two tube-mills, concentrators, and cyanide plant, and its operation will permit of the treatment of a greatly increased tonnage of El Favor ores in the original El Favor 20-stamp mill.

MEXICO

The El Oro Mining & Railway Co., Ltd., reports for July: Mill ran 30 days and treated 23,250 tons of ore and 14,080 tons of tailing, yielding bullion valued at $169,880; working expenses and expenditures on development, 123,050; profit, $46,830; railway profit, $13,970; total profit, $60,800.

SONORA

(Special Correspondence.)—The Nacozari Consolidated Copper Co. is arranging to build a concentrator at its property, near Nacozari, by the first of the coming year, and for this purpose the board of directors has authorized the sale of 25,000 shares at $1 per share. The Company did 600 ft. of work during the past year, and the total development done at the property is 1900 ft., 1500 ft. of which is in adits. A recent report states that the vein cut in the main adit has widened out to over 6 ft. Assays from samples taken across the face of the drift gave the following: 80c. gold, 155 oz. silver, 12% copper, 17% lead, and 2% zinc. The president of the Company is John G. Alexander.

The Calumet & Sonora of Cananea shipped 721 tons of concentrate to the smelter during July. There was 347 tons of lead concentrate, 298 tons of zinc, and 75 tons of copper concentrate in the lot. During the past week the main drift shafting at the wet mill broke, resulting in the mill being shut down for two days.

Cananea, August 23.

The Tigre Mining Co., operating at El Tigre, reports as follows for July:

Ore crushed, tons	5,119
Tailing (current and dump) treated, tons	6,635
Value of shipping ore	$ 12,955
Value of concentrate	42,142
Value of cyanide bullion	64,268
Total	$119,365
All expenditure, including taxes	76,970
Net profit	$ 42,395

Owing to interruptions to electric power, due to thunderstorms, the mill was shut down for five days.

Personal

Professional men are invited to send news of their engagements and travels. Such news is interesting to friends.

P. R. WHITMAN is at Los Angeles.

C. F. RAND was at Ely this week.

L. S. AUSTIN has returned to Salt Lake City.

C. S. HERZIG was in San Francisco last week.

HENNEN JENNINGS was in San Francisco Friday.

ADOLPH KNOPF was in San Francisco this week.

P. D. BURTT has left Cordova for the Chisana gold find.

S. H. BROCKUNIER, of Nevada City, has gone to Phoenix.

G. B. STREET has gone to Valdez and other Alaskan points.

JOSEPH DURKEE has returned to Berkeley from Reno, Nevada.

L. Y. YOUNG will be lecturer at the University of Illinois this year.

V. C. BENNETT, formerly of Mexico, is now at Sydney, Australia.

BERTRAM HUNT has returned from Broomassie, West Africa, to London.

THOMAS T. READ has returned to New York from Sudbury and Toronto.

GEORGE H. YOUNG has accepted a professorship in the School of Mines of Minnesota.

VAN H. MANNING and GEORGE S. RICE, of the U. S. Bureau of Mines, are in San Francisco.

R. B. LAMB, of Toronto, is in Nevada on professional work, until the end of September.

CHARLES JANIN has returned to southern France from a visit to Switzerland and Germany.

J. A. HOLMES is in the Nenana coalfields, but will leave Valdez September 12 for the Matanuska.

GEORGE L. ALEXANDER, manager of American Type Founders Co., San Francisco, died on August 19.

REIJI KANDA, who has been on sick leave at Lake Hamana, Japan, has recovered and is back at Tokyo.

J. P. HUTCHINS has been examining platinum mines in the Urals, and is now in the Lena region, Siberia.

JOSEPH H. PLAYTER has returned to Golconda, Nevada, from Salt Lake City and an examination trip in Utah and Colorado.

H. C. RAY has left Butte, Montana, and is now at the School of Mines, University of Pittsburgh, Pittsburgh, Pennsylvania.

D. W. BRUNTON and JOHN W. FINCH have been appointed consulting engineers for the city of Denver in connection with the proposed Moffat tunnel.

L. D. RICKETTS and J. C. GREENWAY will sail from New York the middle of September for Europe. Among other countries they expect to visit the Balkan states.

TADASHIRO INOUYE has been transferred from the Imperial University at Kyoto to the corresponding institution at Tokyo. He will be succeeded at Kyoto by K. IDE, who has been studying in Germany and is now visiting the United States.

Company Reports

DALY-JUDGE MINING COMPANY

This Company operates at Park City, Utah, and the report of the general manager, George W. Lambourne, covers the first half of 1913. Results may be shown as follows:

Development, feet	9,000
Average monthly cost of development	$16,280
Concentrating ore, tons	25,514
Shipping ore, tons	2,155
Lead concentrate, tons	5,808
Zinc concentrate, tons	2,489
Average monthly earnings	$15,485
Balance July 1, 1913	$527,386

Most of the development was done on the 500 to 2300-ft. levels. In regard to the development done, the greater portion was toward the Bonanza Flat section in following the fissure systems, and the faces of the various drifts were kept far ahead of the workings. This was necessary, as drainage was thereby afforded, so that more detailed exploratory work was possible. There is therefore in the great number of points of attack a marked advantage for the future work, and good results are to be expected with the least loss of time and money.

To date the Daly-Judge company has proved the famous Daly vein for a distance of over 4000 ft. southwest of the shaft, and with a large territory still awaiting development, throughout which this vein trends. In addition to its extensive development campaign at the mine, the Daly-Judge company has a large interest in the Snake Creek Tunnel Co., which is another Park City enterprise now driving a tunnel at the rate of 300 to 400 ft. per month.

MINES COMPANY OF AMERICA

This Company operates four important properties in northern Mexico, and the report covers the quarter ended March 31, 1913.

Bullion and concentrate production	$535,679
Sundry receipts	6,566
Total	$542,245
Mining, milling, etc.	388,638
Operating profit	$153,607
Net profit after interest, general expenses, and taxes	152,052

According to the last advices received, all of the Mines Company's properties were still operating, though at two of the mines railway communication had been somewhat irregular.

Recent development work has been meeting with good results. At the Dolores, on the Prieta adit-level, an orebody has been cut, assays of which have returned $12.44, $25.25, and $34.68 per ton. The average width of this ore is 2 to 4 ft. In a cross-cut which is being driven to the west at the mouth of the main adit, a body of sulphide ore has been cut which assays about $100 per ton. The average width of this ore is 2 feet.

At the El Rayo mine an adit is being driven north and south from the shaft. It is expected that this will have soon gained a point underneath the large orebodies in the old El Rayo mine, and in this section some important developments are expected.

At the Creston-Colorado property, in the Colorado mine, between the No. 3 and 4 levels, an orebody from 4 to 6 ft. wide, assaying $6 per ton, is being opened. At the Creston mine, on No. 6 level, a large amount of development is being done. This has resulted in opening a shoot averaging 8 ft. wide and assaying $6 to $8 per ton.

At the La Dura property, in the Prieta mine, on the 1040-ft. level, in an incline known as No. 3, some promising developments have resulted, and ore averaging from 160 to 200 oz. per ton silver has been opened. At the Gloria mine some good ore has been opened in the northern portion of the property on the No. 5, 7, 8, and 9 levels. This ore, although somewhat lower than that at the Prieta, is of a good grade.

NORTH BROKEN HILL MINING COMPANY.

This Company was registered at Melbourne in 1905, in reconstruction of a former colonial company of the same name, registered in 1895. The property owned is situated at Broken Hill, New South Wales, and yields silver, lead, and zinc. The latest report of the Company covers the period ended November 30, 1912. On December 4, 1912, the North Broken Hill, Ltd., was registered to acquire the undertaking of the North Broken Hill Mining Co., no liability. The authorized capital of the latter Company is $960,000, in 200,000 shares of $4.80 each; all the shares are issued and fully paid. The total number of shares of the North Broken Hill, Ltd., is 600,000, and all of them were alotted as fully paid otherwise than in cash as part of the consideration for the purchase by the Company of the undertaking and assets of the North Broken Hill Mining Co., no liability. On the report of this last-named Company the amount of ore extracted is given as 125,944 tons. During the period the mill treated 125,738 tons of ore assaying 15.81% lead, 7.18 oz. silver, and 13.35% zinc, yielding 21,781 tons of concentrate assaying 69.03% lead, 22.19 oz. silver, and 6.89% zinc. The recovery of metals was: lead 75.62%, silver 53.52%, zinc 8.95%. The total working cost was $24.62 per ton of lead concentrate. The total output of zinc tailing was delivered to the Amalgamated Zinc Co. Two dividends were declared, a total of $3.84 per share, amounting to $768,000. An additional dividend of $1.08 and bonus of 36c. per share has been declared payable on March 26, 1913, equal to 24c. per share in the shares in the 'Limited' company. The balance of liquid assets over liabilities is $1,507,000. There was a great shortage of labor, and the contract miners earned a high rate of wages.

ST. JOHN DEL REY MINING COMPANY, LTD.

This Company was first established in 1830, and was reconstructed in 1858, 1887, and again in 1888. It owns the Morro Velho and Cuiaba gold mines in Brazil. The output from the Morro Velho mine during 1912 was 21,550 tons less than that of the preceding year. The average amount recovered from the ore, $11.04 per ton, was about the same, but the total produce shows a reduction of $220,000. The falling-off was entirely due to the inadequate labor available. Although the working cost, $1,214,000, is lower than that of last year by $67,200, the average of $7.06 per ton of mineral treated is higher, owing to the reduced tonnage. The profit, $566,000, although less than that of last year, $676,800, compares favorably with the average profit of the past five years, namely $518,000. The Brazilian authorities have granted the Company permission to introduce Japanese laborers and the Japanese Foreign Office has approved a contract made with the Emigration Society of Tokyo, including a contract with the individual laborers, who can engage for 5 years of service with the option of returning to Japan after 2½ years of service, if they so desire. A trial will be made with about 100 men, who are expected to reach the mine in September. Hard ore for the tube-mills was obtained during the year from the Cuiaba and Rapasos properties, but no mining work of importance was done there. In addition to the working cost $1,214,000 the sum of $83,000 was paid on duty and transport charges, $20,000 on development, $25,000 on the London office, $20,000 as debenture interest, and $24,000 as income tax. The preference shares received $48,000, the usual 10%, and the ordinary shares received a similar dividend absorbing $264,000. The remainder, $249,000 was transferred to capital account for expenditures on new plant, etc. Recently, extensive deposits of iron ore have been discovered on the Company's property and a great deal of adjoining territory has also been acquired by purchase. It is estimated that 160,000,000 tons of ore is available, the average assay from 570 samples taken underground showing 67.3% iron and 0.053% phosphorus. The iron is neither as hard as the Lake Superior hard ores, nor as soft as the soft ores, and it is expected that it can be easily stoped and will yield an excellent smelting product.

Concentrates

Most of these are in reply to questions received by mail. Our readers are invited to ask questions and give information dealing with the practice of mining, milling, and smelting.

REGULAR TESTS should be made of the burning rate of fuse used in mines, and results posted in a conspicuous place.

PAVING BRICK is being made at Middlesborough, England, from blast-furnace slag. The bricks weigh 14 lb. each and wear well.

TIMBERS in manways in daily use in mines should be cleared of all loose rock lodged upon them at least once in every 24 hours. Manways should also be kept clear of all obstructions.

SAND-FILLING OF STOPES at the Robinson Deep mine, Johannesburg, is done by carrying the sand to the mine by gravity, and then sending it underground through a bore-hole 1700 ft. deep.

ICELAND, an island northeast of the British Isles, and just south of the Arctic Circle, has large water-power possibilities, and a Norwegian concern, the Nitrogen Products Co., has an option on 410,000 hp. in that country.

CYANAMIDE, nitric acid, ammonium nitrite, fertilizers, and other nitrogenous products are to be manufactured at Aura, near Kristiansund, in Norway, when the new 100,000-hp. hydro-electric power-plant is erected.

ELECTRIC POWER is to be generated by two hydro-electric stations in New Caledonia, and will be used in the manufacture of nickel and chrome alloys, this island being rich in these ores. The proposed scheme will cost about $1,000,000 to $1,170,000, and will take three years to finish.

A NITRE DEPOSIT occurs along the face of cliffs of black limestone, about 3½ miles northeast of Melrose, Silverbow county, Montana, the salt consisting of a snowy white to slightly yellowish mass of needle-like crystals, according to R. W. Richards. Analyses show the following: calcium sulphate, 13.94%; sodium sulphate, 3.30%; sodium chloride, 20.42%; sodium nitrate, 21.77%; nitre, 39.48%, and nitrogen pentoxide, 1.19%. The value of the deposits cannot be safely estimated from the data collected, and it is calculated that a gross yield of about $1.80 per ton of rock treated would result.

EXPERIMENTS on a silver ore containing a large percentage of manganese were made at the Thames School of Mines, New Zealand, several years ago, with the following results. The ore was worth 2.5 dwt. per ton in gold and 2.8 oz. in silver. Part of the sample, which weighed 3000 lb., was dry crushed and leached by 0.5% cyanide solution in a vat, by which method there was a saving of gold 95% and silver 63.3%. The remainder of the sample was treated by hot pan amalgamation (Washoe process), which resulted in an extraction of gold 94% and silver 14%. During crushing, the ore, which consisted of soft, friable, somewhat clayey quartz with the large percentage of manganese mentioned, formed a large percentage of slime which was troublesome in cyaniding by percolation.

VELOCITY CARDS of the stamps at the Winona mill, Lake Superior, show a blow from 24 to 33-ft. tons. The total cost of regrinding copper-bearing rock at this plant averages 26.93c. per ton reground. The 8-ft. diam. by 30-in. straight-face Hardinge mills have proved to be the most economical in power cost per ton ground, and also has the largest capacity of any tried. They are fitted with Falk's cut herringbone gears, according to R. B. Seeber, in a paper prepared for the Lake Superior Mining Institute. The first mill installed had a silex lining, but newer mills are lined on the straight face with pebbles set in grooves in steel plates. The conical faces are lined with silex blocks. Steel pebble linings have proved very satisfactory. A mill is out of service at least four days to replace silex lining, as the cement must be allowed to set. With a steel-pebble lining, the mill can go into service again as soon as new plates are placed, a matter of hours only. So far, experience shows that the steel-pebble linings are cheaper. All the new mills will be equipped with the steel-pebble lining on the cones as well as the straight faces.

GLACIERS in Alaska have been studied by the United States Geological Survey, and in a report on the coastal glaciers of Prince William sound and Kenai peninsula by U. S. Grant and D. F. Higgins the following is in the summary: Some of the glaciers described, the Valdez, Shoup, Columbia, those of Port Wells and the Bear, have been under observation on several occasions during a period of 10 years. On the whole, the glaciers here studied do not give uniform evidence as to a general retreat or a general advance within the last half century; some are evidently in a period of retreat and others in a period of advance, and the general balance between retreat and advance can not be accurately determined by data now at hand.

SPUDS for gold dredges were at first made of wood, but with increasing size and weight of dredges, steel came into use. At first these were made of I-beams set parallel and bound together. Difficulties in repairing such spuds led to the development of a box-beam made of heavy steel plates. Such a spud was first built for the El Oro dredge at Oroville. A modern steel spud weighing about 20 tons is shown in the accompanying picture.

STEEL SPUD FOR ALTA BERT DREDGE, TRINITY COUNTY, CALIFORNIA.

Gogo juice is universally used by the natives of the Philippine Islands in panning gold-bearing sand, and an investigation was made by the Bureau of Science. The native has for panning a large wooden bowl (*batea*), which is about 22 inches in diameter and slopes to a point in the centre like a flat inverted cone. The panner, usually a woman, has a little *gogo* bark at hand which at certain times she squeezes over the pan, causing the juice to fall on the water in the pan. It is believed that in this way more gold is recovered by causing the fine gold to settle quickly and not float away. *Gogo* is taken from the plant *Entada scandens* Bentham. It is called *gogo* by Tagalogs and *bayogo* and *balogo* by the Visayans and Pampangans. The solution obtained from *gogo* is neutral, neither acid nor alkaline. Its chief constituent is saponin, a complex vegetable poison, which has a very slight acid reaction, and constitutes one of the groups of glucosides. These are generally colloids. In a summary of experiments on its effects on gold solutions, F. T. Eddingfield states that colloidal gold can be formed by (1) gold chloride, fresh *gogo*, and oxalic acid, plus heat; (2) gold chloride and *gogo* (after standing), plus heat; (3) gold chloride, *gogo*, and calcium carbonate, plus heat; (4) gold chloride, *gogo*, and sodium carbonate, plus heat; (5) gold chloride, saponin solution, and sodium carbonate, plus heat; and (6) gold chloride, saponin powder, and sodium carbonate, plus heat. The natives in Borneo also use the juice of certain plants to settle gold when panning gravel.

The Metal Markets

LOCAL METAL PRICES

San Francisco, August 28.

Antimony	17-18c	Quicksilver (flask)	$60
Electrolytic Copper	16-16½c	Tin	46-47c
Pig Lead	4½-4¾c	Spelter	5-5½c

Fine dust, 140 lb. casks, per 100 lb., small lots $6.50; 2,000 lb. lots $5.50; large $5.00-5.50

SILVER

Below are given the average New York quotations in cents per ounce of fine silver.

Date		Average week ending	
Aug. 21	[illegible]	July 26	65.65
" 22	[illegible]	" 28	65.79
" 23	[illegible]	Aug. 2	65.75
" 24 Sunday		" 9	65.69
" 25	[illegible]	" 16	65.50
" 26	[illegible]	" 23	65.46
" 27	[illegible]	" 30	65.46

Monthly averages

	1912	1913		1912	1913
Jan.	58.06	65.01	July	61.61	65.72
Feb.	59.06	64.79	Aug.	61.59	
Mch.	59.57	63.97	Sept.	61.95	
Apr.	59.00	64.58	Oct.	62.16	
May	57.94	62.77	Nov.	62.75	
June	61.59	65.35	Dec.	63.58	

The silver market has been fairly steady, prices varying slowly and orders from London or India and China showing a healthy tone as compared with the same period last year. Stocks of silver in Bombay and Shanghai are slightly less in value.

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date		Average week ending	
Aug. 21	4.50	July 26	4.55
" 22	4.50	" 28	4.55
" 23	4.50	" 29	4.50
" 24 Sunday		" 30	4.47
" 25	4.50	Aug. 6	4.50
" 26	4.50	" 13	4.45
" 27	4.50	" 20	4.45

Monthly averages

	1912	1913		1912	1913
Jan.	4.45	4.58	July	4.72	4.55
Feb.	4.23	4.55	Aug.	4.36	
Mch.	4.47	4.50	Sept.	4.00	
Apr.	4.30	4.50	Oct.	3.95	
May	4.32	4.54	Nov.	4.01	
June	4.40	4.55	Dec.	4.20	

ZINC

Zinc is quoted as spelter, standard Western brands, St. Louis delivery, in cents per pound.

Date		Average week ending	
Aug. 21	5.45	July 9	5.10
" 22	5.45	" 16	5.25
" 23	5.45	" 23	5.30
" 24 Sunday		" 30	5.37
" 25	5.35	Aug. 6	5.42
" 26	5.45	" 13	5.45
" 27	5.55	" 27	5.51

Monthly averages

	1912	1913		1912	1913
Jan.	6.42	6.55	July	7.12	5.72
Feb.	6.50	6.15	Aug.	6.53	
Mch.	6.52	5.86	Sept.	7.01	
Apr.	6.65	5.92	Oct.	7.56	
May	6.65	5.25	Nov.	7.23	
June	6.55	5.00	Dec.	7.10	

COPPER

Quotations or copper as published in this column represent average wholesale transactions in the New York market and refer to electrolytic copper. Lake copper commands premium from ½c to 1c per lb. more. Prices are in cents per pound.

Date		Average week ending	
Aug. 21	[illegible]	July 5	16.55
" 22	[illegible]	" 12	16.61
" 23	[illegible]	" 19	17.07
" 24 Sunday		" 26	17.55
" 25	[illegible]	Aug. 2	17.62
" 26	[illegible]	" 9	17.65
" 27	[illegible]	" 16	17.65

Monthly averages

	1912	1913		1912	1913
Jan.	16.68	[illegible]	June	[illegible]	16.22
Feb.	16.76	[illegible]	July	[illegible]	
Mch.	16.65	[illegible]	Aug.	[illegible]	
Apr.	[illegible]	[illegible]	Sept.	[illegible]	
May	[illegible]	[illegible]	Oct.	[illegible]	
June	[illegible]	[illegible]	Nov.	[illegible]	
			Dec.	[illegible]	

COPPER SURPLUS.

Figures showing the visible supply of copper at the beginning of each month are as recorded below. The amounts are given in pounds. The figures are those of the Copper Producers Association supplemented by Merton's figures of foreign surplus.

		U. S.	European.
August	1912	50,281,280	118,286,560
September	"	46,703,376	112,743,680
October	"	65,066,387	107,596,800
November	"	76,044,967	106,805,840
December	"	86,164,759	96,949,440
January	1913	105,513,560	96,559,840
February	"	125,198,562	100,060,960
March	"	122,532,295	95,342,720
April	"	104,069,520	106,365,360
May	"	79,949,198	105,694,720
June	"	67,474,225	95,578,880
July	"	52,904,606	85,471,040
August	"	55,594,945	82,492,480

United States Production and Consumption

		Production	Domestic deliveries.	Exports.
August	1912	140,828,721	78,777,415	70,145,150
September	"	140,865,829	65,462,910	60,264,756
October	"	140,695,695	54,104,734	47,901,542
November	"	134,551,140	65,555,795	55,276,550
December	"	140,505,000	54,450,550	60,701,540
January	1913	140,119,575	65,000,050	60,585,945
February	"	130,545,551	58,674,400	70,165,625
March	"	139,502,569	76,092,471	77,889,506
April	"	135,558,402	78,558,557	55,594,727
May	"	140,308,436	81,108,500	66,066,007
June	"	131,580,595	65,452,972	65,967,901
July	"	135,074,600	66,904,192	78,450,071

QUICKSILVER

The primary market for quicksilver is San Francisco, California, being the largest producer. The price is fixed in the open market and as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 76 lb. are given below.

Week ending			Aug. 14	
July 31	41		" 21	40
Aug. 7	41		" 28	40

Monthly averages

	1912	1913		1912	1913
Jan.	45.75	38.87	July	45.50	41.00
Feb.	46.50	41.50	Aug.	42.50	
Mch.	46.50	42.50	Sept.	42.13	
Apr.	42.25	41.00	Oct.	41.50	
May	41.75	42.25	Nov.	41.50	
June	41.50	41.00	Dec.	39.75	

TIN

New York prices control in the American market for tin, since the metal is almost entirely imported. San Francisco quotations average about ½c per lb. higher. Below are given average monthly New York quotations in cents per pound.

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	42.55	37.45	July	44.25	42.74
Feb.	42.56	45.27	Aug.	45.50	
Mch.	42.56	46.95	Sept.	45.64	
Apr.	45.93	45.27	Oct.	44.71	
May	46.45	43.10	Nov.	45.62	
June	45.76	43.10	Dec.	45.50	

Asbestos production in Russia continues to develop satisfactorily and should greatly all those interested in the mining prosperity of the country. It was discovered in 1720 by Seybran Sorga and is found mostly in the Urals district, which is Russia's great mineral region, and in large quantities. The principal deposits are found on the western slope of this rising ground, and they extend over a great tract of country beginning with the northern part of the Urals in the Bogoslaff mining district. At the present time asbestos is produced mostly by the asbestos mines not far from the town of Ekaterinburg, which is the central metal-market town of the Urals. The deposits worked are largely situated in the estates of the Kamensk Treasury factory, Beresoff and Monetnoi. The production in 1912 was 1,407,978 poods[1] and the value at the mine was 2 to 2½ rubles[2] 20 kopeks[3] per pood. A great part of the Russian production is exported.

[1] One pood = 36 lb. [2] One ruble = 51c. [3] One kopek = ½c.

The Stock Markets

SAN FRANCISCO STOCKS AND BONDS

(San Francisco Stock and Bond Exchange.)

BONDS

Listed.	August 27. Bid	Ask	Unlisted.	August 27. Bid	Ask
Associated Oil 5s	$ —	100	Natomas Dev. 6s	$ —	100
E. I. du Pont 4½s	83½	—	Pac. Port. Cement 6s	99	—
Natomas Con. 6s	—	80	Riverside Cement 6s	77	79
Unlisted.			Standard Cement 6s	91½	—
Ass. Oil 1st ref	77	—	Santa Cruz Cement 6s	80	—
General Petroleum 6s	57	—			

STOCKS

Listed.	August 27. Bid	Ask	Unlisted.	August 27. Bid	Ask
Associated Oil	41	—	Mascot Copper	1½	2½
Amalgamated Oil	85½	90	Noble Electric Steel	2	4
E. I. du Pont com	—	135	Natomas Consol	5½	10
Pac. Cst Borax, com	—	100	Pacific Port. Cement	51	—
Pacific Crude Oil	25c	—	Riverside Cement	45	—
Sterling O. & D.	70c	95c	Santa Cruz Cement	30	37½

NEVADA STOCKS

(By courtesy of San Francisco Stock Exchange.)

San Francisco, August 28.

Atlanta	$ .15	Mizpah Extension	$ .45
Belcher	.23	Montana-Tonopah	1.17
Belmont	7.00	Nevada Hills	.80
Big Four	.32	North Star	.76
Cash Boy	.08	Ophir	.25
Florence	.24	Pittsburg Silver Peak	.45
Goldfield Con	1.65	Round Mountain	.44
Goldfield Oro	.08	Sierra Nevada	.07
Halifax	1.35	Tonopah Extension	2.10
Jim Butler	.58	Tonopah Merger	.71
Jumbo Extension	.12	Tonopah of Nevada	4.75
MacNamara	.12	Union	.12
Mexican	1.10	West End	1.27
Midway	.44	Yellow Jacket	.12

COPPER SHARES—BOSTON

(By courtesy of J. C. Wilson, Mills Building.)

	August 28. Bid	Ask		August 28. Bid	Ask
Adventure	$ 1⅞	2	Mohawk	$ 43½	44
Alloucz	36	36½	North Butte	28	28⅛
Calumet & Arizona	64	64½	Old Dominion	49½	50
Calumet & Hecla	400	405	Osceola	80	82
Centennial	13½	14	Quincy	60	61¾
Copper Range	39½	40	Shannon	6½	6⅞
East Butte	11⅞	12	Superior & Boston	2½	3⅛
Franklin	4½	4⅝	Tamarack	28½	29
Granby	64½	65	U. S. Smelting	36	37
Greene Cananea	6¾	7	Utah Con	9	9⅛
Hancock	17⅞	18½	Victoria	1	1⅛
Isle-Royale	19	19½	Winona	1½	1⅝
Mass Copper	2⅜	3⅛	Wolverine	44½	45

NEW YORK QUOTATIONS

(By courtesy of E. F. Hutton & Co., Kohl Building.)

August 28.

	Bid.	Ask.		Bid.	Ask.
Alaska G. M.	18¼	18½	Mason Valley	6	6⅝
Braden Copper	6⅝	6¾	McKinley-Dar.	1¾	1⅞
B. C. Copper	2½	2½	Mines Co. Am.	2⅛	2⅜
Davis-Daly	1⅞	2⅛	Nipissing	8⅞	9⅛
Dolores	2	4	Ohio Copper	¼	⅝
El Rayo	1	2	San Toy	18	22
Ely Con.	7	7½	Sioux Con.	1	2
First Nat.	2½	3¼	So. Utah	⅛	¼
Giroux	1	1⅜	S. O. Calif.	183	185
Greene Can.	6¾	7	Tri Bullion	⅛	¼
Hollinger	15	15¾	Tuolumne	¾	⅞
Iron Blossom	120	130	United Copper	¼	¾
Kerr Lake	3½	3⅝	Wettlaufer	15	17
La Rose	2⅛	2⅜	Yukon Gold		2⅛

LONDON QUOTATIONS

(By cable, through the courtesy of Catlin & Powell Co., New York.)

	August 28. £	s.	d.		August 28. £	s.	d.
Alaska Mexican	1	17	6	Kern River Oilfields	0	6	3
Alaska Treadwell	8	5	0	Mexico Mines	5	5	0
Alaska United	4	0	0	Messina	1	10	0
Arizona	2	0	0	Oroville	0	7	6
California Amalg	0	2	6	Pacific Oilfields	0	2	6
California Oilfields	5	10	0	Rio Tinto	78	5	0
Camp Bird	0	18	9	Santa Gertrudis	0	18	9
El Oro	0	13	9	Stratton's	0	2	6
Esperanza	1	1	3	Tanganyika	2	8	9
Granville	0	11	3	Tomboy	1	6	3

AUSTRALIAN

	August 28. £	s.	d.		August 28. £	s.	d.
British Broken Hill	1	18	9	Mount Boppy	0	15	0
Broken Hill Prop	1	15	0	Mount Elliott	5	11	3
Golden Horse-Shoe	2	16	9	Mount Lyell	1	6	3
Great Boulder Prop	0	12	6	Mount Morgan	3	11	3
Ivanhoe	3	0	0	Waihi	2	6	3
Kalgurli	1	18	9	Waihi Grand Junc	1	1	3

COPPER EXPORTS

The Government figures for the first seven months of 1913 show the following exports of copper to European countries:

	Pounds.
United Kingdom	71,957,760
France	80,310,720
Germany	190,917,440
Holland	106,585,920
Belgium	3,097,920
Austria	19,535,040
Italy	26,232,640
Others	2,522,240
Total	501,159,680
Monthly average	71,594,268

GOLDFIELD CONSOLIDATED REPORT

During July the Company treated 29,550 tons of ore, yielding a net return of $168,754, according to Albert Burch, the general manager. Operating costs were as follows:

Mining:	
Stoping	$2.86
Development	0.68
Moving dumps	0.06
Transportation	0.08
Milling	1.91
Marketing	0.05
General expense	0.45
Bullion tax	0.04
Construction	0.03
Marketing ore shipped	0.71
Total costs	$6.87
Miscellaneous earnings	0.04
Net costs	$6.83

Development covered 3430 ft., at a cost of $5.84 per foot.

On No. 7 level of the Combination mine, the cross-cut was extended to a point 125 ft. east of the 414-D winze, where it cut what is believed to be the downward extension of ore previously cut by a diamond-drill hole. Where cut the vein was narrow, and, about the end of the month, driving was commenced for the purpose of prospecting a part of the vein more nearly in line with the drill-hole.

Near the end of the month the 135 cross-cut in the Mohawk mine cut the high-grade ore previously followed by the 127-X intermediate, and it will now be developed on the main No. 1 level instead of on the intermediate, which is only 20 ft. higher.

The 241 drift on No. 2 level of the Laguna mine followed a narrow vein of good ore throughout the month. This is in the hanging wall from the old 229 Bull Dog Fraction stope and may be the upward extension of the 303 J, O & P, which are the best producers in the Laguna.

The 901-E sill in the Clermont-Jumbo was slightly extended and produced 121 tons of $14 shipping ore. The 916 cross-cut on the 1400-ft. level cut a strong fissure in the shale containing copper ore of too low grade to ship. It is probably the downward extension of the copper vein which has been so productive a few feet above; but it was cut in the Curley George claim, on which the Company holds a lease, and too close to the boundary line between the property and the Merger Mines claim to justify driving on it. Another cross-cut farther from the line will be driven to open it, and driving will be done in search of the shoot.

Recent Publications

SECOND ANNUAL STATISTICAL REPORT. San Francisco Chamber of Commerce. Year ended December 31, 1912. P. 122. Ill., plan, index. This report contains a vast amount of interesting matter about San Francisco and California.

Proceedings of the Colorado Scientific Society, Denver, 1913:

UNIFORM MINE ACCIDENT LAWS. Report of the Committee of the Colorado Scientific Society. P. 31.

RADIOACTIVITY OF THE MINERAL SPRINGS OF MANITOU, COLORADO. By John C. Shedd. P. 31. Illustrated.

INVESTIGATION OF ROOF-SHALE DUST WITH REFERENCE TO ITS ADAPTABILITY AS DETERENT IN COAL-DUST EXPLOSIONS. By Richard C. Hills. P. 12 and 4 plates.

United States Geological Survey, Washington, 1913, advance chapters from 'Mineral Resources of the United States, 1912':

PRODUCTION OF SALT AND BROMINE. By W. C. Phalen. P. 23.

PRODUCTION OF MAGNESITE. By Charles G. Yale and Hoyt S. Gale. P. 9.

PRODUCTION OF MANGANESE AND MANGANIFEROUS ORES. By D. F. Hewett. P. 21.

PRECIOUS AND SEMI-PRECIOUS METALS IN ALASKA. Mine Production. By Alfred H. Brooks. P. 16.

Bureau of Mines, Washington, 1913:

INVESTIGATIONS OF DETONATORS AND ELECTRIC DETONATORS. By Clarence Hall and S. P. Howell. Bulletin 59. P. 73. Ill.

ABSTRACT OF CURRENT DECISIONS ON MINES AND MINING, OCTOBER 1912 TO MARCH 1913. By J. W. Thompson. Bulletin 61. P. 82.

AN ELECTROLYTIC METHOD OF PREVENTING THE CORROSION OF IRON AND STEEL. By J. K. Clement and L. V. Walker. Technical Paper 15. P. 19. Ill.

THE PREVENTION OF WASTE OF OIL AND GAS FROM FLOWING WELLS IN CALIFORNIA. By Ralph Arnold and V. R. Garfias. With a discussion of special methods used by J. M. Pollard. Technical Paper 42. P. 15. Ill.

PORTABLE ELECTRIC MINE LAMPS. By H. H. Clark. Technical Paper 47. P. 11.

THE USE AND CARE OF MINERS' SAFETY LAMPS. By J. W. Paul. Miners' Circular 12. P. 19.

U. S. Geological Survey Bulletins:

Advance chapters from Bulletin 540, 'Contributions to *Economic Geology*, 1912, part I':

NITER NEAR MELROSE, MONTANA. By R. W. Richards. Bulletin 540-Q. P. 6. Map.

ALUNITE IN ARIZONA AND NEVADA. Papers by Frank C. Schrader. Bulletin 540-I. P. 12.

YELLOW PINE MINING DISTRICT, CLARKE COUNTY, NEVADA. By James M. Hill. Bulletin 540-F. P. 58. Map.

COPPER DEPOSITS NEAR SUPERIOR, ARIZONA. By F. L. Ransome. Also COPPER DEPOSITS OF THE WHITE MESA DISTRICT, ARIZONA. By J. M. Hill. Bulletin 540-D. P. 27.

GEOLOGY OF THE NOME AND GRAND CENTRAL QUADRANGLES, ALASKA. By Fred H. Moffit. Bulletin 533. P. 140. Ill., maps, charts, index.

GEOLOGY OF THE GOLD BELT IN THE JAMES RIVER BASIN, VIRGINIA. By Stephen Taber. Virginia Geological Survey Bulletin No. 7. P. 271. Ill., maps, index. Charlottesville, 1913.

MISCELLANEOUS ANALYSES OF COAL SAMPLES FROM FIELDS OF THE UNITED STATES. Advance chapter from Bulletin 531, 'Contributions to *Economic Geology*, 1911, part II.' Bulletin 531-M. P. 27.

PRODUCTION OF SPELTER IN THE UNITED STATES, JANUARY 1 TO JUNE 30, 1913. By C. E. Siebenthal. P. 2. This gives the complete statistics of the industry for the half-year, which were given in last week's issue of this journal.

Catalogues Received

POWER AND MINING MACHINERY CO., Cudahy, Wisconsin. Bulletin No. 46, 'Cyaniding.' 60 pages. Illustrated. 6 by 9 inches.

DODGE MANUFACTURING CO., Mishawaka, Indiana. Bulletin, 'Dodge-Zimmer Conveyor.' 12 pages. Illustrated. 8½ by 11 inches.

I. L. SMITH CO., Milwaukee, Wisconsin. Catalogue No. 252, 'Rock-Ore and Gravel Handling Machinery.' 40 pages. Illustrated. 6 by 9 inches.

BROWN HOISTING MACHINERY CO., Cleveland, Ohio. Catalogue K, 'Brownhoist Locomotive Crane with Grab Bucket.' 56 pages. Illustrated. 6 by 9 inches.

CLARK MINING MACHINERY CO., 444 Henry Bdg., Seattle, Washington. Catalogue on the 'Clark Gold Saver' and other gold-saving machines. 16 pages. Illustrated. 6 by 9 inches.

CHICAGO PNEUMATIC TOOL CO., Chicago. Bulletin E-29, 'Duntley Electric Grinders.' 8 pages. Also Bulletin No. 34-B, 'Power Driven Compressors.' 30 pages. Illustrated. 6 by 9 inches.

CYANIDE PLANT SUPPLY CO., 1 Broad Street Place, London. Supplement No. 24, 'The Komata Liner for Tube Mills.' 16 pages. Illustrated. 8 by 5½ inches. Also Supplement No. 25, 'Neal's Pebble-Retaining Discharge for Tube Mills.' 4 pages. Illustrated. 8 by 5½ inches.

Commercial Paragraphs

GOLDSCHMIDT THERMIT CO. has moved its San Francisco office to 329-333 Folsom street.

F. W. Wetherill, formerly of New York, is now associated as engineer with the Seattle office of MEESE & GOTTFRIED CO., where he will give especial attention to elevating, screening, and transmission machinery.

The HARDINGE CONICAL MILL CO., New York, reports that the Braden Copper Co. has placed its fourth consecutive order, amounting to twelve of the largest size Hardinge mills. When shipped this will make a total of thirty-six identical mills installed in the Chilean plant of this Company. The Cuba Copper Co., of Santiago, Cuba, has also placed an order for four of the largest size Hardinge mills for grinding in connection with the flotation process to be installed at its plant.

On account of the rapid growth of business since the great San Francisco fire, the MEESE & GOTTFRIED CO. has been obliged to move its main offices in San Francisco from the old location at 55 Main street to the four-story steel-frame building at 660 Mission street, just back of the Palace hotel, where its engineering and sales departments will be better able to handle the many problems in transmission, elevating, conveying, and screening machinery, for the manufacture of which class of machinery this firm has the largest plant on the Pacific Coast. Branch houses and a complete stock are maintained at Vancouver, in British Columbia, Seattle, Portland, and Los Angeles.

The S. FLORY MANUFACTURING CO. suffered the loss of a large part of its plant at Bangor, Pennsylvania, through fire recently, but reports that arrangements have been made to construct a new and up-to-date machine-shop, foundry, and necessary appurtenances as soon as it is possible to do so. In the meantime, temporary buildings will be erected and the necessary machinery installed to continue the manufacturing of engines, etc., with as little delay as possible. One building was saved from the fire. The foundry can be repaired in a short time to make castings for repairs and general construction of machinery within a very reasonable time, and no effort will be spared by the Company to provide facilities by installing the necessary machinery as promptly as possible.

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EDITORIAL

A SINGLE shipment of silver bullion to London, recently made by the Nipissing mine at Cobalt, amounted to nearly 260,000 ounces, or about nine tons.

NOW that Sun Yat-sen has fled from China and William Sulzer, governor of New York state, has been impeached, the crooked promoter with an alleged mine can resume his wonted place in the limelight.

MINERS are to have a large part in National Conservation Exposition held at Knoxville, Tennessee, in September and October. A miners' field day is to be held September 20 and under the active supervision of Mr. C. H. Gordon, associate state geologist, an excellent display of exhibits relating to mines and minerals is being arranged.

RAND difficulties seem to have been smoothed over for the present, but the future is not altogether assured. The men would do well to note that mining on the Rand is at or near its high-water mark of prosperity. With lowering grades of ore, smaller profits, and, above all, with non-resident ownership of the mines, it seems probable that wages will decrease rather than the reverse. The white laborer on the Rand would do well not to rock the boat.

THE official call for the sixteenth annual session of the American Mining Congress has been issued. The Congress is to meet at Philadelphia, October 20 to 24, inclusive. Under the presidency of Mr. D. W. Brunton, and with the active assistance of a strong local committee, the meeting is certain to prove notable. A special feature of the occasion is to be an exhibit of instruments and appliances designed to promote efficiency and safety in mining. The nearness of the great anthracite mines will make possible a display of large interest to Western mine managers, who can easily learn much from their associates in eastern Pennsylvania.

WHILE selective mining is practised to a greater or less extent in the working of almost every type of metalliferous deposit, the degree to which this refinement may be conducted has been the subject of a great diversity of opinion, especially among Rand operators. The range of opinion there is all the way from supporters of an extremely large tonnage of comparatively low-grade material, to those who favor a practice which amounts to high-grading the mine as fast as ore of first class can be developed. Arguments can be found in favor of both extremes, but each property presents its own problems and there is, within limits, opportunity to choose that

degree of selectiveness which, when applied to the particular case, will produce the best economic results. In discussing Mr. Owen Letcher's article on 'Rand Conditions and Future Outlook,' Mr. H. S. Denny presents elsewhere a most interesting analysis of the principles of selective mining. As Mr. Denny was actively connected with the management and engineering problems of one of the Rand's largest groups for a number of years, he is particularly well qualified to treat this question.

TELLURIDES form a group of minerals which while rare are of large economic importance. In view of the small notice given to them in many textbooks of mineralogy, we are glad to print this week the detailed notes of Messrs. Malcolm Maclaren and J. Allan Thomson. This closes the series of informing articles on Kalgoorlie to which the profession is indebted to these gentlemen. We shall shortly begin publication of an equally authoritative account of the Rand, written by Mr. C. B. Horwood, who has devoted ten years to the study of this the world's greatest goldfield, bringing to the task not only careful scientific training, but the thorough experience of a mine manager who has served his apprenticeship in subordinate positions.

The Administration and Mexico

Although the administration's statement of attitude toward Mexico has been the subject of no little criticism both at home and abroad, it is to be noted that there has been no better policy suggested by any of those dissatisfied with the course which has been followed since the beginning of the present controversy. The administration's treatment of the situation is to be generally commended, and the absence of jingoism from both houses of Congress, with the exception of that one lonely voice from the Senator from Pennsylvania, is evidence of the unanimity of the belief in the President's policy and the wisdom of his course. To those familiar with the ways of the Latin, it was to be expected that President Huerta would reject any proposal coming from the United States; but *manana* when there has been time for reflection, it is not at all improbable that Don Victoriano will awake to the realization that the American people are Mexico's best friends and that our motives have been solely altruistic. As the situation stands, there are but two available policies, the present policy of diplomatic solution of Mexico's difficulties and the alternative of an armed intervention. The latter course is untenable under existing conditions and could only be sanctioned as a very last resort. While the ultimate result of such a conflict is assured, there could be nothing gained by such a move, and another addition to the 'white man's burden' is by no means an asset. The United States has domestic problems of greater import which demand attention, and while it is our duty to protect American lives and investments in Mexico, it is also our duty not to engage in a warfare which, judging from the war with Spain, would cost a large number of lives and from half a billion to a billion dollars, except as a last resort. American investments together with those of foreign nations have suffered and are suffering from the present revolution in Mexico, but a resort to arms at this time is by no means warranted and might easily result in still more serious consequences and a paralysis of industry in that country which would take years in righting itself.

The Institute and the Society

One of the amendments to the constitution of the American Institute of Mining Engineers, which was adopted at the annual meeting last February, authorized the directors to arrange for affiliation of other technical societies. This amendment was adopted with full knowledge that among the affiliations contemplated was one with the Mining and Metallurgical Society of America. Indeed, at the meeting, Mr. J. W. Richards, chairman of the committee on amendments to the constitution, stated that in view of the pending plan of union of the Mining and Metallurgical Society with the Institute, the proposed amendment providing for a class of 'Fellows' of the Institute was unnecessary and undesirable, and advised a vote against it. The amendment was thereupon voted down by means of a block of proxies, though the general vote of the membership is said to have been favorable. This would seem to make it clear that so far as the whole membership of the Institute expressed any opinion it was not adverse to a classification of membership, and that the particular plan proposed by the 'Fellowship' amendment was defeated in view of plans already contemplated, for affiliation of the Mining and Metallurgical Society. The vote in favor of the new constitution delegating to the directors authority to effect affiliations was clearly taken with a view to the particular affiliation mentioned, and one or two others that had been also discussed. Negotiations for affiliation were therefore resumed through duly appointed committees of the governing bodies of the two institutions. In due time a plan of union was agreed upon. Whether or not this was the wisest plan is, we think, beside the question. It was the only practicable plan upon which the two committees were able to agree. As is true of all compromise agreements, it was unsatisfactory in part to each party to it, but in our judgment, in case it had been carried out, it would have afforded a working basis, and the spirit of harmony would have been more effective than any technical or formal obstacles standing in the way of complete union.

The constitution of the Mining and Metallurgical Society contained no provision for affiliation, as did that of the Institute, nor had the membership of the Society, as had that of the Institute, voted upon the principle involved. The Council of the Society, therefore, endorsed the plan and also obtained a favorable referendum vote of the members. Not only was this done, but the Council obtained authority, upon the effecting of the affiliation, to offer membership in the Society practically without restriction or formality to all those members of the Institute who, by reason of experience and professional attainments clearly specified in the constitution, were eligible. A rough calculation will

make it clear that this plan would have made 500 to 1000 members of the Institute immediately eligible. Carrying it out in good faith would have given potential control of the Society to those who at present are non-members. There can be no question of the absolute good faith of the Society and its members in this matter, and therefore talk of the Society becoming a small inner clique to control the Institute is nonsense. The Institute is, and always will be, dominated by its strong and capable members, as it should be. The men who know how to lead do lead, and under the proposed plan the men who have the professional qualifications demanded of members of the Mining and Metallurgical Society, some of whom are members of it and some of whom are not, would have dominated the Institute by force of ability, as they do now.

At the time of these negotiations and up to a recent date there was no hint that the directors of the Institute were not authorized to make the agreement outlined and there was no indication that they would not endorse the action of their own properly appointed and especially capable committee. The Society accepted the report in good faith and even went so far as to amend its constitution in order to carry out the plan of union. Now the directors of the Institute have voted as follows:

"The board of directors of the American Institute of Mining Engineers has carefully considered for several months the question of union or affiliation with the Mining and Metallurgical Society of America, and while at an earlier time and under other circumstances such a union might have been accomplished, yet under present circumstances, the directors of the Institute deem such union inexpedient. While thanking the Mining and Metallurgical Society of American for its consideration of the matter, we believe that further discussion of the subject will serve no useful end, and we conclude it best that the Society and the Institute continue their useful functions and friendly relations side by side as heretofore."

It becomes a pertinent question as to what are the changes of circumstances that warrant the directors in backing out of an agreement so nearly concluded; one, moreover, that resulted from negotiations initiated on its side. Clearly the significant change is the regeneration of the Institute itself and the belief that it is now in position to undertake, in addition to the work it has long and excellently accomplished, the new responsibilities neglected for years by the Institute and first undertaken by the Society. The most important of these are: (1) creation of a means of ascertaining and expressing the opinion of the profession on public matters touching mining; (2) formation of local sections to stimulate interest and promote friendly coöperation. The third major activity of the Society, the creating of a definite standard of conduct and attainment as a basis for membership, the Institute frankly abandons. The Institute is endeavoring, through large committees, to find a means of ascertaining and expressing the opinions of its members on various subjects. Whether in the end this method will prove as effective as that of committee action followed by referendum vote developed by the Society, is fairly an open question. As to that, time will tell. In the matter of local sections it needs but little consideration to make clear that any section built on the large and miscellaneous membership of the Institute must be very different in character from the sections of the Society and must find its field in the reading of papers, giving of lectures, and similar activities rather than the friendly, informal, after dinner meetings of the Society. The matter of standards of membership is, we think, too important for a great profession to ignore permanently, and the only way to create and maintain a standard is by voluntary affiliation in some organization of those who are eligible. How the Institute is to meet this problem without the help afforded by the Society as a nucleus, is far from clear; and, recalling the history of the formation of the Society, it is even less clear how the action of the directors of the Institute in rejecting the plan of affiliation is going to promote that spirit of harmony and friendly relations, that all would like to see obtain. To our way of thinking, rejection of the agreement was a mistake. Those directors who felt they could not vote favorably should, we think, have made their influence felt earlier. Practically, if not technically, the action of the board savors of repudiation.

We feel keenly that it would be better for the profession to have one society rather than two, and we regret greatly that there seems no immediate prospect for bringing about that condition. As good democrats, and "forward-looking men" we are more concerned with the future than the past, and it is evidently to be a period for repressing any disposition to criticize uselessly, however natural it may be. The men of the Mining and Metallurgical Society will, of course, maintain their organization and keep up their work. No other course is open to self-respecting engineers such as constitute its membership. The Society, while small, is influential, and every effort should be made to make it most effective. It is not impossible to maintain small professional societies with low dues, where their purpose is sound and their leadership wise. Something over a quarter of a century ago it became evident that the large and miscellaneous membership in the geological section of the American Association for the Advancement of Science did not afford a sufficient bond among professional geologists. The Geological Society of America was therefore created and, with a limited membership, it has attained a position of conspicuous usefulness and influence. The secret lies in the fact that it has maintained a high standard of membership and of work. It is a real honor to be a member of it. Incidentally, out of dues of $10 per year and a low initiation fee, it has published an excellent series of bulletins and has accumulated a satisfactory reserve fund. The life of a society is conditioned by its usefulness. Let it serve a high purpose diligently and it may be sure of success and the respect that success brings. We counsel the members of the Mining and Metallurgical Society to look at the situation with good humor and to persevere in their efforts to place the profession of mining engineers on at least as high a plane as that of the civil engineers and of the great learned professions.

Mining by Wholesale

By Thomas T. Read

Progress in the mining of copper and gold ores tends steadily toward the mining of large low-grade orebodies by wholesale methods, thus minimizing operating costs. As a result, metal mining comes more and more to resemble quarrying, and in the best and cheapest methods of quarrying work the metal miner may find much that is suggestive and useful. The following description of the quarry and crushing plant of the Tomkins Cove Stone Co., Tomkins Cove, New York, which is commonly accepted as the largest stone-crushing plant in the world, follows closely a description which appeared in *The Excavating Engineer*, December 1912, only such corrections having been made as were necessary to cover recent changes. An excellent description of the plant as originally designed appeared also in *Engineering News*, January 12, 1911.

TOMKINS COVE STONE QUARRY AND PLANT.

Certain of the illustrations used in the articles are here reproduced, and to them are added halftones from photographs kindly furnished by the Stevens-Adamson Company.

Income and Expenditure

The most interesting part of this work to the miner, namely, the cost of the different steps of the work, is unfortunately not available for publication, since the Company is privately owned and is unwilling to disclose its operating costs. It may be stated, however, that the product, crushed limestone (of three sizes, 1½, ¾, and ⅜-in. ring), is sold f.o.b. railway cars and barges at the plant at the average rate of 75c. per cubic yard or 57c. per ton, the crushed rock averaging 2600 lb. per cubic yard. From this average return, all operating costs, overhead charges, and general expense must be met, and a good operating profit is made. The plant has a capacity of 8000 tons in a 10-hour day. Ordinary laborers are paid at the rate of 20c. per hour, and skilled workmen higher wages; steam-shovel operators, for instance, receiving $150 per month. The low rents paid by the workmen who live in Company houses may also be regarded as a part of their wages. Comfortable small houses of four to five rooms are rented for 57 to 76c. per week, according to their size and desirability. About 160 men are employed, including farm hands, etc. The quarrying work is done in hard blue or gray limestone which rises to a height of 200 ft. above the Hudson river.

The limestone is blasted from a high vertical quarry face, loaded by Bucyrus steam-shovels to cars on a high level track, and drawn an average distance of about 800 ft. to the top of the crusher house. It is dumped directly into the crusher hopper and passes vertically downward through three successive sets of horizontal crusher rolls, which reduce it to a maximum size of about 2 in. From the lower rolls it is raised about 90 ft. by a steeply inclined steel pan elevator which discharges into a hopper in the top of the preliminary screen-house. This hopper discharges into a distributer that spreads the broken rock evenly over a gravity screen that removes all stone larger than 1½ in. and delivers it to a belt conveyor by which it is returned to the last pair of rolls.

About 90% of the product which passes through the preliminary screen is delivered by a belt conveyor 362 ft. long, inclined about 10° to the top of the main screen-house, where it passes by gravity vertically through a stationary distributing and screening apparatus which separates it into 1½, ¾, and 3⅜-in. sizes, each of which is discharged on a separate horizontal belt conveyor and dumped into one of the five storage-bins with a combined capacity of 20,000 cubic yards.

Loading Capacity

The loading capacity is at present about 600 yd. per hour. Both loading and shipping capacities can easily be largely increased at any time by the use of wider belts on the present conveyors.

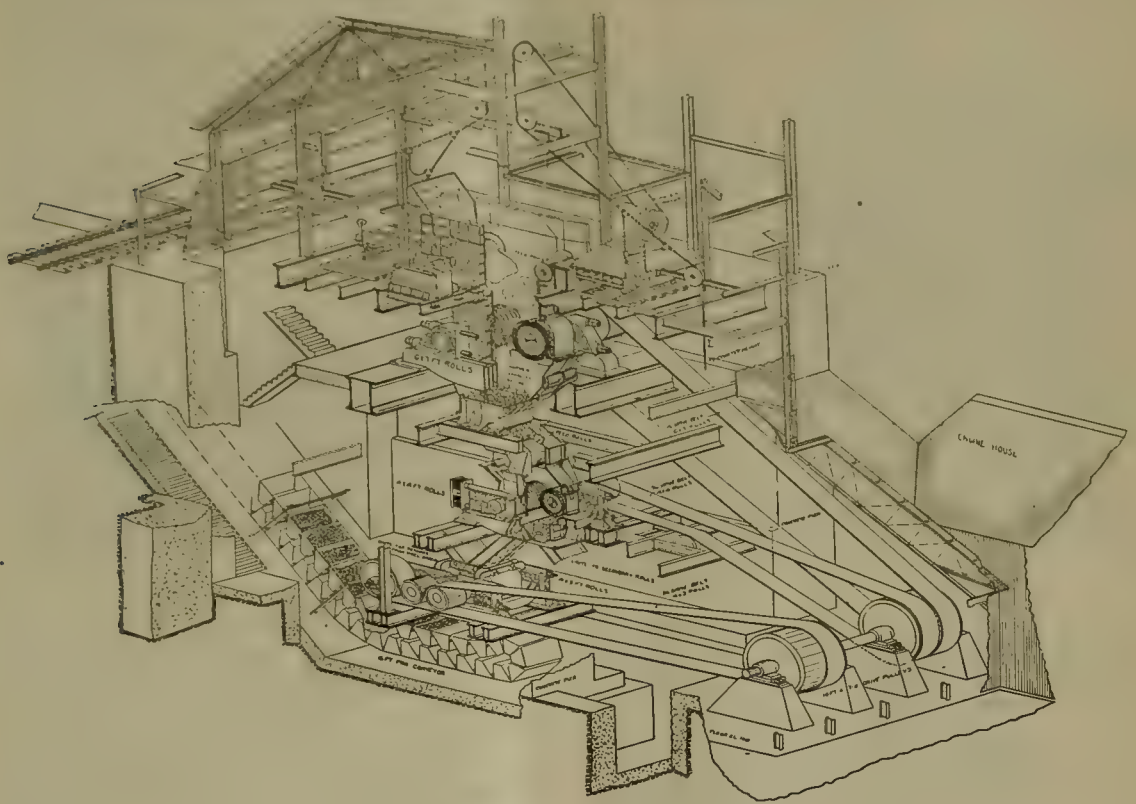
The conveyor-galleries, supporting trestles and towers, and the roofs, beams, girders, and columns of the crusher and screen houses and power-house are of structural steel, sheathed with corrugated iron and furnished and erected by the Snare & Triest Co. All floors are of concrete, all foundations on solid rock. Excepting the steam-shovels, locomotives, and the main jack-shaft operating the crusher roll, all of the equipment is operated by separate electric motors of Allis-Chalmers make, and all electric wires that otherwise would be dangerously exposed are run in pipe conduits.

At present the stone for the new plant is taken wholly from the upper bench of the quarry, since its floor is at the same level as the receiving platform of the crusher house.

The face of the upper bench of the quarry is about 140 ft. high and 700 ft. long, and is worked by full-depth holes of a uniform diameter of 6 in. These are drilled by three Keystone and two Clipper drills operated day and night by two men each.

The holes are about 8 ft. apart in rows 30 ft. back from the face of the quarry, and are each charged with from 400 to 600 lb. of 60% dynamite, chiefly furnished by the Du Pont de Nemours Powder Co., and are fired in groups of 5 to 6.

In blasting, as many as 56 holes have been fired at one time, using 6 to 10 tons of powder in 85 or 90-ft. holes. Under the management of William Lange, now in charge of the quarry, the firing of giant blasts has been introduced with good results. Small adits are driven into the quarry face, turned off at right angles, and the powder stowed at the end of the drifts and at intervals along their length; as much as 22 tons of Judson powder and 60% nitroglycerine being used in one blast, resulting in breaking down 250,000 cu. yd. of rock. Some interesting work is being done in the driving of these adits and cross-cuts, which are roughly oval in cross-section and not large. The driving is done by contract at the rate of $2 per foot of advance, the Company furnishing powder, tools, and electric light. One man and his helper, working 10 hr., advance 6 to 7 ft. on the average, and have made as much as 9 ft. in 10 hours.



ISOMETRIC VIEW OF CRUSHER HOUSE.

Quarrying Operations

The limestone is shattered into irregular pieces, roughly cubical, nearly all of which are within the capacity of the three 95-C Bucyrus steam-shovels, having 4½-yd. dippers. The shovels load the stone into 8-yd., 6½ by 9-ft. steel skips, 4½ ft. deep, manufactured by John Turls Sons, Newburgh, New York. The skips are set on separate steel-frame standard-gage cars manufactured by the Pamapo Iron Works, and are drawn by 40-ton American Locomotive Co. locomotives to the crusher house. There are also three Shay locomotives to handle the cars on the 4½ to 5% grades that are used in some places. A new design of car carries three such skips on one frame, the longer wheel-base thus afforded resulting in fewer derailments and consequently greatly lessened repairs and lost time. The lost time of the shovels, on account of 'spotting' cars and the other ordinary delays, amounts to about 50 to 55% of the total time. There are in the quarry and around the plant about three miles of standard-gage track laid with 80-lb. rails.

The loaded skips are delivered at ground level in the upper story of the crusher house on both sides of the first rolls. They are unloaded from the cars by a counter-weighted whipline led over a sheave in the roof and thence to a Lidgerwood hoisting engine. The skip is dragged to the receiving table, where its forward lower edge engages a stop against which it is revolved upward to dump its contents into a vertical-sided hopper made of heavy ribbed sectional cast steel plates with a 7 by 9-ft. rectangular opening to the rolls.

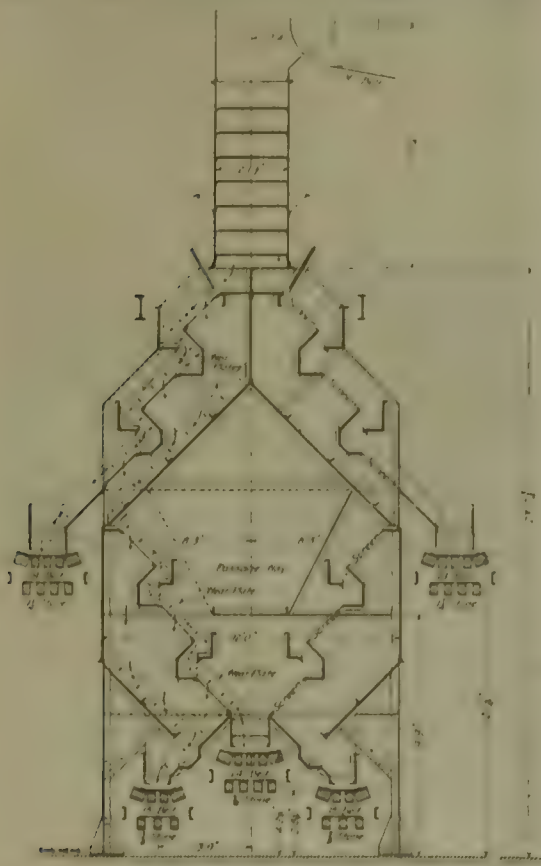
Roll Crushing

Any stone which can be loaded in a skip or handled by a shovel is crushed by the Edison rolls, which reduce a 9 by 4½ by 4½-ft. hard stone to 6 or 8-in. pieces in 10 seconds. Sometimes larger pieces are chained and loaded, and when by accident a piece is delivered which is too large to pass through the opening, or jammed diagonally, a short hole is quickly drilled in it by a pneumatic tool

and a light charge of dynamite fired without removing it from the bin. This breaks it enough to enable it to drop into the rolls, and it is immediately crushed without difficulty or injury to the machinery and with very little loss of time. Under ordinary conditions, 8 cars can be dumped in 6 minutes.

Power-House

The 60 by 123 ft. power-house on the second bench of the quarry, close to the vertical face of the rock, has a trussed roof about 20 ft. high in the clear.



SIDE ELEVATION OF SCREEN USED FOR FINAL SEPARATOR.

and is divided by an interior row of columns in two parts with separate double-pitched roofs and monitors. In the 43 by 60-ft. boiler-room there is a battery of three 600-hp. Heine boilers, with room for one more; two 12 by 8¼ by 12-in. Davidson single-acting feed pumps, and a Cochrane water heater and purifier. Two boilers supply all the steam at present required, leaving the third always in reserve. A sidetrack from the boiler-house to the main line of the West Shore railroad and an elevated coal storage-bin with automatic feed to the boilers has been provided.

Engine-Room

In the 60 by 80 ft. engine-room there is installed a heavy-duty cross-compound 18 by 36 by 36-in. condensing engine of the Reynolds type direct-connected to a 500-kw. generator furnishing 500-volt, 25-cycle, 3-phase current for all electric light and power throughout the plant. There is also installed a 1000-hp., heavy-duty, cross-compound, 22 by 44 by 42-in. condensing engine of the Reynolds type, connected to a 15-in. jack-shaft 36 ft. long, with two double-face pulleys, 10 ft. diam., belted to the Edison crusher rolls.

Condensation water is pumped from the river through a 10-in. spiral-riveted pipe by a centrifugal pump driven by a 30-hp. motor, and is returned to the river through a pipe of the same diameter. There is also in the engine-room a large Ingersoll-Rand air-compressor, and the usual complement of oil separators, traps, filters, and a gravity oiling system. The engines and generators were installed by the Allis-Chalmers Co., Milwaukee, which also furnished all of the 13 motors, from 15 to 150 hp., which are required in different parts of the plant for the separate and independent operation of all the principal items of the machinery.

In order to pass the stone by gravity through the sets of crusher rolls, the latter are arranged in a vertical line between the levels of the floors of the second and third benches of the quarry. The skip-dumping machinery and the lubricating oil reservoir are placed in the roof of the crusher house, and the rolls are supported on very heavy steel girders.

Crusher House

The general arrangement is indicated in the diagram. The rolls are of the Edison type, designed by the Edison Crushing Roll Co. The first or upper pair of rolls, 6 ft. diam. and 7 ft. long, are run at 180 r.p.m. and will crush the stone much faster than it can ordinarily be delivered. They are set about 6 ft. 6 in. apart on centres and have forged steel mandrels about 5 ft. diam., to which are cap-bolted 16 half-length segmental surface plates of chilled cast iron, 6 in. thick, with projections or spurs about 3 in. long. On one of the rolls are two diametrically opposite longitudinal rows of spurs 6 in. long, which act as sledges to break the rock which is crushed between the other spurs.

Horizontal feed rolls 30 in. diam., and both operated by a 15-hp. motor, are set, one on each side of the opening in the feed tube, and a pair of full length distributing rolls, 30 in. diam., are placed in the bottom of the receiving hopper, so as to deliver its contents more uniformly to the second pair of rolls 13 ft. vertically below the first pair. These are 4 ft. long and 4 ft. diam., and of similar construction to the first pair. They are arranged to deliver to either of two pairs of finishing rolls several feet below them, which are 4 ft. long and 3 ft. diam., with corrugated surfaces instead of spurs. Only one pair of the corrugated rolls has been installed, but provision is made for the installation of a second pair if necessary, thus making the plant symmetrical and delivering broken stone on both sides of the centre line to the pan conveyor.

The rolls are enclosed in riveted steel hoods hinged on their upper edges and lifted by tackles provided for the purpose. All of their bearings are flooded with oil in dust-proof iron boxes and the oil from a 500-gal. reservoir in the roof of the building is distributed through pipes and sight feeds to the bearings and collected from them in pipes which

deliver to a 600-gal. drain tank in the basement. From this tank the oil is forced by a Davidson vertical triplex pump through a filter and back to the roof tank, thus providing for constant circulation and purification of the oil at a minimum loss.

The product of the rolls is elevated 83 ft. by a 45° pan conveyor, said to be the largest yet constructed, with 116 triangular 72 by 30-in. riveted steel pans 2 ft. deep, with a capacity of about 1000 lb. each. This conveyor is operated by a 150-hp. motor at a speed of 87 ft. per minute and carries 1000 yd. of broken rock per hour. All the other conveyors, which with this exception are of the belt type, manufactured by the Stephens-Adamson Manufacturing Co., Aurora, Illinois, are operated by separate electric motors.

LOADING CARS AT THE QUARRY.

Sizing Screens

The pan conveyor discharges into the hopper of a fixed gravity screen which separates the broken stone into two sizes, one of which contains pieces above 1½ in. and the other contains everything below 1½ in. These screens are Edison patent and have a number of comparatively long and narrow inclined shelves over which the broken stone falls in a sort of cascade with its velocity checked at each step, so that all of the screens are efficient.

The screens are arranged symmetrically inside a steel plate shell, and the two sets, each with a total area of 96 sq. ft., are separated by a central vertical diaphragm enabling either or both sides to be used at will. The removable screen plates, 2 ft. wide, are made in sections 4 ft. long, of thin carbon steel plates punched with square holes and are set at an angle of about 40° with the horizontal.

The efficiency of the screen is very sensitive to changes in the character of the material or in the amount of moisture which it contains and to the degree of inclination of the screen, therefore the plates are made adjustable by the insertion of shims, up to ½ in. thick, under the lower edges. Extended experiments were made before the installation of this screen and resulted in the determination of the 40° angle, which will probably be maintained, although the provision here described permits it to be quickly and easily changed if necessary. The screen plates are of commercial manufacture and can be quickly replaced when necessary, but they show such durability that it is believed that the use of ordinary steel will be continued instead of manganese steel, which would cost about four times as much.

Course of Rock Through Screens

The material passing over the first screen strikes a right-angle steel shelf just below it and covers the same with a cushion of broken stone which protects the surface of the steel and soon acquires a permanent slope on which all the succeeding material stops and then falls again to the next screen, from which it is deflected to a second shelf, and so on, this stopping at every step and zigzagging down from top to bottom at a moderate velocity.

The large stones rejected by the screens are discharged from their upper surface to a 24-in. belt conveyor 92 ft. long, driven by a 10-hp. motor, and are returned to the finishing rolls.

The remainder of the stone, passing through the screens, is caught on an inclined bottom plate provided with transverse angles which check the speed of the stone sliding down over it to a second chute delivering to a 36-in. belt conveyor 362 ft. long that is inclined about 10°, driven by a 100-hp. motor, and has a capacity of about 800 yd. per hour. It discharges its burden to the receiving hopper in the top of the main screen house about 60 ft. above the point of delivery.

This hopper delivers to a distributer, which is a steel-plate box containing two inclined tiers of narrow horizontal shelves on which the broken stone falls and accumulates in full-width heaps with sloping sides, over which the succeeding pieces slide and fall in sheets on both sides of each shelf, thus equally distributing the crushed rock over the screen plates below. The shelves, 3 ft. long and 12 in. wide, are provided with rack and pinion connections which give them horizontal motion in either direction so that they can be adjusted if necessary to suit changing conditions.

From the distributers the broken stone passes through an 8 by 12 ft. rectangular box, about 23 ft. high, in which there are installed, on each side of the centre line, three successive sets of screens of the same type as those described in the preliminary screen house. The screens are symmetrical on each side of the centre line and each half, having a total screening surface of 192 sq. ft., can be used independently of the other and is designed to be served by two belt conveyors on each side, besides a fifth conveyor on the centre line which receives the ¾-in. stones from the screens on both sides.

Advantages of the Screening System

This method of screening is considered by the owners to be more rapid, efficient, and economical than the use of revolving screens and is believed by them to possess a great advantage over that method, in that much less dust is produced and the sharp corners of the stone are not broken off as is the case when it is revolved in a cylindrical screen. The screens are completely enclosed, they are made of commercial plates easily secured, replaced, and adjusted, the installation is compact and convenient, and most of the steel work excepting the screen plates is protected from wear by cushions of broken stone, thus greatly increasing its durability.

The 1½, ¾, and ⅜-in. sizes of broken stone are respectively delivered from the screens to 30, 24, and 18-in. conveyor belts, 120 ft. long, on centres that are driven with a speed of 400 ft. per minute and discharge their burdens to corresponding horizontal 30, 24, and 18-in. belts, 140, 210, and 275 ft. long respectively, all of which are driven at a speed of 300 ft. per minute by separate 20, 15, and 10-hp. motors. They are at right angles to the first set of belts and carried through an elevated gallery over the tops of the storage bin, about 65 ft. above its floor, discharging at any point of any bin by means of standard automatic trippers.

The storage bins have a common horizontal concrete floor, 40 ft. wide and 292 ft. long. On it there are seated five reinforced concrete transverse partition walls, 48 ft. high, which separate it into an outside extension, and four independent bins enclosed by a vertical wall, 32 ft. high, on one longitudinal side, and by the vertically excavated rock face of the bluff on the opposite side.

Belts

The widths of the belts are proportioned to the different quantities of stone produced by the crusher, namely, 56% of 1½ in., 30% of ¾ in., and 14% of ⅜ in. As the demand for different sizes of stones varies with different seasons, considerable flexibility is required for the storage system, and one bin is reserved for 1½-in. stone exclusively, another for ¾-in., and two for ⅜-in., which is more likely to accumulate, and one large bin nearest the screen house is kept available for any size required.

In the floor of each bin there is a row of 18 by 24-in. holes, 10 ft. apart on centres. Each hole is provided with a steel quadrant valve operated by a lever in the tunnel below. When stone is required for shipment, two valves are usually opened and discharge the stone on a 36-in. horizontal belt 291 ft. long, which is operated by a 50-hp. motor and runs from end to end of the tunnel at a speed of about 400 ft. per minute with a capacity of 10 yd. per minute.

This belt delivers to an inclined 36-in. conveyor belt 170 ft. long, run by a 50-hp. motor at a speed of 350 ft. per minute, which elevates the stone to a height of 97 ft. above the ground and discharges into a hopper with transverse chutes on both sides through which the stone may be loaded into cars on the railroad track below, and also with a longitudinal chute through which, if the transverse chutes are closed, the stone may be delivered to the last conveyor, which has a 36-in. belt 240 ft. long, run by a 50-hp. motor at a speed of 400 ft. per minute, to the end of the dock, where it terminates about 28 ft. above water-level with a hopper provided with a telescopic steel chute 20 ft. in maximum length. This can swing 180°, is supported at the outer end by a boom and tackle, and is thus enabled to reach any part of the 500 or 600-yd. barges moored to the front or side of the dock.

Magnitude of the Plants

About 15,000 cu. yd. of concrete and 700 tons of structural steel was used in the construction of this plant, which was designed and constructed by P. K. Yates, following general plans prepared by the Edison Crushing Rolls Co., Stephens-Adamson Manufacturing Co., Allis-Chalmers, and others. The quarry has been in the hands of the Tomkins family for 75 years, reaching its present stage of development under the administration of Walter Tomkins, president of the Tomkins Cove Stone Company.

The Lovett Grinder

The Winona Copper Co., after extensive experiment with the Lovett grinding machine, has decided to make a trial installation. The machine consists of two cast iron disks running face to face in a horizontal plane. The bottom disk rotates about its axis, while the top disk reciprocates across the face of the bottom disk. The material to be ground is fed through a hole in the top plate. The top plate is made in sections, secured in a harness, which maintains contact with the lower plate simply by their own weight. Some middling on which an extraction of 29% in direct mineral was usually obtained was treated in this machine. After grinding in the Lovett machine an extraction of 71% in direct mineral was made. The feed going to this machine contained 34% of material through 200 mesh (ordinary number 24.4) and the product contained 63% through 200 mesh (ordinary number 26.4).

Official figures show the following output from Charters Towers, Queensland, for the month of May. Mills crushed 6537 tons yielding bullion 4745 oz., value $77,000; cyanide works treated 9206 tons, yielding bullion 5223 oz., value $38,400; smelters treated 276 tons yielding gold 1640 oz., value $33,600; silver 2200 oz., value $1050; lead 21 tons, value $1480; alluvial gold 15 oz., value $310; copper ore 2 tons, and copper concentrate 17 tons, yielding bullion valued at $115; silver 40 oz., value $19; copper 3½ tons, value $2232; black tin, value $31; slag 15 cwt., value $210; the total value being $154,463.

The Re-Awakening of an Old Placer Camp

By Ernest G. Locke

Twenty years ago American cañon, in Humboldt county, Nevada, was the scene of great activity. Hundreds of Chinamen were working the gravels, and recovering millions in gold dust, of which fact ample evidence remains in the hundreds of shallow shafts, and the piles of worked gravel spread over not less than two miles of the river-bed. The first discoveries were probably made by white men, but they proved indifferent to the riches at their hands, so the ground was leased to a Chinaman on a royalty basis. It is said that this Chinaman brought in hundreds of his countrymen to whom he sub-let the ground in blocks 20 ft. square. Each lessee sunk a shaft to the pay-streak and mined out the ground comprised in the lease. Thousands of piles of tailing attest the energy with which work was conducted. An old Chinaman still living on the ground—the last of five hundred—states that each block of ground 20 ft. square produced from $1500 to $3000 in gold dust and nuggets. The source of the gold has not been definitely traced, but it is believed to have originated in a range of porphyry hills through which the old river cut its bed, and the remains of which can now be examined still carrying gold contents varying from a trace to $15 and $20 per ton. In my mind, there is no doubt that these porphyries provided the placer gold of American cañon, and of the several other cañons lying north and south, which also produced the yellow metal.

Production of American Cañon

It is a difficult matter to endeavor to make an estimate of the aggregate amount of gold taken out of American cañon. Chinamen are secretive as to their gold, but it is said that the Wells Fargo & Co. Express has a record of several millions of dollars worth carried out by it. F. L. Ransome gives a reported output of ten millions, and others believe twenty millions to be nearer correct. However, it is certain that the extraction has been good from an area represented by only two miles of river bed, which was the extent of the gold-bearing gravels.

In working the gravels down the river the bedrock was porphyry up to a certain point, where it changed to limestone. The pay-streak lay on a false bedrock of clay, generally about 60 ft. from the surface, being shallower at the upper end of the diggings and increasing in depth at the lower part. A shaft nearly 200 ft. deep was sunk through gravels to the limestone. The pay-streak, however, still retained its position at about 70 ft. from the surface; little or no gold was found below the false bedrock, and none on the limestone.

About half a mile below this shaft the gold spread into a fan-shaped deposit and gradually was lost. The cañon continued, so why did not the gold? It is believed by many that the lower part of the old channel with its gold gravels was faulted and carried northward for about 2000 ft., the upper portion being tilted up to a steep angle. Some time after this occurrence a flow of lava came from the mountains to the west and filled and concealed this faulted part of the channel.

This portion of the gold river channel, unnoticed by a generation of prospectors, has recently been discovered, through portions of the gravel having rolled down the hillside from under the lava. There can be no doubt of it being an old river channel—the north rim of the channel (limestone) is visible in several places, but the south rim is buried under the lava; in between, the gravel outcrops at one point, and has been uncovered at several places by pick and shovel. A shaft, now down 130 ft., is projected to go to bedrock, and a tunnel is being driven under the lava toward the south rim. All of this work is in washed gravel, sand, and boulders—pannings show that the gravel contains fine colors of gold, some cinnabar, plenty of magnetite, and cubes of hematite; in fact, the porphyry gravels are exactly the same as those worked by the Chinamen in American cañon, there can be no doubt that the same hills were the source of both.

Such being the conditions, it is confidently anticipated that when bedrock is reached and the old river channel cross-cut from rim to rim, rich returns will be had.

American cañon is situated a short distance from the new camp of Rochester, the head of the cañon being no more than one mile north of Newel hill; the diggings are about three miles down the cañon, and many now look forward to seeing there the life and battle of a successful gold district.

Operation of the Great Boulder Mill

From the annual report of this Kalgoorlie company, the following is abstracted:

During the year 1912, a total of 193,451 tons (2240 lb.) of sulpho-telluride ore was treated in the sulphide mill for a return of 59,284 oz. of bullion by amalgamation, worth approximately £213,924, and 98,249 oz. of bullion by cyanidation worth approximately £354,850. Also treated 14,467 tons of old tailing for 1204 oz. of bullion, worth approximately £4385, making a total for the year of 158,738 oz. of bullion produced, worth approximately £573,159.

The loss of mercury per ton of ore treated in the sulphide mill has averaged 0.178 oz. The loss of cyanide has been 0.9 lb. per ton of ore treated.

The average assay value of the residue of the ore treated during the year is 1.60 dwt. per ton of 2240 lb., and the average assay value of the residue of the old tailing dump is 1.37 dwt. per ton. Costs were $1.92 in the sulphide mill and 82c. per ton in the cyanide plant, a total of $2.74 per long or $2.44 per short ton.

Dividends paid by gold mines on the Rand during the first half of 1913 total $19,200,000, while those from outside districts, diamond, coal, and tin mines made a total of $21,600,000.

During the month of July the Elmore vacuum plant, at the mines of the Sulitjelma company, Norway, produced 850 tons of copper concentrate.

Geology of the Kalgoorlie Goldfield—V

By Malcolm Maclaren and J. Allan Thomson

Kalgoorlie is not rich in variety of vein minerals, nor are good crystals of the rarer species often obtained. In rock-forming minerals, however, it is well represented. The following list gives the species that have been noted by us, or recorded by previous observers.*

Actinolite	Coloradoite	Melonite
Albite	Dolomite	Mesitite
Altaite	Emmonsite[1]	Muscovite
Amalgam[1]	Enargite[1]	Olivine
Amphibolite	Epidote	Opal[1]
Apatite	Fahlore	Orthite
Arsenopyrite	Fluorite[1]	Pennine
Asbestos	Fuchsite	Petzite
Asbolite[1]	Galena	Psilomelane
Augite	Gold	Pyrite
Axinite	Graphite	Pyrrhotite[1]
Biotite	Gypsum	Quartz
Blende	Halite	Rhodochrosite
Bornite	Hematite	Rickardite
Bournonite[1]	Hessite	Roscoelite
Breunnerite	Ilmenite	Ruby silver ore[1]
Calamine	Kaolin	Rutile
Calaverite	Krennerite[1]	Scheelite[1]
Calcite	Leucoxene	Sericite
Cerargyrite	Limonite	Serpentine
Chalcedony	Lollingite[1]	Siderite
Chalcopyrite	Magnesite	Silver[1]
Chloritoid	Magnetite	Sphene
Chromite	Malachite	Sylvanite
Cinnabar[1]	Marcasite	Talc
Clinochlore	Massicot[1]	Tourmaline
Clinozoisite	Melanterite	

Mode of Occurrence

The minerals may be classified by mode of occurrence under five heads.

1. Those which constituted the original igneous rocks. Olivine, augite, basic plagioclase, and orthoclase (if any) have totally disappeared. Apatite, chromite, magnetite, titanomagnetite, ilmenite, brown and green hornblende, biotite, acid plagioclases, and quartz are still found.

2. Those formed by a rearrangement of material during rock alteration with or without the addition of water and carbon dioxide. They are sphene (including leucoxene), rutile, hematite, magnetite, serpentine, talc, hornblende (uralite), biotite, chlorite, chloritoid, epidote, clinozoisite, zoisite, muscovite (sericite), carbonates, and quartz.

3. Those occurring in 'segregation veinlets' in the altered rocks, consisting for the most part of the minerals produced during the alteration. The composition of the veinlets may be tabulated as follows:

Rock.	Minerals of 'Segregation-Veinlets.'
Amphibolites.	Epidote; quartz and epidote.
Contact-altered amphibolites.	Epidote; quartz and epidote, with actinolite and biotite.
Serpentines.	Serpentine and chalcedony.
Carbonated serpentines.	Carbonates and quartz.
Older Greenstones.	Quartz, carbonates, and chlorite.
Older Greenstones (Calc-schists).	Carbonates, with muscovite or quartz.
Quartz-dolerite greenstones.	Quartz, carbonates, and chlorite; rarely albite or albite and quartz.
Vein-altered quartz-dolerite greenstones.	Any combination of quartz, carbonates, and muscovite; quartz, carbonates, and hematite; rarely albite and quartz.

*Only the occurrence of gold and of the tellurides will be here described in detail.

[1]Not observed by the authors.

Minerals in Altered Rocks

4. Those formed in altered rocks by an introduction of new chemical material, or occurring in fissure veins not entirely filled by segregation from the enclosing rock. The commonest mineral thus formed in rocks is pyrite; it is sometimes noted that pyrite occurs in the rock on each side of a quartz vein which carries no pyrite. In such cases the vein solutions have brought the sulphur which has fixed itself on the iron in the rocks. Chalcopyrite and arsenopyrite have also been noticed as replacement minerals in rocks. In some cases an introduction of magnetite seems probable. The gold and tellurides generally appear to occupy cracks in the rock, but these may be spaces of dissolution. They are frequently accompanied by roscoelite, which appears to replace sericite and requires an introduction of vanadium oxide. All the above minerals with the rarer sulphides are also found in fissure veins. Here also must be included those minerals produced by 'pneumatolytic action,' which imply the introduction of fluoric and boric vapors. Tourmaline is common in small quartz veins, and also as a replacement mineral in rocks. The minerals found with tourmaline in veins include quartz, carbonates, chlorite, albite, pyrite, chalcopyrite, blende, gold, and tellurides. When they pass through ultra-basic rocks tourmaline veins determine the formation of fuchsite, probably by the introduction of fluorine. Axinite has been found in one locality associated with quartz as a vein in the amphibolites.

Minerals Produced by Oxidation

5. Those produced by surface agencies (oxidation) from any of the former. Limonite is by far the commonest product of rock and vein oxidation, and under certain circumstances gives rise to horizontal nodular rocks termed laterites. Next to it comes calcite, which, whether by replacement or accretion, forms spheroidal or ellipsoidal pebbles known as cement pebbles, and also the calcareous cement to the superficial deposits. Mine workings in the oxidized zone show powdery red and yellow rock (colored by limonite) alternating with white material consisting largely of kaolin. These rocks are traversed by veins of quartz and limonite often containing secondary gold. In some cases the quartz itself may also belong to the same period of formation. Incrustations of psilomelane are common. In the oxidized portions of the telluride lodes secondary gold (mustard and paint gold), cerargyrite, massicot, emmonsite, asbolite, malachite, and gypsum have been recorded.

Mineral and Composition.	Color and Lustre.	Cleavage and Fracture.	Chemical Tests.	Notes.
Altaite—PbTe.	Lead gray with a yellowish tinge.	Perfect cubic cleavage.	B.B., easy fusibility; presence of Pb and Te, absence of S. Wet way, presence of Pb and Te.	Resembles galena.
Calaverite—$AuTe_2$.	Pale bronze yellow with bright metallic lustre.	No cleavage, subconchoidal fracture.	B.B., easy fusibility; presence of Te; bead of gold on roasting on charcoal; occasional recalescence.	Some resemblance to pyrite, but much less hard.
Coloradoite—HgTe.	Iron black color.	No cleavage; subconchoidal fracture.	B.B., easy fusibility; presence of Te; complete disappearance on roasting on charcoal; mirror of Hg in the closed tube. Wet way, presence of Hg and Te.	*cf.* petzite and fahlore only distinguished by chemical tests.
Hessite—Ag_2Te.	Lead gray to steel gray; tarnishes readily.	Cleavage indistinct; fracture somewhat conchoidal.	B.B., easy fusibility; presence of Te; Ag bead after heating on charcoal with carbonate of soda. Wet way, presence of Ag and Te.	*cf.* petzite when tarnished.
Krennerite—$(AuAg)Te_2$.	Silver white to brass yellow; brilliant metallic lustre.	Perfect basal cleavage.	B.B., *cf.* calaverite, but decrepitates violently. Wet way, presence of Ag and Te.	When massive indistinguishable from sylvanite unless the latter is twinned.
Petzite—$3Ag_2TeAu_2Te$.	Iron black color; metallic lustre.	No cleavage; subconchoidal fracture.	B.B., easy fusibility; presence of Te; white malleable bead on heating on charcoal with carbonate of soda; the bead becomes yellow on warming in HNO_3. Wet way, presence of Ag and Te.	*cf.* coloradoite and fahlore.
Sylvanite—$AuAgTe_2$.	Silver white; brilliant metallic lustre.	Perfect cleavage in one direction.	B.B., *cf.* calaverite. Wet way, presence of Ag and Te.	*cf.* krennerite; a twin striation perpendicular to the cleavage sometimes observed.

Gold

Unlike its occurrence at Cripple Creek, free gold is common at Kalgoorlie in unoxidized telluride ores as well as in the oxidized. In the former it occurs as large or small lumps of irregular size embedded in the rock, or in quartz veins traversing it. Crystal forms have not been observed, although sometimes the gold is bounded by plane faces where it has rested on quartz crystals. It is generally found in close association with the tellurides, and has probably, in many cases, been precipitated by them. At the Kalgurli mine it occurs in intimate association with a copper telluride, which it veins in a very intricate manner.

The Tellurides

As little information about the tellurides is accessible in the standard English textbooks on mineralogy, the composition, physical character, and the

Analysis of Kalgoorlie Tellurides

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
Te	56.3	55	54.0	56.50	57.27	56.69	58.63	60.30	54.1	57.00
Au	43.7	44	39.2	41.76	41.37	38.70	57.54	33.90	42.6	42.15
Ag	...	trace	3.0	0.80	0.58	1.66	2.06	4.82	0.7	0.60
Cu	...	..	...	....	....	0.21	0.29	0.63	...	....
Fe	...	..	...	....	....	0.18	0.09	trace	...	....
Ni	...	..	...	....	....	....	0.07	....	...	....
S	...	..	...	....	....	0.09	0.10	....	..	....
Se	...	..	...	....	....	....	1.13	....	...	....
Other constituents	...	..	...	....	....	*	†0.23	....	‡2.4	....
	100.0	99	96.2	99.21	99.22	100.53	100.14	99.65	99.8	99.75
Specific gravity	...	..	...	9.377	9.311	....	....	....	...	9.314

*Traces of Pb, Bi, and Zn. †Gangue. ‡Arsenopyrite.

1, Theoretical composition ($AuTe_2$). 2 to 10, Calaverite from Kalgoorlie.

Analyst: 2, Holroyd(a); 3, Holroyd; 4, Mingaye(b); 5, Simpson(c); 6, Rogers(d); 7, Klüss(e); 8, Carnot(f); 9, McGeorge(d); 10, MacIvor(g).

(a) Holroyd, A. G., 'The Discovery and Occurrence of Telluride of Gold upon the Kalgoorlie Goldfields, East Coolgardie District, Western Australia.' *Trans.* Austr. Inst. Min. Eng., IV, 1897, p. 187.

(b) Pittman, E. F., 'Kalgoorlie, a new Telluride from Western Australia.' Rec. Geol. Surv. N.S.W., V, 1897, p. 204.

(c) Simpson, E. G., 'Mineralogical and Petrographical Notes No. 1.' Ann. Rep. Geol. Surv. Western Australia, 1897 (Perth, 1898), p. 47.

(d) Simpson, E. G., 'Notes from the Department Laboratory.' *Bull.* No. 6, Geol. Surv. Western Australia, 1902, p. 15.

(e) Krush, P., 'Uber einige Tellurgoldsilberverbindungen von den Westaustralischhen Goldgängen.' *Cb. f. Min.* 1901, pp. 109-202.

(f) Carnot, A., 'Sur les tellurures d'or et d'argent de la région de Kalgoorlie (Australie occidentale).' *C. R.* Acad. Sci., CXXXII, 1901, pp. 1298-1302.

(g) MacIvor, R. W. E., 'On Certain Tellurium Minerals, and the Action of Sulphur Monochloride Thereon.' *Chem. News*, LXXXVI, 1902, p. 272.

modes of recognition of the different species found at Kalgoorlie will first be briefly outlined.

Composition

Calaverite corresponds nearly to the formula $AuTe_2$, but contains small amounts of silver, as shown in the preceding table of analyses made on Kalgoorlie specimens.

Sylvanite and Krennerite.—Both these minerals are silver-gold tellurides of the general formula $(AuAg)Te_2$, but while krennerite shows variable proportions between the silver and gold, sylvanite approximates closely to the formula $AuAgTe_4$.[2] Since both are silver-white minerals with a good cleavage, their separation, in the absence of crystal forms, as is the case at Kalgoorlie, is not practicable. As will be seen from the table of analyses, both minerals appear to be present. The first analysis referred to by Frenzel as sylvanite has been referred to as krennerite by Rickard[3] and Hintze.[4] The others approximate more nearly to $AuAgTe_4$.

	1.	2.	3.	4.	5.
Te	62.5	58.63	60.83	60.45	54.50
Au	24.2	36.60	28.55	29.85	36.95
Ag	13.3	3.82	9.76	9.18	8.30
Cu	...	....	0.32	0.15	....
Fe	...	....	0.06	....	....
Ni	...	....	0.10	....	....
S	...	....	0.09	0.10	....
Se	...	....	0.20	....	....
Other constituents.	...	....	*0.05	....	....
	100.0	99.05	99.96	99.73	99.75
Specific gravity....	...	8.14	....	....	....

*Gangue.

1. Theoretical composition of sylvanite ($AuAgTe_4$).
2. Krennerite, Kalgoorlie (analyzed by Frenzel as sylvanite).

3 to 5. Sylvanite, Kalgoorlie.

Analyst: 2, Frenzel(a); 3, Wobling(b); 4, Carnot(c); 5, Higgin(d).

(a) Frenzel, A., 'Sylvanite von Kalgoorlie.' *Tsch. Min. Mittl.*, XVII, 1897, pp. 288-9.
(b) Krush, P., *loc. cit.*
(c) Carnot, A., *loc. cit.*
(d) Simpson, E. G., *tom. cit.*, p. 16.

Petzite

Petzite is a gold-silver telluride, the analyses of which approximate closely to the formula Ag_3AuTe_2. Owing to its similarity to coloradoite it is difficult to obtain pure for analysis, as is evident from those quoted below.

	1.	2.	3.	4.	5.	6.	7.
Te	32.8	32.60	31.58	32.33	33.00	34.60	34.83
Au	25.4	24.33	23.58	24.16	23.42	24.64	24.62
Ag	41.8	40.70	43.31	41.22	41.37	40.47	40.55
Hg	...	....	0.88	2.00	2.26	0.29	....
Cu	...	0.10	0.20	0.10	0.16	....	....
Fe	...	0.07	Tr.	....	....	....	....
Ni	...	0.08	....	....	....	....	....
S	...	0.26	....	....	....	....	....
Sb	...	....	0.30	....	....	....	....
Se	...	1.45	....	....	....	....	....
Gangue.	...	0.12	....	....	....	....	....
	100.0	99.71	99.85	99.81	100.21	100.00	100.00

1. Theoretical composition of petzite, Ag_3AuTe_2.

2 to 7. Petzite, Kalgoorlie.

Analyst: 2, Wobling(a); 3, Carnot(b); 4, Carnot(b); 5, Carnot(b); 6, Grace(c); 7, Grace(c).

(a) Krusch, *loc. cit.*
(b) Carnot, *loc. cit.*
(c) Rickard, *tom. cit.*, p. 716.

Spencer[5] considers it probable that in the above tellurides "the gold and silver do not isomorphously replace each other, as is usually considered to be the case, but that they are present in atomic proportions, as indicated in the formulae adopted above. These formulae may represent double tellurides or possibly simple salts (perhaps tellur-aurates, analogous to sulph-antimonites)."

Gold-Tellurium Alloys

On the other hand, Lehner in a recent paper[6] has put forward the view that the gold-tellurium minerals are not chemical compounds at all, but alloys. His chief arguments are that the tellurides can precipitate gold from solution in the same manner as metallic tellurium of gold-tellurium alloys, and that it has proved impossible to prepare the minerals synthetically.

Against Lehner's view, it may be pointed out that three of the above minerals, calaverite, sylvanite, and krennerite, possess definite crystalline form, a property not possessed by alloys. Although in the case of calaverite the crystalline form is peculiar, and has led Smith and Prior to believe that the crystals are really not homogeneous, sylvanite and krennerite have a perfect cleavage, proving a regular homogeneous molecular structure. At Kalgoorlie both calaverite and petzite are found in massive forms that might well be alloys from their physical appearance, but this is also true of coloradoite. Lehner restricts his alloy hypothesis to the gold-tellurium minerals.

The apparent lack of definite molecular proportions is probably due, as Spencer has pointed out, to the difficulty of obtaining pure material for analysis. Still the analyses show that the minerals approximate more closely to definite chemical compounds than would be expected in the case of alloys. Moreover, the close association of several species in the same ore is difficult to understand if they are formed as alloys. It is, however, conceivable that calaverite, petzite, and coloradoite have been formed as definite chemical compounds and have since degenerated into alloys, which, in the case of crystalline calaverite, have formed pseudomorphs after the original crystals.

Kalgoorlie Minerals

Goldschmidtite, kalgoorlite, and coolgardite are names that have from time to time been applied to Kalgoorlie minerals. Goldschmidite, first described from Colorado, has since been shown to be identical with sylvanite. Kalgoorlite (Pittman[7]) and coolgardite (Carnot[8]), two species found in Kalgoorlie specimens have been shown by Spencer[9] in an exhaustive discussion to be capable of explanation as

[2]Spencer, L. J., 'Mineralogical Notes on Western Australian Tellurides,' *Min. Mag.*, XIII, 1903, p. 271.

[3]'The Telluride Ores of Cripple Creek and Kalgoorlie,' *Trans.* Am. Inst. Min. Eng., XXX, 1901, pp. 714-15.

[4]Hintze, C., 'Handbuch der Mineralogie,' 1901, I, p. 898.

[5]Spencer, *tom. cit.*, p. 274.

[6]Lehner, V., 'Some Observations on the Tellurides' *Econ. Geol.*, IV, 1909, pp. 544-564.

[7]Pittman, *loc. cit.*

[8]Carnot, *loc. cit.*

[9]Spencer, *loc. cit.*

mixtures of the above tellurides and coloradoite. As neither Pittman nor Carnot make any mention of coloradoite, which assumes a prominent place among Kalgoorlie tellurides, Spencer's contention possesses considerable weight. In the following table of analyses are also given two (No. 6 and 7) which have been calculated by Spencer as mixtures of petzite and calaverite.

	1.	2.	3.	4.	5.	6.	7.
Te	(37.26)	...	56.55	53.70	51.13	41.11	36.90
Au	20.72	19.4	23.15	27.75	37.06	26.10	15.06
Ag	30.98	30.1	16.65	13.60	4.71	30.43	45.95
Hg	....	...	3.10	3.70	3.70	0.70	....
Cu	0.05	...	0.10	0.25	0.88	0.60	1.16
Fe	....	...	Tr.	Tr.	0.90	0.40	0.08
Ni	....	...	....	....	....	....	0.06
Zn	....	...	....	....	....	....	0.04
Sb	....	...	0.20	0.15	1.20	0.80	0.12
S	0.13	...	....	....	....	....	0.45
Gangue	....	...	....	....	....	....	0.22
	100.00		99.75	99.15	99.58	100.14	100.04

Specific gravity, 8.791.

Analyst: 1, Mangaye; 2, Simpson; 3, Carnot; 4, Carnot; 5, Carnot; 6, Carnot; 7, Krusch.

1. 'Kalgoorlite,' Lake View and Boulder junction, Kalgoorlie. Pittman, *loc. cit.*, p. 203-4.
2. 'Kalgoorlite,' Ivanhoe mine. Simpson, *loc. cit.*, p. 17.
3, 4, and 5. 'Coolgardite.' Carnot, *loc. cit.*
6. Mixed tellurides. Carnot, *loc. cit.*
7. Krusch, *loc. cit.*

Hessite

Hessite is generally ascribed to the formula Ag_2Te, but most analyses show a decided proportion of gold. No analysis has been made of the mineral from Kalgoorlie. It may be pointed out, however, that apparently homogeneous pieces of hessite are shown when polished and treated with acids to be composed of a mixture of hessite and petzite. An analysis made without this knowledge would certainly show a considerable percentage of gold. It is to be noted that among the analyses quoted by Dana those made on crystals of hessite contain but little gold. It is most probable, therefore, that hessite is a pure silver telluride without gold.

Coloradoite was described by Genth from Colorado as HgTe, but Simpson,[10] from an analysis of the Kalgoorlie mineral, suggested Hg_2Te_3 Spencer made a new analysis[11] on carefully selected material, with the result that Genth's formula (HgTe) was confirmed. The analyses were as follows:

	1.	2.	3.
Te	38.8	(49.48)	39.38
Hg	61.2	50.40	60.95
Ag	...	0.12	....
Au	...	Tr.	....
	100.00	100.00	100.33
Specific gravity		9.21	8.07

Analyst: 2, Simpson; 3, Spencer.

1. Theoretical composition, HgTe.
2. Coloradoite, Australia G. M., Kalgoorlie (sp. gr. determined on another sample).
3. Coloradoite, Great Boulder Main Reef G. M., Kalgoorlie.

Altaite from Kalgoorlie has not been analyzed. No doubt attaches to the formula PbTe.

[10]Simpson, E. S., 'Mineralogical and Petrological Notes, No. 2,' Ann. Rep. Geol. Surv. Western Australia, 1898 (Perth, 1899), pp. 57-58.

[11]Spencer, *tom. cit.*, pp. 275-278.

Melonite. A hitherto unrecorded telluride of nickel has been found at the Hidden Secret mine. It agrees in physical characters with the melonite as described in Dana's 'System of Mineralogy,' and gives all the usual blowpipe tests for nickel and tellurium. The following characters were noticed:

Sulphuric acid test for tellurium, very good.

Heated before the blowpipe on charcoal; does not fuse readily; colors the reducing flame blue-green; gives a white sublimate of TeO_2 and the characteristic tellurium odor; after long heating fuses with spluttering; the yellowish green or brown residue colors the borax bead a reddish brown color when very little of it is introduced.

In the closed tube does not fuse; indistinct sublimate of TeO_2.

Dissolves in nitric acid to a colorless liquid, which becomes green with one drop of hydrochloric acid.

Torrington Blatchford, of Kalgoorlie, kindly made a qualitative examination, which showed the absence of silver, lead, copper, and bismuth, and abundance of nickel and a slight trace of zinc. As very little material was available, a quantitative analysis was left for one more expert in telluride analysis.

Rickardite

Rickardite (?). Rickardite, the tellurium of copper (Cu_4Fe_3) has been recorded only from the Hope mine, Vulcan, Colorado, by Ford.[12] M. Brimsden, metallurgist of the Kalgurli mine, called our attentiontion to a telluride in that mine containing copper and gold. Etching experiments showed that the mineral is intricately veined by free gold, so that it is probably a pure copper telluride. The mineral varies somewhat in appearance according to the abundance and fineness of distribution of the free gold, which is seldom visible before treatment in acid. Two varieties were noticed, the one with very fine fracture and a black metallic appearance; it proved to have leaf-like films of gold often between the cleavage planes; the other was coarser and of a grayish metallic appearance, with a distinct cleavage; the included gold was not too finely distributed. The mineral is quickly attacked by cold nitric acid which renders the free gold visible.

A small fragment, as free as possible from included gold, fused easily before the plowpipe on charcoal, colored the flame blue-green, and gave a dense white sublimate of TeO_2; the bead obtained, which was small in proportion to the original fragment, was of a brownish color when cold, and was malleable. On treatment with hot acid it effervesced and became golden. The solution obtained by decomposition in nitric acid was of a greenish color, which turned to blue on neutralization by ammonia. The sulphuric acid test for tellurium was obtained more easily than in the case of any other telluride. It was further observed that the mineral was decomposed by long heating with ammonia with the production of a blue solution.

The above tests leave little doubt that the mineral is a telluride of copper. It differs considerably in color from that recorded for Rickardite. It was noticed, however, that occasionally on tarnished surfaces the colors were similar to those of bornite.

[12]Ford, W. E., *Am. Jour. Sci.*, XV, 1903, p. 69.

A quantitative analysis was made in the laboratory of the Kalgurli Gold Mines.

Diagnostics

The presence of tellurium may be easily detected by blowpipe tests. When heated on charcoal, in the oxidizing flame all the gold and silver, lead and mercury tellurides quickly fuse and emit dense white fumes, which have a characteristic odor. They coat the charcoal with a volatile white sublimate of TeO_2. When the bead is touched with the reducing flame it imparts to it a bright bluish green color. When heated in the closed tube, they again fuse and form a white sublimate of TeO_2 near the test. This fuses on further heating to a liquid, which is yellow when hot and white when cold. Occasionally also a black sublimate of metallic tellurium is obtained, especially with calaverite, but also with coloradoite when large fragments are used. An easily performed wet test consists in heating a fragment of the mineral on a porcelain plate, and allowing a few drops of sulphuric acid to flow over it. Under certain conditions of temperature a flash of purple color is obtained, owing to the formation of tellurates. This test may also be applied to the sublimate of tellurium in the closed tube, or to the coat of TeO_2 on charcoal.

Determination of the Tellurides

The distinction of the different tellurides can easily be made by a combination of physical characters and blowpipe tests. Calaverite and sylvanite give a malleable yellow bead when simply roasted on charcoal, but may easily be distinguished by color and cleavage. Petzite gives a silvery, malleable bead only when heated with soda on charcoal, and this bead becomes golden on parting with nitric acid. Coloradoite, which greatly resembles petzite in physical appearance, disappears completely when heated on charcoal, and gives a mirror of globules of mercury when heated in the closed tube. Hessite resembles petzite in giving a brittle bead, but is much harder to reduce with soda and charcoal. If a large piece is used, dendritic growths of silver form on the surface of the bead. Altaite may be distinguished from the others by its cubic cleavage and greater flexibility. While lead may be detected by blowpipe methods, it is more satisfactory to have recourse to wet tests. From galena it may be distinguished by the sulphuric acid test for tellurium.

Melonite is distinguished from the others occurring at Kalgoorlie by the combination of perfect cleavage and yellow-brown color. It does not fuse readily before the blowpipe or in the closed tube, but forms a greenish yellow mass on roasting. A minute amount of this imparts the characteristic brownish red colors to beads of borax and microcosmic salts. The copper telluride found at the Kalgurli mine is distinguished by the combination of cleavage and gray-black color. Owing to the presence of veinlets of gold penetrating it, some difficulties are met in blowpipe analyses. Thus, when roasted it gives at once a yellow bead. It is very easily soluble in cold nitric acid to a greenish solution, which turns blue with addition of ammonia, while the free gold does not pass into solution. It is noteworthy that ammonia itself turns blue after prolonged heating with the natural mineral.

Metallography of the Tellurides

A few experiments, with a limited amount of material and the rudest of apparatus, were made on the behavior of tellurides when polished and etched. The results were sufficiently encouraging to show that much information as to the constitution and interrelation of the minerals may be gained by more extended work in this direction. Because of the difficulty to the ordinary man of obtaining material suitable for handling, it could be done most easily by the mine chemists.

Owing to the softness of the tellurides, it is difficult, in thin sections of rocks containing them, to obtain a smooth surface; calaverite, in particular, shows a coarse hackly surface, which alone, without the paler color, would distinguish it from pyrite; sylvanite, petzite, and coloradoite give much smoother surfaces, but generally rougher than magnetite, which the last two resemble in color.

If larger pieces of the tellurides alone are taken, it is possible to grind a smooth metallic surface. The abrasives used were, first fine emery on a wheel, then flour emery on glass, and the final surface was obtained by 'dynamite cloth,' although washleather is preferable. The chief difficulty is to remove the larger scratches made by the fine emery.

On the polished surface it is sometimes possible to recognize the presence of more than one kind of telluride, or the inclusion of extraneous minerals, such as gold and chalcopyrite. In the case of the copper telluride the cleavage was visible, but not in the case of sylvanite or melonite.

Solvent for Tellurides

The most suitable solvent employed was nitric acid. In the case of the copper telluride, a few seconds' immersion in cold nitric sufficed to bring into relief the veining by gold and the cleavage of the mineral. In other cases the mineral was heated for a few minutes with the acid. It was noticed that the greater amount of silver compared to gold in the mineral the quicker the decomposition. In this manner the presence of petzite in the Hidden Secret hessite was demonstrated. Etching with nitric acid brought to light no trace of crystalline structure, except in the case of sylvanite, in which a polysynthetic twinning, invisible on the cleavage planes, was brought to light. The presence of this twinning serves to distinguish sylvanite from krennerite. On one occasion a slight indication of cleavage was suspected in hessite, but was destroyed by further boiling in nitric acid. No success met attempts to bring out the cleavage of sylvanite.

Considerable difficulty was experienced owing to the deposition of chloride of silver on washing in the Kalgoorlie 'scheme' water. On allowing the specimen to dry, the surface became blackened. This and the tarnish produced by nitric acid can be removed to some extent by washing in solutions of potassium cyanide.

With *aqua regia*, on the other hand, the order of solubility changed. The greater the amount of silver in the telluride the slower was the decomposi-

tion, owing to the deposition of silver chloride. In this way petzite became dissolved away below the surface of the preparation, while the hessite enclosing it was little attacked. The 'solution surface' of the petzite presents curiously curved shapes, and seems to indicate a lack of crystal structure. Sulphuric acid failed to give any satisfactory results as a solvent. Time did not permit further experiments. A large number of solvents might be suggested, including $KMnO_4$, $K_2Cr_2O_7$, $FeCl_3$, sulphur monochloride, etc., all of which are known to decompose tellurides.[13]

The results obtained may be briefly summarized:

Calaverite.—Surface slowly lowered and tarnished by HNO_3; more rapidly lowered by *aqua regia.*

Sylvanite.—A polysynthetic twinning revealed by HNO_3; iridescent colors obtained by *aqua regia*, followed by cyanide solution.

Petzite.—Surface slowly lowered by HNO_3; if subsequently polished on wash leather, becomes golden colored; an undulating solution-surface produced by *aqua regia.*

Hessite.—Surface lowered by HNO_3, apparently quite regularly; a slight indication of a cleavage or parting obtained; deposit of silver chloride by *aqua regia.*

Coloradoite.—Surface lowered by HNO_3, not so quickly by *aqua regia.*

[13]Lehner, *tom cit.*

Copper telluride. Surface quickly lowered by HNO_3, cleavage becomes marked.

Occurrence

The tellurides are for the most part confined to the richer shoots in the large lodes in the 'Mile.' Outside of this, they have been found in most abundance in the Block 45 and Eclipse leases of the Oroya Links and the Hidden Secret gold mines. From a mineralogical point of view, the shoot now worked at the 400-ft. level of the Kalgurli G. M. and the Hidden Secret shoot are the most interesting. The Kalgurli shoot is very rich in sylvanite and contains also calaverite, petzite, coloradoite, and the hitherto unrecorded silver and copper tellurides, and also fahlore, cerargyrite, bornite, and oxidized materials difficult to separate from the tellurides and sulphides, but suspected to be cuprite, emmonsite, and montanite (the last as a coating on coloradoite). The Hidden Secret telluride is mostly a black color, proving on etching to consist of mostly hessite with subordinate petzite, while altaite and melonite are also present. The non-telluride minerals are chiefly chalcopyrite, pyrite, and bornite, while large masses of cerargyrite were obtained from the oxidized zone. The following table, amplified from Spencer, gives the list of species so far identified from the chief mines of the field. It will be noticed that sylvanite is commoner on the eastern than the western side of the 'Mile.'

Mines.	Tellurides.								Other minerals closely associated.					
	Calaverite	Sylvanite	Petzite	Hessite	Coloradoite	Altaite	Melonite	Copper telluride	Fahlore	Chalcopyrite	Bornite	Gold	Magnetite	Roscoelite
Western group:														
Great Boulder Proprietary	*	..	*	..	*	*	..	..	..	..	..	*	..	*
Ivanhoe	*	..	..	..	*	..	..	..	*	*	..	*	..	*
Golden Horse-Shoe	*	..	*	..	..	..	..	..	..	..	..	*	..	*
Boulder Main Reef	*	*	*	..	*	..	..	..	*	..	..	..	..	*
Hannan's Star	..	..	*	..	..	..	..	..	..	..	..	*	..	..
Central group:														
Kalgurli	*	*	*	*	*	..	..	*	*	*	*	*	..	..
South Kalgurli	*	..	*	..	*	..	..	..	*	..	..	..	*	..
Great Boulder Perseverance	..	..	..	..	*	..	..	..	..	*	..	*	..	..
Lake View	*	*	..	..	*	..	..	..	..	..	..	*	..	..
Oroya-Brownhill 'pipe':														
Oroya-Brownhill	*	*	*	..	*	..	..	..	*	*	..	*	*	..
Associated Northern Blocks	*	*	*	..	..	..	..	..	..	*	..	*	*	..
Associated	*	*	*	..	*	..	..	..	*	..	..	..	..	..
Eclipse	..	..	..	..	..	*	..	..	..	..	..	..	..	..
Hidden Secret	..	..	*	*	..	*	*	..	..	..	..	..	..	..

Sulphur as a Fertilizer

In connection with the wide outcry made over the effect of sulphur fumes upon vegetation, it is interesting to note that sulphur itself is well known to have marked value as a fertilizer. B. Heinze, in Germany, has recently called attention to this, his experiments showing the beneficial action, which is not well understood. A. Demolin, in France, concludes that the sulphur is converted to SO_4 by micro-organisms and that its fertilizing action is partly due to its action on micro-organisms and partly to the formation of H_2SO_4, which by its action on lime salts and other bases makes mineral matter more readily available to the plants. V. V. Sabashnikov, of the Russian Agricultural Experiment Station Service, has found that an application of 10 gm. of sulphur per square metre to a fertile clay soil greatly increased the yield of barley and rye. E. Lierke, in Germany, finds that fertilizers containing sulphur compounds gave better results with fruits than other fertilizers.

Coke production in Illinois in 1912 amounted to 1,764,944 short tons, valued at $8,069,903, against 1,610,212 tons in 1911.

Temperatures at the Morro Velho

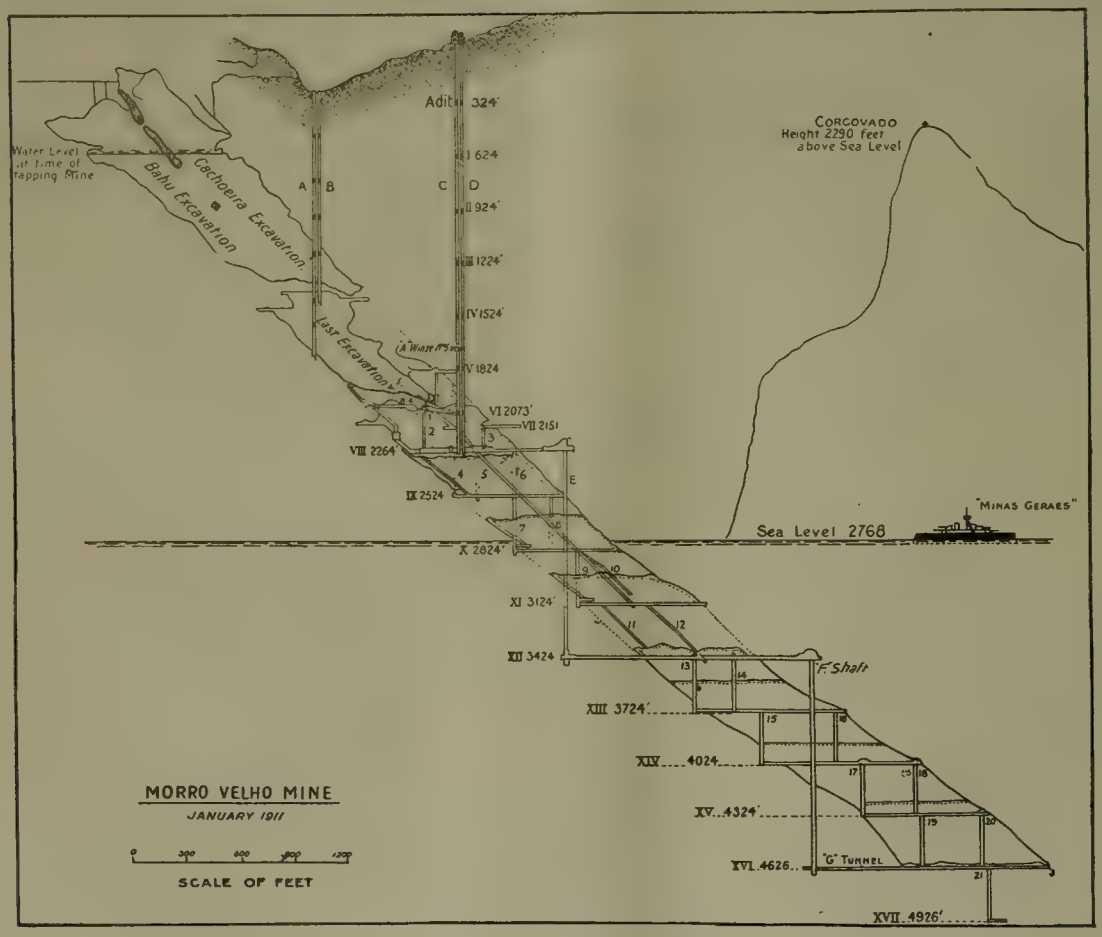
The Morro Velho, the famous Brazilian gold mine owned by the St. John Del Rey Mining Co., which has now reached a depth of 4926 feet, affords opportunities for measuring rock temperatures that are unusual. Incidentally, these temperatures make the problem of ventilation severe. In his recent annual report, George Chalmers, the superintendent, discusses the matter in part as follows:

The Sirocco fan plant, installed in February 1912, has run satisfactorily during the year, with the exception of the interruption attributed to a number of small stoppages, amounting in all to 13 hours 40 minutes, caused by the generating plants supplying the power being temporarily shut down by thunderstorms, and not due to any trouble in the fan-house.

Power Consumption

The average power put into the fan has been below the full capacity of the 150-hp. motor, but sufficient to pass through the mine about 72,000 cu. ft. of air per minute, which after being split up among the several parts of the mine, has kept the workings at a temperature, although hot, not sufficiently so to interfere with the efficiency of the men. As a proof of this it may be said that there are many contractors and others working in the mine who would not be satisfied to remain there if they could not work 50% overtime, or a total of 12 hours. By referring to back reports on the temperatures of the rock and levels or excavations, it will be found that the rock temperature as represented by readings taken at the extremity of 10-ft. holes in the rock, shortly after the particular locality had been opened, decreases, and continues to do so for a considerable time after being exposed to the air from surface, and consequently it is probable that even the first reading is a little below the temperature of the rock previous to the excavation being made in it. No doubt longer holes would give readings approaching more closely the true rock temperature, but the thermometer at the extremity of a 10-ft. hole probably gives readings sufficiently close for practical purposes.

It has been previously pointed out that horizon



14 (4024 ft.) at the time of being opened, showed a rock temperature of 98°, and at horizon 17 (4626 ft.) it was 105°. A line passing through these two points and projected to horizon 22 (6120 ft.) indicates a temperature of 117°, and at horizon 18 (4926 ft.) one of 107½°, but the actual temperature registered from the bottom of a 10-ft. hole, bored as soon as possible after the shaft reached that point, showed 1½° less. This can be accounted for by the cold air from machine-drills working close at hand, together with the cooling effect by the large volume of air coming into the bottom of the shaft from the 12-hp. auxiliary fan. As a proof of what has been stated above as regards the fall in rock temperature when exposed to air from surface for some time, it will be seen that at horizon 17 the rock temperature at the

time of the first reading shortly after the rock was opened, was 105°, that during the hot months from November to March it had fallen a degree, that for 1911-12 for the same months it fell to 100½, and for 1912-13 it was only 98°, or a total fall of 7°, and at the horizons above, the fall has continued with marked regularity. At horizon 16 and those above, the air temperature is not quite so regular, but represents a considerable average fall since 1910-11.

Changes in Temperature

There is, however, little change for the past year as compared to that of the year previous, probably owing to the fact that during the past year there has been no increase in the volume of air, while the mine has been deepened, and a considerable area of heating surface has been added by the rock opened in development. Had the fan been worked to the full power of the 150-hp. motor, which it must be remembered is only half what it is finally to work under, no doubt the temperature of the air for the past year would have more closely approached the average temperature of places opened for some time, and what may possibly be expected after the horizons have been connected with the main ventilating system, and with an ample supply of air. It must be remembered that the above readings have been taken during the four hottest months, when the surface temperature is considerably greater. During the remaining eight months the average surface temperature would be lower, and the readings within the mine would be less to some extent. In sinking and driving in new rock dependent on auxiliary ventilation, the temperatures are higher; for instance, at the bottom of the 'G' shaft, at horizon 18, during sinking operations the rock temperature was 106°F., and the air temperature 98°. The men working there did not appear to feel the heat very much, and in the drift from the present bottom of the shaft, where probably the temperature is slightly higher, the drillers are penetrating the rock at about a yard per day, which is a good average for tunneling in this rock close to surface. The fact of the mine being a dry one is probably a matter of considerable importance, the wet bulb showing a temperature considerably below the dry. It has been stated by writers on the subject that a temperature of 100°F. with the air so dry that the wet bulb temperature is only 80°F., is no worse for the efficiency of the men than a saturated atmosphere of 80°. I also find it recorded that the Yellow Jacket rock on the Comstock, at the 2840-ft. level shows a temperature of 154°, while the air in the adits is 110°, yet good English, American, and Canadian labor is available at reasonable prices. It may be mentioned that the native working in the open here with the sun over his head, has to bear a temperature of 107° and upward, and not unfrequently in our shops, with open sides, the temperature in the day is over 100°.

Minimum Temperature

It is evident that everything possible should be done to reduce the temperature to a minimum, both from a humane as well as business point of view, and the only effective way to accomplish this is by paying special attention to the airways, keeping the mainway into depth below or ahead of the explorations beneath the stopes, and by reserving ample power for the fans. By attending to these points the maximum quantity of air can be passed through the workings, but the air must enter the mine as cool and dry as possible. Experiments on cooling the intake air by suitable arrangements in which power water is being used, without interfering with the power, are being tried; also some experiments in insulation have given results of interest.

Metallurgy in Rhodesia

The following notes were recently published in the *Kalgoorlie Miner*, Western Australia, after an interview with H. T. Brett, who was a metallurgist at Kalgoorlie several years ago, but has since been in Rhodesia with the Consolidated Gold Fields of South Africa.

There was recently erected at the Shamva mine a mill of 56 stamps, using ¼-mesh screens and having a capacity of 1800 tons per day. On the Falcon there are 24 Nissen stamps, with a capacity of 500 to 600 tons per day, and it is expected that a flotation process will also be installed. At the gold and copper mine it is also proposed to erect 24 Nissen stamps. The Globe & Phoenix, considered to be one of the richest mines in the world, has developed 180,000 tons of ore, worth $33.60 per ton, notwithstanding that the mill has been crushing similar ore for the past two years. Among the mines which will start crushing during the next twelve months are the Shamva. This is a big low-grade property, situated on a hill, the ore from which is worth $4.80 per ton. This, it is estimated, will be mined and treated at a cost of $2 per ton. A plant is being erected to deal with 50,000 tons per month. From this property 2,000,000 tons can be worked by open cut. The development of this mine to date has not cost much above 12c. per ton. The Falcon, a copper and gold property, with ore containing 3% copper, and $5 gold per ton, will also begin crushing shortly. There has been developed in this mine about 600,000 tons of ore, and the plant will contain Nissen stamps, a Minerals Separation plant, blast-furnace, and convertors. Then there is the Cam & Motor, which will be equipped with a large plant on Western Australian lines—dry crushing, roasting, involving cyaniding, and capable of treating 500 tons per day. In this mine there is developed 1,000,000 tons of ore, worth about $10.80 per ton.

Flotation at Broken Hill

The following are outputs of the Zinc Corporation and Amalgamated Zinc company's plants during May:

	*Zinc Corporation.	Amalgamated Zinc.
Tailing treated, tons	27,670	46,960
Zinc concentrate, tons	7,605	12,603
Lead concentrate, tons	4,154	137
Total income	$244,000	$173,000
Working profit	68,000	86,000

*This Company also treated 15,554 tons of ore from its South Blocks mine.

Manufacture of Eucalyptus Oil

*The use of this oil was until recently restricted to medicinal purposes, but now that the Minerals Separation process of flotation of sulphides from ores finds a use for it, the manufacture has attained quite an important place.

A recent visit to one of the stills belonging to the Eucalyptus Oils, Ltd., which Company is operating in the Braidwood district, New South Wales, afforded an opportunity of inspecting the methods employed in producing the oil, and supplied a cheerful example of another source of wealth to Australia, which, with the extension of the patent process (since its complete success has been proved here) to other mining countries, will, doubtless, also mean in the future a valuable export trade.

There are over 200 varieties of eucalyptus now classified, and it is the peppermint class which meets the requirements of oil production. Their oils contain a large percentage of *phellandrene*, which, while being detrimental to their use for medicinal purposes, increases their suitability for flotation purposes, and they are large producers, giving in the case of *Eucalyptus amygdalina* up to 40 lb. of oil per 1000 lb. of leaves, and can thus be produced sufficiently cheaply to be profitably employed.

The first step taken is to fell the trees selected, and as the foliage only is required, all of them having a fairly good leaf growth, from saplings to those of about 18 in. diam., receive the attention of the ax. The large branches are then cut off, and these, in turn, cut up with a knife to branchlets not exceeding 16 in. long. The wood is useless, consequently as little of it is left as possible, having due regard to the time taken in the trimming. These branchlets are piled by the fallen tree, and later collected by bullock or horse drays, which traverse the bush on rough tracks cut for the purpose. Thence they are conveyed to the still, which is usually situated on the side of a running creek. The form of still mostly used is made from 400-gal. square tanks, with the tops cut out and steam-proof lids substituted; these are used singly, coupled, or in three, as the output may demand.

Holes for fire are dug under them, and pipes carried from the sides through the running water and emptying their mixture of distilled oil and water into a suitably placed receiver, complete the plant, and the oil is subsequently skimmed from the top of this receiver, much in the same manner as cream is skimmed from milk. A wooden platform is usually employed at the bottom of the tank, leaving several inches under it in which to boil the water, and the tank having been filled with the leaves and tightly pressed down, the lid is screwed on, the fire lighted, and nothing remains but to attend to the stoking for a period ranging from 4 to 6 hours, by which time practically all the oil contained in the leaves has been carried off into the receivers. It is not claimed that this form of plant is an ideal one, and better results can be obtained by the use of an improved class of still; but the cruder form has many advantages, including that of being rapidly constructed, easily moved from place to place as circumstances may require, and of being so simple in construction as to need little or no expert attention. The oil, when taken from the receiver, having been tested and classified, is packed in drums and is then ready for use. In the case of the medicinal oils, it has further processes of re-distillation to undergo in separating its various constituents for the uses to which they are applied, but as it is only in regard to the oils used for mineral separation that these enquiries were made, they do not come within the scope of this article.

*Abstract from *Australian Mining Standard.*

The Irvinebank Aerial Tramway

*The Irvinebank Mining Co., Ltd., North Queensland, has recently completed the erection of an aerial ropeway connecting the Governor Norman mine with the stamp-mill storage-bins and is effecting a large saving in the cost of transit of ore between those points, and is otherwise giving every satisfaction. The length of the tramway is nearly 1½ miles. It crosses the Ibis gorge, and its greatest span is 1300 ft., the buckets being about 300 ft. above the stream. It is built on the single-rope system; that is, a single traveling rope which both supports and pulls the load along. This system, which has been brought up to its present state of perfection by J. Pearce Roe, director of Ropeways, Limited, of London, is remarkable for simplicity of working, construction, and low cost. The ropes are supported on 15 trestles of an average height of 21 ft., built of light steel sections securely braced by tension rods. On the ropes there are 45 buckets, each hung from patent carriers and capable of holding about 500 lb. of ore. The buckets are despatched from the loading station at the rate of one per minute. A patent bell-timing apparatus, mounted at the loading station, regulates the spacing. The stations, or terminals, are of simple design, and only one man is required at each terminal. As soon as a bucket arrives at the loading station, it automatically releases itself from the rope, and, running on to a shunt rail, is carried under the ore-bins, where it is filled from chutes specially constructed to facilitate the loading. The carrier is then run round to the take-off point, where it again automatically attaches itself to the rope, and so travels on to the unloading station, where a similar action takes place. The bucket is here received by the man in attendance, who, by simply knocking up a catch on the bucket, tips the ore into the receiving bins.

The ropeway is driven by a 10-hp. engine. The power necessary, however, to keep the machine running after it is under way is approximately 4 hp. The total cost of the entire plant, including bins at the mine, engine, etc., was under $17,000, and it has reduced the cost of conveyance of ore from $1.44 to about 12c. per ton of ore carried.

*Abstract from *Queensland Government Mining Journal.*

Gold is reported to have been discovered in large quantities in the southern part of the Province of Katanga, in the Belgian Congo.

Discussion

Readers of the MINING AND SCIENTIFIC PRESS are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment. Insertion of any contribution is determined by its probable interest to the readers of this journal.

Rand Conditions and Future Outlook

The Editor:

Sir—Owen Letcher, by virtue of a long residence on the Rand, coupled with unique facilities for getting detailed information in regard to the mining industry, is a writer who must be taken seriously on such a subject as that selected by him in your issue of June 28, 1913.

It would be impossible, however, for any writer to take up the controversial points that must enter into the consideration of such a subject, without laying himself open to criticism on some point or other, and, as a matter of fact, I find that there are several questions upon which I feel that issue may be taken with Mr. Letcher.

The burden of Mr. Letcher's article is that the Rand, as a gold producer and profit earner, has just about reached its zenith, and that, in the near future, the beginning of a gradual and general decline must be looked for. On this broad platform I am entirely in agreement with Mr. Letcher, and I consider that his presentation of the case in support of this contention is extremely lucid and convincing.

Influence of Depth on Grade of Ore

It is on some of the internal questions touched upon by Mr. Letcher that I would wish to remark. For instance, he says: "I do not see any real evidence to support the statement that poorer ore is the rule as greater depths are reached on the Witwatersrand." He continues: "This is, of course, based on experience to date when a maximum depth of 5000 ft. has been reached, but I do think that many of the Witwatersrand mines have milled ore having a higher value than the average value throughout this region" (the central mile).

I must confess that I cannot follow Mr. Letcher in this statement. It is some years since I left the Rand, but certainly up to that time the available evidence in my possession was in support of the argument that there is diminution of grade as depth is attained. This expression "as depth is attained" in itself, however, requires some explanation, for it must not be understood that it is intended to mean that the first hundred feet must necessarily be richer than the eighth hundred feet. There are many cases, of course, where this was so, but this is not the argument. It is in dealing with the main reef series as a whole, and dividing the area on the dip of the series into three parallel zones of 2000 ft. each in width, the first zone extending say from the outcrop to 2000 ft., the second from 2000 to 4000 ft., and the third from 4000 to 6000 ft., that I would prefer to take as my basis, explaining at the same time that this classification is more or less arbitrary, and to be only taken as a generalization. Would Mr. Letcher then tell me that the average grade of the ore disclosed in the known developed mines, as arrived at by a 5-ft. sectional sampling throughout, shows no falling off as between these three zones? I do not wish to take the case of particular mines, as I have no desire to express an opinion which might be judged as prejudiced, or damaging to any one part, but here there is presented a question that, from the engineering and scientific standpoint, is of great interest, and I believe, and it is my firm and unhesitating opinion, that a comparison such as that suggested by me would show that there is undoubtedly, on average, a material falling off as between the second and first zones, and again, but in lesser degree, as between the third and second zones. This same question was taken up by Mr. Schmidt in an article presented by him to the Institution of Mining and Metallurgy in 1911, and at that time there was some discussion on this particular point, and, in my judgment, the general trend of opinion then was opposed to that now expressed by Mr. Letcher.

I cannot see what useful purpose it serves to make a claim, such as that put forward by Mr. Letcher, which, according to my observations and experiences on the Rand, is quite inaccurate, especially as it appears to me that the figures submitted by him, reflecting the operations over the past five years, are in direct conflict with that view.

Mr. Letcher's next point is contained in the following: "Admittedly, there is much to be said in favor of selective mining—in other words, making hay while the sun shines. Unfortunately, however, that such a policy has been pursued is not generally recognized. Unfortunately, also, the expectations of lower working costs have not been realized. On the face of official statistics, given herewith, the winning of an equal dividend from ore of lesser grade as a consequence of lower running charges has been a presumption that has not been fulfilled. Neither has the automatic transfer of ore from the unpayable or unprofitable side of the ledger to the payable or profitable side been manifested, and this despite the operation of 858 additional stamps and 173 additional tube-mills."

Selective Mining

Selective mining is a complicated question, and, unless its application is expressed in figures, it is difficult to follow any argument closely. All mining is more or less selective, within limits, and it is only a question of the degree that really calls for criticism. Mr. Letcher's idea, of course, is quite clear. He is referring to the policy, advocated by certain engineers, of attacking, whenever and wherever possible, the richer parts of any mine, regardless almost of everything. The argument made in favor of this policy is that the ultimate profit made is greater because of the compound interest factor.

Take, for instance, a mine in which the ore developed amounts to a total of 100,000 tons blocked out, giving an average recovery value throughout of, say, 7 dwt., divided as follows: 5000 tons at 40 dwt. equals 200,000 dwt.; 75,000 tons at 6 dwt. equals 450,000 dwt.; 20,000 tons at 2.5 dwt. equals

50,000 dwt.; total, 700,000 dwt.; and assume further that this 5% of 2-oz. rock (recovery value) is distributed in small blocks at various points in the mine; also that the cost of development on the full tonnage of 100,000 tons has amounted to 2s. 6d. per ton. The advocates of selective mining would then proceed to deal only, in the first place, with 5000 tons of 2-oz. rock.

If this could be done, maintaining an average working cost, such as could be realized in taking merely average-grade ore and working on some scheme of concentration in the mine, then there would undoubtedly be a great deal to say in favor of it from a present-value standpoint.

Selective Mining v. Working Cost

But what would happen? In order to mine only this grade of ore, work would have to be conducted on every level in the mine. Tramming, shoveling, skip-filling, lighting, air-lines, rails, etc., would all have to be maintained at each of these points, from which only very small quantities of ore would be taken. The supervision would have to be out of all proportion to the tonnage, seeing that the points of attack would be so far apart, and from every conceivable working condition aspect, the result of such policy must be reflected in abnormal cost. It is in this that the danger of the policy lies, as the only offset to this inflated expenditure is the interest obtainable on the larger amount realized per ton of ore handled. It is too complicated a matter to deal with in figures in an article of this kind, but I have made many calculations on hypothetical cases, and it is not difficult to postulate a case where persistence in such a policy might rob a mine of 50% of its potential profit. Contrariwise, however, it can be shown that the opposite policy of including worthless rock with the higher-grade ore may be followed to equally disastrous limits.

In fact, the whole problem of the limitations of selective mining rests in the factors of grade of ore *vis a vis* concomitant operating expenses, it being axiomatic that the more selective the mining the higher the working cost. In almost every form of mining, however, a certain amount of selection must be followed. It is in determining correctly the economic limit of the application of the principle that the capabilities of the administration will be shown. It is quite certain that there are mines where a straightforward policy, practically devoid of all selection, will show the best economic result, while there are others that could only be made to yield profits by sticking closely to that policy. It is absurd to generalize, and until a specific case is taken, it is quite impossible to have any view one way or the other.

Steadiness of Output

But ultimate profit is not the only objective—there are other weighty considerations. Steadiness of output, for instance, is desirable in mining, and the only way to arrive at anything stable in this direction is by creating reserves of the higher grade of ore. All mines vary in some degree in the distribution of their mineral value, and, in consequence, all mines will have their phases of lower and higher grade ore periods of development. If a mine has two or three years ore-supply developed ahead of its mill, it is not difficult to regulate, within fair limits, the average output, seeing that the grade can be modified from time to time, as dictated by the results of current development. That is to say, if new development continues to show a better grade than the average of the existing ore reserves, then an increase in the grade milled might be allowed; whereas, on the contrary, if new development continues to show poorer average results, the grade of the current ore being milled might be correspondingly reduced. In this way a steady level of returns can be maintained and shareholders and directors can look forward with considerable certainty to the immediate future, and two or three years beyond that.

Influence on Returns

On the other hand, if a policy of selective mining is to be followed, where the richest ore is always to be taken out as soon as discovered, and sent to the mill, regardless of everything, there must be undoubtedly violent fluctuations in the returns, and considerable uncertainty as to the value of the Company's shares and its future. Furthermore, as already stated, operations under such conditions cannot possibly be carried on as economically as in the other case, and it is not at all improbable that the advantage and interest obtained by getting the returns from the higher-grade ore early into the bank, under this system, would, in many cases, be more than offset by the corresponding increase in the operating costs entailed. It should not be impossible, at a given time, to figure what the most profitable limit of selection should be, but I would say in general that if the principle is adopted, merely with the idea of rushing those points where the best ore appears, regardless of other factors, it must prove to be economically unsound, as there are undoubtedly many occasions when the working of lower-grade ores simultaneously with some of the higher-grade ores will yield a joint aggregate profit that could never be arrived at by selecting first the higher-grade ore and finally going back to the lower.

Effect of Increased Tonnage

This is one side of the question. Mr. Letcher has pointed out another feature, namely, that the increase of the number of stamps and the addition of tube-mills has not resulted in increased profits.

The object of adding this additional plant was originally to permit of the handling of much larger quantities of ore, with the idea that the general reduction of operating cost to be brought about in handling such larger quantities would result in showing a profit on a grade of ore that could not be made to yield a profit when only a small tonnage was being handled. Up to a certain point, this idea was undoubtedly sound, but here, just as in selective mining, the principle can easily be carried too far. Whether 100 tons or 1000 tons of ore are being broken per day, the hardness of the ore is not affected, and it still takes so much dynamite

and so much labor and so much other material to win one ton of rock from the mine. The main saving—and within certain limits a most important one—is in general administration charges, and other main charges, such as power, etc., but unless there are other factors of advantage automatically brought into play in the actual work to be done, the benefits possible are somewhat restricted.

If it be assumed that on the higher-grade ore, when handling a small tonnage, a stoping width of 24 in. has to be maintained, while in the other case a stoping width of 12 ft. could be carried, and assuming further that there was still a definite margin of profit to be made on the 12-ft. width, then there would unquestionably be a serious problem facing the administrator who had been instructed to follow the selective mining principle; and in fact, given that the margin of profit in the case of the 12-ft. stope were appreciable, a case might easily be postulated where the following of the selective mining principle would become merely absurd.

Increased Equipment

The real truth of the matter is, that in some cases additional stamps and tube-mills have been provided in mines whose more recent developments have not come up to the average of the earlier developments, and in some cases the falling off has been so considerable that it has been found impossible to keep even the same number of stamps running as the mine originally had on a much lower grade of ore. In other cases, it was found that the mine was in such a condition that it was quite impossible to do both the necessary amount of mining and development to feed the larger number of stamps even after incurring heavy expenditure on new shafts, ore-bins, and works of that sort, and undoubtedly mistakes were made in many cases for lack of a proper understanding of these internal considerations.

Turning again to Mr. Letcher's paper, I find that his charts are instructive. It will be noticed that the gross production from 1908 to 1912 has increased from 28,810,393 to 37,182,795, but, per ton, the output has decreased from 31.5s. to 29.9s., while the working costs have increased from 18s. to 18s.8d., the working profit decreasing from 13s.5d. to 11s. 1d. (There is a clerical error in Chart No. 2 in the working profit figures.)

The most significant figure, however, is that dividends in 1908 on 18,196,589 tons of ore milled were over half a million sterling greater than on 25,486,361 tons in 1912, despite the increase in the gross production of £8,000,000 in the latter period. The increase of 8d. in the cost and the decrease of 1s.8d. in the recovery makes a difference of 2s.4d. per ton as between the two periods. It will be noticed that the dividends over the period amount to only 71.8% of the profit declared, and to about 26.5% of the gross production. It must not be forgotten that there is an appreciable percentage of the amount distributed as dividend which is not profit. Some few companies have declared intermittent dividends, representing only a part replacement of capital, and then have stopped.

The charts clearly reflect, however, what has happened on the Rand in the past five years, and, to my mind, these figures may be taken as having an important bearing on the question of the diminution of grade and increase of cost, as depth is attained.

Decline in Production

According to Mr. Letcher, the decline of the Rand is to be of the same gradual nature as its rise, and in this he is possibly right. A precipitous decline could only be brought about by unfavorable conditions regarding labor, or foolishly selective mining, or some equally potent factor in the working of the mines. He does not emphasize the fact that the decline may be a great deal more gradual than the rise, owing to possible future improvements, by virtue of which the enormous tonnages of 3 to 4 dwt. ore of the Rand may be ultimately handled at a profit. If it should be possible to handle these ores, of which many millions of tons partly developed exist within the area of present developments—and no man will be bold enough to say that such things cannot come about—then there is a possibility of finding the Rand still in existence as an important mining district many years ahead.

Personally, I have the conviction that the Rand will die hard, and, as the grade of the available ores becomes lower and lower, necessity and invention combined will contrive ways and means of showing profits that, under the methods and general procedure obtaining today, would be quite impossible.

London, July 30. H. S. Denny.

[The question when to adopt selective, and when wholesale mining methods is a live one in many districts other than the Rand. We will be glad to hear from other of our readers.—Editor.]

Trent Agitators

The Editor:

Sir—In the article on Symmes agitators, published some time ago, it was claimed by the author that his agitator was as near perfection as any agitator could be, because of the fact that it started up freely after a shut-down of four hours and fifty minutes.

In connection with this matter I would like to call your attention to my experience with the Trent agitator here last night. There was a severe thunder storm and lightning struck the sub-station, demolished one of the switches, and short-circuited the line. As a result of this, the plant was without power for a period of fifteen hours, until ten o'clock the following morning. I was fully prepared to sluice out the agitating vats, but was surprised to find that after the pumps had been started and the agitators shaken a little, every one of them started and were running within fifteen minutes. The specific gravity of the pulp varies from 1.25 to as high as 1.35, and the ore that is treated contains a good deal of porphyry, which packs solid after a shut-down. I consider today's performance of the Trent agitator as remarkable and do not know of any agitator that would do the same thing.

Walter Techow.

Virginia City, Nevada, July 22.

Special Correspondence

NEW YORK

THE MEXICAN SITUATION.—PRESENT AND FUTURE COPPER PRODUCTION.—ZINC PRICES AND BUTTE & SUPERIOR OUTPUT.—BUTTE MINING COMPANIES IN TROUBLE.—STEWART, FEDERAL AND UNITED STATES STEEL CORPORATION.

The leading topic of the week has been the relations between the United States and Mexico, and the message read to Congress by President Wilson has been thoroughly discussed, both at home and abroad. The stock markets regarded the outcome as favorable, as securities in Mexican enterprises advanced toward the end of the week, but generally the action of the administration has come in for criticism. European critics point out that the withdrawal of all Americans, leaving something like $500,000,000 of assets behind, is scarcely practicable, and the firm and aggressive attitude taken by Sr. Gamboa has caused much favorable comment. The view held by some is that the elimination of Huerta would be a great mistake, since what is needed in Mexico is a man of sufficient force to control the situation, and during the months in which he has been tried out Huerta has given good evidence of possessing the necessary characteristics. To throw him overboard and begin again with an untried leader probably would mean repeating the incidents of the past half-year. The means by which Huerta acquired control of the government are repellant to Americans, but, on the other hand, our own means of acquiring the control of the Panama canal zone was not so blameless as to justify us being too particular as to the antecedents of the Huerta administration. It would seem better to tolerate the past of the present government than to follow a course of action which may lead to a repetition of similar occurrences. Meanwhile little has been accomplished beyond creating the impression that the United States is disposed to take a firm stand regarding Mexico, rather than attempting to ignore the turmoil to the south of us.

The market of electrolytic copper was firmly established at 16c. per pound by the end of August, a good deal of October and November copper having sold at that price. This figure was the one held abroad and cables from London on August 28 stated that dealers, who usually undersell the producers, had advanced prices to £74 10s. (16⅛c.), Aron Hirsch & Sohn quoting £74 5s. The latest report from the Lake Superior district was that 17 shafts had resumed hoisting. The Laurel Hill refinery is endeavoring to recover some of the output it lost when shut down by the strike earlier in the summer, but, even so, it is prophesied that the Copper Producers' Association figures will show a decline of 15,000,000 lb. in the output for August. The following table shows the refinery production and deliveries for the first seven months of this year:

	1913.	1912.	Increase, per cent.
Production (7 months)	947,268,638	872,976,969	8.6
Deliveries (7 months)	999,676,265	911,921,286	9.6
Excess deliveries	52,407,627	38,944,317	..

C. W. Barron returned from Europe last week and has given out the following statement: "Although Germany for two years has been trying to curtail industry and stop new construction, she has increased her consumption of copper more than any other country and is still at the maximum of consumption. This month there has been an active buying movement in the metal in England and Europe, and unless buyers now go slowly copper may sell sharply higher, until the Lake Superior mines can get over their strike and come into the market. It should not be forgotten in this connection that the Calumet & Hecla has been the sole American copper mining company to check sharp advances in copper. It has not been the policy of the Company to sell ahead, and with two smelters and its reserves it has usually been in a position to check a runaway market. Calumet is now powerless to check the market, if consumers take fright over the absence of copper reserve supplies of any consequence anywhere in the world. Recently copper has been shipped upon express steamers to Europe at higher than ordinary freight rates because of the shortness of supplies." Looking at the matter from another viewpoint, it may be said that general business is now very dull, and the manufacturer will shortly have to adjust himself to the unknown effect of the new tariff. He is not insensible to the fact that Chino is expected to break its best previous record with an output of over 5,000,000 lb. in August. The Calumet & Arizona has blown in its new smelting plant and will raise its monthly output 5,200,000 lb. from the Calumet & Arizona ores, while the Shattuck-Arizona ore is expected to provide 1,000,000 lb. per month in addition; nearly a 50% increase over output last year. By the first of the year Inspiration will have a 600-ton mill at work, with its big mill coming in a year later. Braden is increasing its output, the Granby will blow in its smelter at Hidden Creek by the end of the year, while in the background looms Chuquicamata with its immense output, and the possibilities at Tanganyika as well. Until the selling outlook for manufactured products is better it is scarcely likely that consumers will stampede the copper market from the fear that they will not be able to secure copper to fill orders.

Spelter continues on its upward way, touching 5.8c. per pound for September, delivery on October 28. This makes boom times for the Butte & Superior, which has been rapidly increasing its output recently. At the middle of August it was treating 975 tons per day, and making an 86.5% recovery of the zinc in concentrate containing 48.9% Zn. The estimated tonnage milled during August is 30,000 tons, yielding 11,000 tons of concentrate, or over 10,000,000 lb. of zinc. The Mississippi Valley had always been the chief zinc-producing area, but the success of the Butte & Superior has shifted the centre of gravity of zinc production a good deal to the west. It will continue to take its way westward, for the zinc output of the Coeur d'Alene, Idaho, is rapidly growing as well, and California has immense resources of zinc ore which, at perhaps no very distant date, will become a market factor. Some Butte copper companies are having hard going. The Butte Central Copper Co. has been petitioned into bankruptcy by three creditors whose claims are $300, $400, and $300 respectively. This concern, with a capitalization of $2,500,000, has a remarkable set of names associated with it. The mine is called the Ophir, and, though not full of gold, was claimed to contain 1,000,000 tons of ore yielding copper, lead, zinc, silver, and gold. Among the directors are F. A. Cave and R. Forget; W. L. Creden being consulting engineer. After being thrown into bankruptcy for sums totaling $1000, it seems evident that too much credence was placed on the estimates. The United Copper Co. is a man-sized mix-up, the claims filed against it amounting to $2,745,375, and those against the Montana Ore Purchasing Co., one of its subsidiaries, being $5,728,048. Justice Holt has recently appointed Henry D. Estabrook a special master to pass upon these claims, which have been filed with the receivers, J. S. Sheppard, Jr., and Addison E. Cudworth. The United Copper, it will be remembered, was the concern with which F. Augustus Heinze was connected, only to come to grief. While speaking of Heinze companies, it is interesting to notice that the Stewart Mining Co. has postponed its annual meeting until September 28. The directors state that present earnings justify dividends of 10c. per share per quarter; the next dividend being payable on September 15. Mrs. A. P. Heinze has just lost her suit against F. R. Hutton & Co., whom she sued to recover the amount of her margins, alleging that she bought United States Steel common stock on the assurance of the firm that it had inside information that the stock would advance, which it failed to do. Justice Whitaker held that a broker is not liable for expressing his opinion on the future course of the market.

The Federal Mining & Smelting Co. has been making good profits this year. It is reported that during the first eleven months of its fiscal year, which ended August 31, its earnings brought its surplus up to $916,000, or nearly $200,000 in excess of the $720,000 required for its present dividend rate of 6%. Now that lead has advanced in price and spelter is high, the company should do even better. There is still 1¾% back dividends due on the preferred stock, which might have been paid this year if the directors had

thought advisable. The steel market has shown a marked increase of buying, the Steel Corporation showing an improvement of 30-35% as compared with three months ago. Present pig iron prices, averaging all districts, are about 25c. higher than when the lowest sales were made in June and July, and correspond, on the average, to the prices ruling in the middle of last August. The steel mills vary greatly as to their orders on hand, and the company which had the biggest tonnage ordered at the beginning now stands near the bottom. Some heavy rail orders are likely to be placed, among them that of the Pennsylvania railroad for 180,000 tons.

JOPLIN, MISSOURI

CARTHAGE MINES HAVE HEAVIER OUTPUT.—PLANTS OF AMERICAN ZINC, LEAD & SMELTING CO. RESUME.—ZINC AND LEAD NOTES.

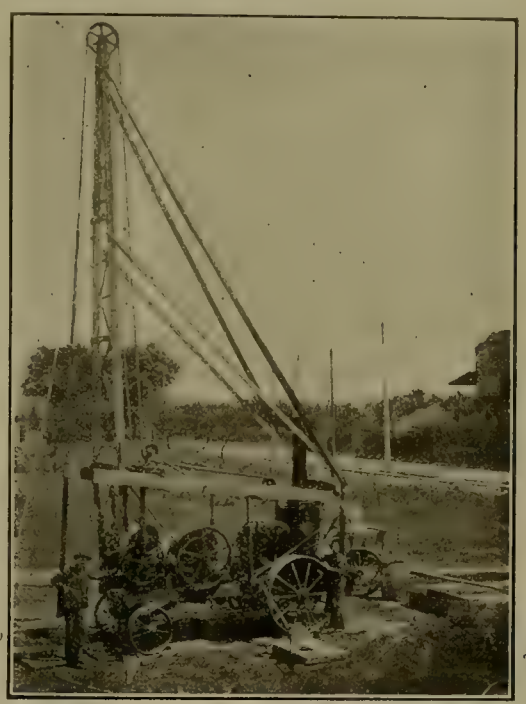
Heavier production than usual is recorded from the mines of the Carthage, Missouri, district, where an extraordinarily high grade of zinc sulphide and some high-grade galena is produced. Much of the zinc ore brings better than the prevailing figure paid for 60% metallic-zinc lots. The S. Y. Ramage Co., which has been a conspicuous producer of the Webb City-Carterville district, has extended its field of activities to the South Carthage district. Different levels are being opened and hand jigs used to clean the ore. The Hermosa Mining Co. is operating on a lease of the Waddell Zinc Co.'s tract northwest of Carthage. A mill of 200 tons daily capacity has just been placed in operation. The Wise Guy tailing mill, treating residue from the rich old Vesuvius mine and the Linzee Hill Zinc Co., all northwest of Carthage, are other producers that are swelling the output of that camp. The ore of this region occurs usually in very soft ground. The roofs of the drifts are not substantial as a rule, and unusually heavy timbering is necessary. The district is producing close to 300,000 lb. of zinc ore weekly, valued at about $7000.

Of much importance to the local district is the resumption of activities at mines No. 2 and 4 of the American Zinc, Lead & Smelting Co., at Webb City. Out of four large mines in the Prosperity group, only one has been working steadily through the era of comparatively low prices; the opening of the other two will give employment to about 250 men, and will increase the production of zinc concentrate about 400,000 lb. weekly. The lead-ore production will also be increased. The mines were closed because of low prices for ore. The drifts, however, have been kept drained and the task of resuming work was not difficult. The mines are equipped with mills of 400 tons daily capacity. A thin sheet-ground formation, occurring at a depth of 190 to 210 ft., is worked. The mill recovery is about 2.5% zinc concentrate and 1% lead concentrate. The bulk of the zinc ore is used by the American company in the manufacture of metal and is smelted at the Company's plants at Hillsboro, Illinois, and at Dearing and Caney, Kansas.

The Kansas City Zinc Co., operating on a lease of the Rusk land in North Joplin, has opened a zinc deposit at a depth of 140 ft., and a remodeled mill, moved to the lease, has just been placed in steady operation. The lease was worked to some extent by the Big Irish Mining Co. a year or more ago, but the present development is in virgin ground to the north of the old workings, while some distance to the east another shaft has cut the same formation, and this is to be connected with the mill by a long inclined tramway. The ore contains about 10% iron pyrite, for which a deduction is made, but the richness of the zinc sulphide in the mill ore overbalances the presence of the undesirable element. The ground is soft, some timbering being necessary, although some of the drifts have substantial roofs.

On the Hemphill land, Belville, northwest of Joplin, an open-cut near Turkey creek is showing a workable deposit of tripoli, a mineral used in the manufacture of scouring and cleaning compounds. Preliminary development is being conducted by a Joplin company with a view to placing the property on a productive basis. This is the only occurrence of this mineral discovered near Joplin. A large deposit at Seneca, Missouri, twenty miles southwest of Joplin, is now being extensively worked.

A lead ore discovery, apparently rich, is being worked by Edward Buxton and associates on a lease of the Charles Schifferdecker land, nine miles east of Joplin. In view of the fact that this is in a virgin territory where little mining has been done, the outcome of the operations is being watched with much interest. In drilling, the ore was cut at a depth of 50 ft. and extended down to 100 ft. The formation was shown in a number of drill-holes. The ore is 'free' in character, occurring in a talcose formation, and can be treated on hand jigs. It is estimated that it will yield close to 5% lead, although there are streaks of several feet in thickness which could be worked, and yield more than 20% lead. W. G. Stevens and others, of the Betsy Jane Mining Co., who have been drilling this land, have moved their prospecting rig to a point one-fourth



PROSPECTING WITH A KEYSTONE DRILL, JOPLIN, MISSOURI.

mile north of the lead-ore development and have started their first hole.

For the first time in years a number of mines have been forced to suspend operations because of a water famine. Mines that usually keep one or more large pumps at work steadily, have gone completely dry, and in some instances it has been found impossible to procure enough water to carry on milling operations. Prospect drillers have also had an extra demand for their services, the call coming from many farmers whose wells have also gone dry. The use of churn-drill rigs in sinking deep wells for water is common throughout the district at this time.

Zinc and lead ores at Joplin, Missouri, and adjacent districts are bringing better figures than at any time since the first part of the year, the former product commanding $48 to $50 per ton, basis of 60% metallic zinc, at the beginning of September, while the extra choice ores sell as high as $53. Spelter at East St. Louis is quoted strong at $5.75 to $5.85. Prices are low when compared with the record figures of a year ago, when for the corresponding week of 1912 zinc sulphides brought $52 to $56, basis, with choicer grades commanding as high as $59. Metal was quoted at 7.05c. per pound. Lead ore is stronger at $58 per ton, while pig lead, East St. Louis, is quoted at 4.75 to 4.85c. per pound. For the corresponding week of 1912 ore brought $61 and metal sold for 4.775c. per pound. Calamine brings $22 to $24, assay basis of 40% metallic zinc, with choicer grades selling for as high as $30. A year ago the range was $29

to $31, with a top for choice lots of $36. Zinc-blende production is now close to 5000 tons, lead ore about 750 tons, and calamine about 400 tons per week.

BOSTON

LAKE COPPER CO.'S AFFAIRS.—BOSTON & MONTANA DEVELOPMENT CO. AND THE BUTTE, WISDOM & PACIFIC RAILWAY.—BUTTE CENTRAL, TONOPAH VICTOR, ALASKA GOLD MINES, AND TUOLUMNE.

The expected happened when the directors of the Lake Copper Co. met in Boston a few days ago and called an assessment of $2 per share on the stock, payable September 9. This is the first time the stockholders of this Company have been assessed, and with the payment of the present levy the stock will read "$5 per share paid in." The stock has the usual Lake par value of $25 per share, and 100,000 shares. Lake made the high record of $94.50 per share and has recently sold down to $6. Its history has been one of great vicissitudes, as it was proclaimed a second Calumet & Hecla and afterward a worked-out property. The formation of the famous Lake lode has proved to be irregular, and this has hurt the Company's market standing. About three years ago, after the Paine management assumed control of the property, 13,500 shares of treasury stock were offered at $35 per share, the underwriters, Hayden, Stone & Co., getting a commission of $2 per share, the offering netting the Company $443,850. Including the present assessment, Lake has had over $1,000,000 spent on it, and is now selling at a market valuation of between $600,000 and $700,000. Few mines ever had a more variegated and checkered history, and the remaining solution seems to be a general consolidation of South Range properties in order to keep within one management the 'elusive' Lake lode.

The Boston Stock Exchange and Curb, following the example of New York and Philadelphia markets, observed Saturday, August 30, as a holiday, preceding Labor Day.

The Boston banking interests which are financing the Boston & Montana Development Co. and its subsidiary, the Butte, Wisdom & Pacific Railway, have received word that W. R. Allen, president, and W. C. Siderfin, vice-president, have made an automobile trip of nearly 300 miles over the route out of Butte which will be covered. The road will be about 128 miles long, including two spurs from the main line to connect the Elkhorn district in Beaverhead county and the French Gulch district in Deer Lodge county. About three miles from Divide, on the Oregon Short Line, is the dam of the Big Hole Power Co.'s plant, where the railroad company has a corps of engineers now in camp surveying the line. At this point there is about a mile of difficult engineering to be done to provide a roadbed on the side of the mountain. Outside of this point, it is said that the average grade of the road in its entire length is less than 1%. The road will open the country around Bannack, the first capital of Montana when it was a territory, and the scene of the first rich placer-gold discovery in Montana. A stampede resulted up the gulches to the north, culminating in Butte. The president, Mr. Allen, former lieutenant-governor, is known throughout Montana as 'Governor,' and the vice-president, Mr. Siderfin, is general manager of W. A. Clark's business interests. The road will open the Big Hole basin, a valley of about 1000 square miles, this being the only rich valley in Montana which has no railroad.

Butte Central will have to undergo reorganization, and the stockholders are being advised to that effect. The Company is involved in debt. It has a good mill, but is unable under present conditions to supply it with ore averaging more than $5.50 per ton. This is about half the average expected by the management, and places the Company in a position where it cannot make a profit with a 100-ton plant. The mill, however, which is all paid for, is a splendid asset, opening the way for the treatment, by combined concentration and cyaniding, of Butte argentiferous ores which formerly went to waste. It is believed that this will bring about an important feature of Butte operations, and to the ill-fated Butte Central the credit may be given.

The Boston Curb has listed for trading in its unqualified department 1,200,000 shares, par value $1, of the Tonopah Victor Mining Co., of Tonopah. This is the second Tonopah stock to be admitted to trading on the Curb. Tonopah Victor is sinking the main shaft down nearly 600 ft. in cap rock. The president of the Company is John G. Kirchen, general manager of Tonopah Merger and Tonopah Extension, and the treasurer is Key Pittman, United States Senator from Nevada. Seeley W. Mudd, of Los Angeles, is one of the directors.

Alaska Gold Mines stock has recently been under pressure, a block of several thousand shares having been liquidated, but shows recovery.

Boston takes considerable interest in the losing fight which has been made by Tuolumne officials to increase the capitalization of that Company from 800,000 to 1,500,000 shares and in the expansion to acquire the Butte Main Range property, a prospect of considerable value in the Butte district. The opposition to the president, Mr. Hickey, and his associates was led by Lee Mantle, former senator, who had a clean-cut victory. It was foreseen that the Tuolumne plans would not go through, and the officers of the Butte Main Range Co., who are largely the same as those of Tuolumne, met and withdrew Butte Main Range from consideration in the deal. This was prior to the Tuolumne meeting and made the defeat of the expansion plans a certainty. It is believed here that the outcome of the fight between Messrs. Mantle and Hickey places the responsibility of Tuolumne's future upon Mr. Mantle, an unsought and unexpected honor, and will logically relieve Mr. Hickey of that burden. The fight was a fast and furious one, and came to a climax by the Mantle faction preferring charges of irregularities in the Tuolumne management, and an investigation has been ordered. The Tuolumne group is the largest local independent one in Butte, but has met defeat in trying to make Tuolumne, a rich but small property, larger than it really is. The stock of Tuolumne has been traded in at times with some activity on the Boston Stock Exchange, and it is supposed that there is some scattering of the shares, but the control is held in Butte. Mr. Mantle is the owner of 5000 shares.

TORONTO, CANADA

DOME MILL EXTENSION.—DEVELOPMENTS AT THE HOLLINGER, PEARL LAKE, AND BURNSIDE MINES.—NORTHERN CUSTOMS CONCENTRATOR BEING ENLARGED.—AFFAIRS OF THE CANADIAN IRON CORPORATION.

The construction of the addition to the Dome stamp-mill is progressing rapidly, and it is anticipated that the 40 new stamps will be in operation early in 1914, increasing the capacity from 370 to upward of 650 tons per day. A change will be made in the process of treatment, and six sand-leaching vats will be added to the equipment.

The Hollinger company has opened on the 425-ft. level its No. 1 vein, which had dipped out of the winze. It is reported to be as rich as in the upper levels. The winze will be sunk another 125 ft. No. 4 vein is opening well on the 300-ft. level. The shaft on the Dixon property, owned by the same interests that control the Hollinger, will be sunk from 235 to 500 ft., with cross-cuts at every 100 ft. Development will include driving from the Hollinger, work having been already commenced at the 100-ft. level.

A find of rich ore has been made at the Pearl Lake, in a raise from the 400-ft. level. The ore shows a good deal of free gold. This is stated to be the first time that free gold has been discovered at this depth. The discovery and the production of fine specimens of the ore caused a revival of interest in the stock market, and an active demand for shares. The Pearl Lake shaft is down to 725 ft., which is the lowest depth reached in the Porcupine district.

Shareholders of the Dome Lake, at a meeting held here on August 25, ratified the proposed increase in the capitalization from $500,000 to $750,000, but refused sanction to

the proposal of the directors to offer $100,000 in shares for sale at 35c. Strong dissatisfaction with the course of the management was expressed, and action postponed until fuller information as to the condition of the Company was forthcoming. At the Burnside, in the Kirkland Lake area, some good surface finds have been made. A cross-cut has been started at the 100-ft. level to cut the vein, which dipped out of the shaft at 50 ft. depth.

The Northern Customs Concentrator has placed with the Power & Mining Machinery Co. an order for 80 stamps, to be delivered at Cobalt within 60 days. The Cochrane has adopted a policy of deep mining. This mine has taken out some high-grade ore from and above the 200-ft. level, but the ore-shoots have all been short and quickly exhausted. The shaft is to be sunk from the 200-ft. level to reach the diabase formation, which in this neighborhood underlies the Keewatin at a depth of about 600 ft. Levels will then be driven through the Keewatin to cut the main vein. At the Cobalt Lake underground exploration has been undertaken to prospect several acres at the north end of the property hitherto undeveloped. The work will be done north and west of the old No. 4 shaft on the east side of the lake. A cross-cut will be driven at the 300-ft. level across the lake to cut fault veins, and another will be driven north down the lake centre at the 225-ft. level.

The Canada Iron Corporation has been placed in the hands of a receiver, F. F. White, of New York, pending the reorganization of its finances. It has been adversely affected by foreign competition since the abolition of the iron and steel bounties, and has found difficulty in making collections. The directors concluded that as there seemed no prospect of relief by favorable tariff changes, the best course was to reduce fixed charges by reconstructing the finances. The Company's headquarters are at Montreal, and it has iron mines at Egansville and Bessemer, Ontario, Bathurst, New Brunswick; and Torbrook, Nova Scotia; and furnaces and foundries at Midland, Hamilton, and Fort William, Montreal, Londonderry, and several other widely scattered points in eastern Canada. Its outstanding securities consist of first mortgage bonds, $2,920,000; consolidated bonds, $1,717,933; preferred stock, $2,909,000; and common stock, $4,832,300. Most of its securities are held abroad. The plants continue in operation, and it is stated that business will be conducted without interruption until the reorganization is effected.

BUTTE, MONTANA

BUTTE & SUPERIOR ZINC ORES.—BUTTE, WISDOM & PACIFIC RAILWAY.—BUTTE CENTRAL AFFAIRS AND THE MINE.—MINE RESCUE WORK.—TUOLUMNE COPPER COMPANY.—BUTTE MINERS AIDING MICHIGAN STRIKERS.—BUTTE & ZENITH SHAFT SINKING.—EQUIPMENT COMPLETE AT BELMONT SHAFT OF ANACONDA COMPANY.

Good reports continue to come from the zinc mill of the Butte & Superior Copper Co. Considering the published results the success of the zinc industry at Butte seems assured, and it appears to be high time to prospect some more of the many large manganese veins of Butte in search of other zinc orebodies.

Of local interest to the mining industry is the proposed construction of a new railway in Beaverhead county, Montana. The line is being surveyed from Divide Station, on the Oregon Short Line, to Wisdom in the Big Hole basin. A branch line will be laid up Wise river to the Elkhorn mining district. It is probable that the promoters of this enterprise have visions of larger things still, and may attempt that difficult and expensive engineering task of continuing through Idaho to Boise and further, for the name suggests the Pacific Ocean as the final terminus of the line. As the crow flies, a southwest line from Montana to California would seem to have strategic advantages from the traffic-man's point of view, but field engineers state that the vertical components of a railway through that part of Idaho are something sad to contemplate. In any case the Butte, Wisdom & Pacific railway promoters want to get rail transportation to their mines at Elkhorn, and incidentally will gather in what tonnage they can from the stock raising and lumber communities of the Big Hole basin.

According to press reports the Butte Central company is still trying to blame its troubles on makers of stock-market raids and others. It is claimed that 'bear' raids scared off the money supply at just the wrong time. To an onlooker it would seem, however, that the true cause of financial fright was the failure of the expected returns from the mill. A first-class mill was erected under competent direction and was operated for some time; then the crash came, and it seems hard to get away from the conclusion that the real trouble lay in the disappointing returns from the ore milled. With the ore in the mine as claimed, and the mill in operation why couldn't the stockholders rest on their oars and let the mill do some of the paying? Now that Boston creditors have brought bankruptcy proceedings against the property, something may yet be done. A reorganization may be effected and a fair trial made for a zinc mine. Promising manganese veins exist in the property, and no one knows but what zinc orebodies similar to those of the Butte & Superior or Elm Orlu mines might be developed. Comparing the veins with those on Anaconda hill, and hoping for copper at depth seems hardly justified, because no typical east-west manganese vein, such as the Ophir of Butte Central, has proved profitable in copper at any depth. Several such veins have been developed sufficiently deep to satisfy engineers conversant with Butte that these veins are not promising for copper.

Mine operators in Butte are taking an active interest in the government system of mine rescue and first-aid instruction. Oxygen helmets are in constant use in several of the Butte mines, on account of troublesome mine fires. The companies are assisting those in charge of the Mining Bureau's rescue car in every way possible. This has resulted in many of the mine employees becoming fairly well skilled in the use of the necessary apparatus. There is no doubt that many lives can be saved by proper use of the information offered by these government specialists.

The Tuolumne Copper Co. is also having troubles. It is to be commended, however, for not trying to hide them from those interested. In the first place comes a statement from the secretary, Mr. Harrington, to the effect that the Company lost $8000 on its mining operations last year. This same statement acknowledges the fact that the directors saw fit to declare $160,000 in dividends during this depressing period, leaving but $37,000 on hand with which to operate a copper mine. Also, the scheme of some of the directors to take over another prospect and refinance Tuolumne has met with such strenuous objections on the part of many stockholders that it has apparently been dropped. And as a further reflection of internal troubles, the superintendent, Mr. Sheehan, has resigned, and his successor has not yet been made known. At present Tuolumne is shipping about 100 cars of ore per day, just about sufficient in value to meet operating expenses.

The miners' union at Butte is sending $14,000 per month to the aid of the striking copper miners of Michigan. This fund is secured by a monthly assessment of $2 from every miner in Butte. Outside of the benefit to unionism which this fund is intended to give, the argument is brought forward that the furthering of the Michigan strike will act directly for the benefit of the Butte miners. The price of copper is supposed to be advancing because of the curtailed production from Michigan, and should this curtailment bring the price of copper to 17c. per pound, the Butte miners will receive 25c. per day more wages. In other words, the theory is that by abetting the Michigan strike to the extent of $2 per month the Butte miner will better his own paycheck by the sum of $15 per month. This argument borders on high finance in its reasoning, but is not laying much stress on the financial distress of the Michigan miner.

The Butte & Zenith Copper Co. is to resume sinking its shaft west of Butte. The cross-cutting, which was done from the 500-ft. level, is claimed to have opened promising ground, and the shaft is to be continued to the 1000-ft. level.

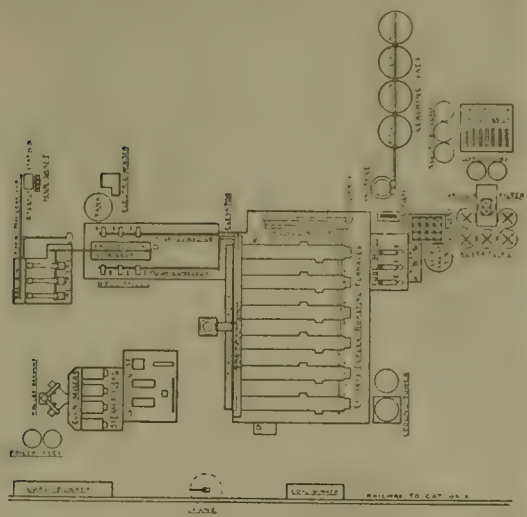
East Butte Copper Mining Co. has extensive improvements under way which will result in an increased production. It is planned to have this work completed by the beginning of 1914. The smelter is being enlarged to double

the present capacity, the concentrator is being remodeled and enlarged, and new underground work is to be undertaken. The old No. 1 mine, the work on which was suspended some six years ago, is to be reopened and deepened, and an electric hoist is to be installed there.

RHODESIA

LABOR IN RHODESIA AND THE RAND.—GOLD PRODUCTION OF THE TERRITORY.—GLOBE & PHOENIX AND BUSH TICK MINES.—ALTERATION TO LAW DEALING WITH PLACER MINING.—LOWER GWELO DISTRICT PROSPECTS.

While mining affairs in the Union of South Africa have been under a cloud for the past six weeks, the mineral industry in the adjacent territory to the north of the Limpopo river has made good progress. All things considered, the last two or three monthly outputs are admittedly satisfactory, and in regard to the development, and more particularly the equipment, of the large 'new' mines of the country, the Shamva, Cam & Motor, and Falcon, good work has recently been achieved. Rhodesia is as yet too young a country for 'trades unionism.' The industrial unrest so noticeable in the Union of South Africa today has not spread to the British South Africa Co.'s sphere of influence, and, having regard to recent events



PLAN OF CAM & MOTOR NEW PLANT OF 15,000 TONS MONTHLY CAPACITY. THE ORE CONTAINS GOLD AND ANTIMONY AND THE MILL HAS BEEN DESIGNED FROM THE BEST PRACTICE AT KALGOORLIE.

on the Witwatersrand, Rhodesian mine-owners must feel devoutly thankful that the labor agitators have not yet attempted to bring about a state of anarchy and industrial paralysis in the several goldfields of Matabeleland and Mashonaland. There are, of course, vast differences between the white labor problems of the Transvaal and of Rhodesia. To begin with, the miner of Rhodesia is a very different person from the miner of the Main Reef group of mines. He is a much more happy-go-lucky individual and not imbued with the truculent feeling of 'I'm as good as you and a jolly sight better' which is too often the attitude of the Rand miner to managers, mine captains, and shift bosses alike. The average worker connected with a Rhodesian mine is a man who has a knowledge of other things than actual mining. He is a prospector; as often as not, a hunter and trader as well. In the dry or winter season many Rhodesian miners 'trek off' into the bush, bent on finding mines of their own. Some of them strike it lucky, others do not and have to return to some employment. But in any circumstances, there is invariably a better *esprit de corps* in the mines of Rhodesia than on the Witwatersrand. On the average, Rhodesian miners earn, if anything, less than miners on the Rand, and in Rhodesia living expenses are appreciably higher than in the Union of South Africa. The phthisis evil is practically unknown in Charterland, but, on the other hand, malaria, which is exceptionally rare on the Witwatersrand, is common in most of the Rhodesian goldfields.

In short, the Transvaal miner has substantial advantages over his brethren in the north, but whereas the man on the Rand appears to be forever discontented, the Rhodesian is generally a cheery soul, quite prepared to take on a contract in a bad end, to slide down an ancient working, or to pump a neighbor's claim, as the occasion requires. The strike on the Rand is not likely to have much effect on the white miners of Rhodesia. But since the Union Government has prohibited recruiting until the present period of industrial unrest is over, the strike is likely to have a beneficial influence on Rhodesian mining in so far as natives are concerned. Large numbers of 'boys' who under normal conditions would go to the Rand compounds, are now likely to find employment at the Rhodesian mines, and as a number of new mines are due to commence treatment operations in Mashonaland before the close of the year, these natives deflected from the Rand by the strike will be a valuable acquisition to the country.

The gold output of Southern Rhodesia for June has been declared at £240,303, which, considering the shorter running time, may be said to compare favorably with a production of £243,452 in May. During the first six months of this year the gold output of the country has been worth £1,412,170, as compared with £2,707,369 in the corresponding period of 1912 and £2,647,896 in the first six months of 1911. Production of minerals other than gold in these three periods was: 1911, £242,863; 1912, £257,230; 1913, £109,217. These figures show that while the rate of output in regard to gold has shown advance during the first half of the year, the production of other minerals records a slight decline. Among 'other minerals', chrome iron ore occupies the leading place, and since the quantity and value of chrome-iron ore raised is dependent on shipping facilities at Beira, the decrease in 'other minerals' is probably more apparent than real.

The largest contributor to the gold output during June was, as usual, the Globe & Phoenix. With 40 stamps and 10 pans at work, this mine milled 6450 tons of ore yielding from the mill £32,168, from concentrate £3347, from tailing £4392, and from slime £2803.

The Bush Tick Mines, Ltd., is a property that has been recording improved returns during the past month or two. This mine is under the Hollins control, and a few months ago the whole surface equipment was reorganized and six Nissen stamps were added to the mill. The March output was 834 oz. gold, and the production for May amounted to 1068 oz. with a total value of £5513. A stamp-duty of 10.13 tons per head per day was obtained. It is important to learn that sinking operations have been resumed in the two main shafts of this property. It is reported that 'development values are improving at depth.'

The Government of Southern Rhodesia has recently been considering alterations to the existing law with a view to giving more favorable chances to men staking placer gold areas. During the past year or two the production of gold as the result of alluvial working in Rhodesia has been practically of a negligible quantity. The Department of Mines does not anticipate the development of any important placer fields, but it is recognized that the gravel in some rivers, notably the Mazoe, is well worth washing for gold.

The Lower Gwelo mining district is again attracting the attention of Matabeleland prospectors, and after a fairly lengthy period of comparative idleness, it is satisfactory to observe that mills are working at most of the old points of call between Gwelo and the Gothic again. The R. W. Syndicate owners are working the Rocksand and Sceptre mines. The 10 stamps on the Shamrock are being worked by Crampin and Masters. The Gretna Green and Alannah mines are also in this neighborhood. On the latter, it is reported, a rich ore-shoot has recently been opened, and a 5-stamp mill is in course of erection. It looks, indeed, as if the lower Gwelo area will become one of the most productive districts in eastern Matabeleland in the near future.

General Mining News

ALASKA

JUNEAU

The Alaska Gastineau Mining Co. will add to the electrical equipment of its plant two 1750-kva. alternating-current generators with a 50-kw. motor-generator exciter set, a 540-kva. induction motor with 22-kw. exciter, six 600-kva. water-cooled transformers, switchboard panels, and accessories. All the apparatus has been ordered from the General Electric Company.

VALDEZ

Letters from the North and returned stampeders bring unfavorable news from the Shushanna goldfields. Prospectors going toward the camp met discouraged men returning, and many turned back. Reports state that about $15,000 has been taken out on the discovery claim, but trenching above and below the claim shows barren ground. Food is said to be at a high price, and flour sells at $1.75 per pound.

ARIZONA

COCHISE COUNTY

(Special Correspondence.)—G. P. Sterrett, a turquoise gem expert employed by the United States Government to report on all precious stones found anywhere in the country, has been in the eastern part of the county lately investigating such properties. The turquoise mine near Courtland has received a great deal of attention, and an examination by Mr. Sterrett convinced him that it is a valuable mine. The fineness and quality of the gems is considered the best in the United States. Mr. Sterrett was greatly surprised at the spectacle of the great quantity of blue stones so eagerly sought for by Eastern collectors of gems. Joseph Mulheim and a number of other prospectors and mining men have taken an option on a zinc property in the Dragoons, west of Tombstone. It is a zinc deposit, the equal of which has not been found in the county. Development work of a preliminary character is under way at present, and indications are promising. Secrecy is being rigidly maintained by Mulheim and his partners in the venture as to the exact situation of the new zinc district, as they are busy securing options and bonds on adjacent territory.

Benson, August 28.

Concreting the Junction shaft of the Calumet & Arizona was finished during the past week. A considerable amount of work has to be done at the surface in the shape of new equipment.

A meeting of the Copper Queen Benefit Association was held during the past week. The report showed that the Association is in a strong position and that there has been a noticeable decrease in the more common accidents, fewer claims along this line having been paid in many months. This is the first tangible result of the widespread 'safety first' movement which is daily being extended more and more in the district.

GILA COUNTY

(Special Correspondence.)—Superior Judge Shute sustained the New Keystone company's demurrer to the Inspiration company's suit for condemnation of right-of-way for a tunnel through the New Keystone property, upon the grounds that it could not be considered a public utility within the statute. Notice of appeal was filed by the plaintiff company, although it failed to avail itself of the opportunity granted by the court to amend its complaint. Local discussion is generally to the effect that the present feeling displayed between the two mining companies, the Inspiration and the Miami, is due to the action of the Inspiration in securing the South Live Oak property by purchase, despite the fact that the Miami company was the only bidder that went to the expense of thoroughly examining the property. Whether the Inspiration will continue its efforts to secure a right-of-way for a transportation tunnel through the New Keystone, or will arrange for another method of ore extraction, is not yet known.

Miami, August 30.

MOHAVE COUNTY

With the new concentrator of the Arizona Southwestern Copper Co., at Copperville, in operation, another great step has been taken in mining development in this county. The mill is of 200-ton daily capacity. Regular shipments of concentrate will be made from now on. Six auto-trucks have been ordered, and they will be used with the one purchased more than a year ago. The trucks will carry the concentrate to Yucca station, where it will be loaded on railroad cars for shipment to the Needles smelter.

PIMA COUNTY

Thomas M. Park, manager of the Elephant Head mine, has received two 6½-ton Sauer motor trucks for use in hauling ore from the Elephant Head mine in the Santa Rita mountains to the nearest railroad point on the Tucson-Nogales line.

YAVAPAI COUNTY

Reports from that portion of Hassayampa district lying east of Copper basin are most encouraging, the miners of that district being busy in the development of their properties. At the Climax, during the past few weeks, water for milling purposes has been scarce. The Lion vein of this property has been opened from No. 4 and 5 adits. The C. B. S. company, whose stockholders are mainly the same as those of the Climax, has also obtained good results from the limited amount of work so far done. A vein was cut in the shaft, assaying 9% copper, $10 silver, and $3 gold per ton. In the Big Bug district, the Humboldt Consolidated company is opening rich silver ore.

YUMA COUNTY

There are reports of the cutting of gold-bearing ore on the 450-ft. level at La Fortuna mine, thirty miles north of Yuma. It is stated that the ore assays $400 to $500 per ton.

CALIFORNIA

BUTTE COUNTY

Emil Autram and L. Fredericks, two miners employed at the Success gravel mine at Thompson's Flat, had a narrow escape from drowning in the lower levels of the mine, on August 27, when they broke through into an old drift which was filled with water.

NEVADA COUNTY

The new shoot on the 300-ft. level of the Oustomah mine is yielding some high-grade ore which adds considerably to the prospects of the mine, as the ore is in new ground. The shaft is being sunk to 1500 ft. E. C. Klinker is manager. The Eagle Bird mine at Maybert has been bonded by W. M. Wilson, owner of the property, to the California Eagle Bird Mining Co., of which Mr. Klinker is the general manager. The new Company will thoroughly develop the property. About 20 men are employed at the mine, sawmill, 10-stamp mill, and other work. The three-compartment inclined shaft is 800 ft. deep and is filled with water within 50 ft. of the collar, but it is estimated that this can be pumped out in 30 days. The Forest Service has sold to the Tightner Mines Co. 30,000 stumpage feet of standing timber on Section 36, the same adjoining the patented section on Oregon creek which the Company bought a few months ago from the Cole estate. The concrete foundations for the new stamps and concentrating tables have been set, and a large platform erected adjacent to the site for the new annex to the mill.

It is stated that rich ore has been opened in the Pennsylvania mine, operated by the Pennsylvania Gold Mines Co. George W. Starr is superintendent.

SHASTA COUNTY

(Special Correspondence.)—The Mammoth Copper Co. is working 8 machine drills at the Stowell mine, situated between the Mountain Copper and Balaklala holdings, and recently opened a large orebody showing good copper ore. A new and interesting situation in the smelter-smoke question has recently developed in Shasta county. The crops have been remarkably large this year and generally free of any insect ravages such as developed in many neighboring counties. It is claimed by many disinterested people that this pleasing agricultural condition is due to

the sulphur that has been deposited on the soil by the copper smelters, and that operation of such works is of direct benefit to agriculturists by increasing fertility of soil and banishing insect life from trees and crops. That the farmers are beginning to appreciate the value of the copper-mining industry to Shasta county was recently evidenced when the Farmers' Protective Association issued an open letter declaring its friendliness for the copper miners and its desire to aid in an amicable solution of smelter-fume troubles. Coincident with the Hall desulphurizing experiments at Coram and Field process trials at Redding, the action of the agriculturists has created a most favorable impression. Frank M. Leland has invited the farmers to inspect the installation and operation of the Hall plant at Coram, in order to satisfy themselves that the Balaklala Copper Co. is using every endeavor to prevent escape of objectionable fumes.

Redding, August 25.

R. E. Scott arrived at Coram from New York and Paris, and will remain until the Hall process is tried out at the Balaklala smelter. Mr. Scott is familiar with the Hall process, as he installed it successfully at some pyrite mines in France. His advice is appreciated by the Balaklala management at this time. The aerial tram-line was started on August 28 and ore is now coming from the mine to the smelter. The gas producer, a part of the Hall process plant, was started on August 26.

Sierra County

A stope, 800 ft. farther northeast than any previous development in the Sierra-Alaska mine, at Pike City, has opened some rich ore. It is only 300 ft. from the surface. The water in the North Fork mine at Forest was lowered 15 ft. during the week. It is expected, however, that from now on the rate will be more rapid, with the probability that the drainage will be accomplished by about September 10. People from Alleghany confirm the report of rich ore in the Eldorado mine. It was made in a raise from the main working adit, at a height of 150 ft. The vein is 3 ft. wide and is rich in free gold and arsenical pyrite. Over $1600 worth of coarse gold was recovered after the blast that opened the ore. It has since been exposed to 12 ft. in height and is undoubtedly the same shoot that was mined in former days 350 ft. higher in the surface workings. The shoot pitches south. The mine is being worked by Fessler Bros. They started the 10-stamp mill during the past week.

The Nissen stamp-mill is being moved from the Red Star to the Sierra del Oro (Ironsides) in the head of Jim Crow cañon. The mill will be erected at once at the Sierra del Oro and used to crush ore from that mine. The Nissen mill consists of a single 1500-lb. stamp in a circular mortar and is practically new, having been run only a short time at the Red Star. One or two good concentrators will be installed to save the sulphides, and the machinery will all be run with a gasoline engine. The Sierra del Oro is owned by Redding, McCormick & Mayer, and Mr. McCormick is in charge of the development. An air-compressor and machine-drills have been installed at the Alhambra at the head of Jim Crow cañon.

Tuolumne County

(Special Correspondence.)—The recent heavy storms in the high mountains have caused a temporary suspension of operations at the Kanaka bar claim, on the Tuolumne river, near Jacksonville. The gravel washed so far has given good returns, and work will be resumed as soon as the swollen stream permits. It is reported that a deal for the sale of the Uncle Sam and Fifth Ward mines, situated near Arastraville, was consummated this week and that the purchase price, said to be $20,000, will be paid in full immediately. Robert Marshall, of Sonora, has for many years been the owner of the properties. A promising claim is being developed near the Black Oak mine by the Nicholls Bros. and Thomas Webster, of Soulsbyville. Some high-grade ore is being mined. A party of San Francisco mining men, accompanied by R. C. Kennedy of that city, inspected the old Starr King mine, east of Tuolumne, this week with a view to reopening the property. Development work is in progress at the Louisiana mine, north of Tuolumne. An assay of some ore lately opened showed $90 per ton. Rich gravel has been uncovered in the Jungerman claim, situated above Pine Log, on the south fork of the Stanislaus river. The property is being developed by Thomas A. Lawson, Louis Hansen, and the Boenig brothers. A controlling interest in the Alameda mine has just been acquired by Charles Fitzgerald, who expects to succeed shortly in reopening the property for further development. Fire in the compressor-room at the New Albany mine this week did damage to the amount of several hundred dollars.

Sonora, August 30.

COLORADO

Clear Creek County

It is reported that the Big Five Tunnel & Ore Reduction Co., of Idaho Springs, which contemplates the erection of a concentrating mill, will wait until the Edison mill at the Waldorf mines is completed, and if it proves the success anticipated, a similar mill will be erected by the Company. A large ore-house is being erected at the dump of the Bard Creek mine, preparatory to breaking down ore during the winter.

Jefferson County

It is proposed to reorganize the North American Smelter & Mines Co., and a new company is to provide $500,000 working capital. This Company proposes to improve and reopen the old Carpenter smelter at Golden and to build a new 300-ton combination mill to work in conjunction with the smelter. It will obtain its ores from Gilpin, Clear Creek, and Jefferson counties, where it owns a number of mining properties. The old company went into liquidation in October 1912.

Ouray County

The machinery for the installation of the flotation process at the Atlas is expected shortly to arrive at Ouray.

San Juan County

Plans have been drawn for the erection of a 500-ton plant to treat the tailing from the old mill at the Silver Lake mine. A. R. Wilfley will test a new concentrating table in this new plant. The examination of the Buffalo Boy properties of the Continental Mining Co. was completed during the last week in August by the engineers who have been there for the past three weeks. The samples were taken, carefully marked, and shipped to Nevada to be sampled and assayed. The results will not be known for several weeks yet, as the last of the samples are just being prepared and shipped.

Teller County (Cripple Creek)

According to local statistics, the Cripple Creek district in August produced 85,381 tons of ore with a gross value of $1,251,809, as follows:

Plants.	Ore treated, tons.	Av. val. per ton.	Gross val.
Golden Cycle	33,500	$20.00	$ 670,000
Portland (Colorado City)	10,000	22.00	220,000
Smelters	4,000	65.00	260,000
Portland (Cripple Creek)	15,800	2.50	39,500
Stratton's Independence	11,286	2.67	30,133
Colburn-Ajax	5,580	3.20	17,856
Gaylord-Dante	1,400	3.00	4,200
Kavanagh-Jo Dandy	1,600	2.10	3,360
Wild Horse	1,165	4.00	4,660
Isabella	750	2.00	1,500
*Rex M. & M. Co.	300	2.00	600
Total	85,381		$1,251,809

*Dump ore experiments.

Dividends totaled $80,000, made up of $30,000 from the Golden Cycle and $50,000 from the Elkton Consolidated companies.

Lessees at the Victor Gold Mining Co.'s property have opened what is thought to be the East Victor vein, a heavy producer, on No. 8 level, at a depth of 650 ft. The vein dips southwest and assays up to $100 per ton in gold.

IDAHO

Bonner County

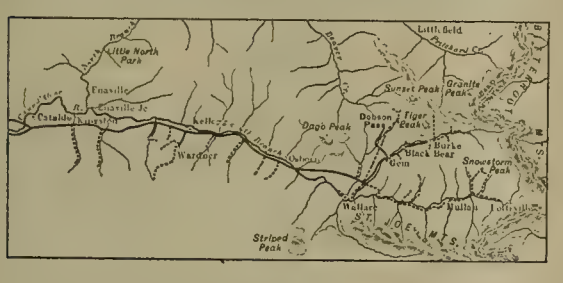
Concerted action by the mining men interested in the Pine Creek district to combat the encroachments of homesteaders is planned as one of the chief matters to be taken up by the Wardner-Kellogg chapter of the Idaho Mining Association, this subject being discussed at the meeting held on August 22. A number of homestead entries have been recorded in the past few months and several of the cases are in court. The mining men claim that the lumber interests are behind the homesteaders in an endeavor to secure the logs from Pine creek. One of the recent homesteads covers the entire Hilarity group of claims, while the Constitution claims are included in a homestead filing now before the Land Office.

Shoshone County

The Federal Mining & Smelting Co. filed suit against the Headlight company on August 23. The Federal company alleges that it is the owner of the Mammoth and Tariff lodes in Lalande mining district and that the Headlight company claims to be the owner of the Headlight, Grey Eagle, Maggie, Ophir Fraction, and Alexander lodes, situated in the near vicinity. The Federal company also alleges in the complaint that the Headlight company, by means of an adit having its portal on the Headlight claim, has driven an adit under and across the Grey Eagle, Maggie, and Ophir Fraction lodes into and through the Cleveland and Cleveland fraction lodes, owned by the Green Hill-Cleveland company, and has wrongfully entered the Mammoth lode and is now wrongfully extracting ore.

The National Copper M. Co. has again sought relief in the district court in its efforts to construct a flume and grade down Deadman gulch to its new concentrator which is now being constructed. This time Wilhelmina Thompson and her son, Einar, appear as the defendants. An agreement was made between the parties for a right-of-way, but the defendants are alleged to have since refused permission for the work to go on. It is necessary to complete the flume within sixty days.

An addition is being made to the Success mill at Nine Mile, which, among other machinery, will house a mag-



MAP SHOWING POWER-LINES OF THE WASHINGTON WATER POWER COMPANY.

netic separator. The process is for the purpose of extracting iron from the finely crushed zinc and lead concentrate, thereby raising the grade of the shipping product, saving freight on worthless material, and avoiding or reducing smelter penalties on the iron. The process is new in the Coeur d'Alene. The Terrible Edith, at Murray, shipped 99 tons of lead and 55 tons of zinc ore in July. It is said that the ore-shoot is 600 ft. long and from 2 to 6 ft. wide in the adit. The workings are situated high up on a hill and transport is difficult. The ore is sorted by hand.

The Hunter company plans the erection of a new 1000-ton capacity milling plant at Mullan to replace the 300-ton plant now in operation. The site for the new mill has been selected just west of the present plant and nearer the town.

The 14-mile transmission line being constructed by the Idaho-Continental Mining Co. from its power-plant at Boundary Creek to the Idaho-Continental mine is about completed, according to A. Klockmann, president of the Company, who has returned from a several days' visit at the property. Work at the power-site and at the mine is progressing satisfactorily, and there is no question that the buildings will be completed and the equipment ready to operate by Christmas. From 125 to 150 men are employed, and the number will be increased if necessary to insure the completion of the work before bad weather interferes with the work.

MICHIGAN

Houghton County

(Special Correspondence.)—The strike has been broken but the mines of this district will be months in getting back to normal working conditions. It is slow work. But the fact is apparent that all the time more of the men are returning to their employment. At the present time all of the conglomerate and two of the amygdaloid shafts of the Calumet & Hecla are in operation; these have been so for ten days. Regular 'rock' shipments are made to the stamp-mills at Lake Linden and the full working force is employed on the surface and in the shops at Calumet. The Calumet & Hecla has the situation in hand better than any of its subsidiaries and other properties. The Superior started a week ago, and while there has been every effort made to intimidate the men and to make trouble for those who have returned to work, ore is being shipped regularly. Isle Royale has started No. 2 and 6 shafts. Quincy is operating two shafts, No. 2 and No. 6, and a large force of men is employed in construction work at the new Pontiac engine-house. Champion has been operating two shafts in a limited way for some time, being the first mine to resume operations. In all of these cases the English, Scotch, Irish, and Welsh miners were the first to return to work, while the Scandinavians have been quite as loyal. The Victoria never suspended. The White Pine, also, has been operating two shafts right along, none of the miners at either of these properties having affiliated with the Federation. It is generally understood that neither the Franklin nor the Winona are in any hurry to resume operations, being content to wait until there is no sign of trouble and the labor market is straightened out. There have been doubtful rumors to the effect that the Winona would suspend operations indefinitely. The failure of the strike here can be laid to the crude methods followed by the officials of the Western Federation of Miners.

Houghton, August 28.

Since the above was written there has been some disturbance in the district, but on the whole the promise of resumption of work is satisfactory. It is estimated that the past month's shut-down resulted in a loss of 16,275,000 lb. of copper and $800,000 in net earnings to the 12 groups of mines in the district.

MISSOURI

St. Francois County

The strike in the lead belt of southwestern Missouri was settled on August 26. The miners agreed to accept a wage increase of 25c. per day. The Western Federation of Miners was not formally recognized in the settlement. The plan of settlement to which both the union men and mine-owners agreed was that submitted by the State Board of Mediation and Arbitration. The plan provides that if any miner feels at any time that he is unjustly treated, he may submit his grievance to the State Board of Arbitration. The mine-owners agree to abide by the decision of the board.

MONTANA

Granite County

The United States Geological Survey has just issued a report by W. H. Emmons and F. C. Calkins describing the geology and ore deposits of the Philipsburg quadrangle of western Montana, an area which has produced $50,000,000 in gold and silver. The first discovery of gold in the state is said to have been made in this area. At one time Philipsburg held a place among the leading gold and silver camps of the country, and it still produces a fair quantity of these metals.

Lincoln County

(Special Correspondence.)—The Hazel T. M. Co., operating the Shaughnessy Hill group, is shipping a carload of its

silver-lead ore to the smelter. According to all reports, the outlook for the property is very favorable. At a recent meeting the following officers were elected: George Chandler, of Spokane, president and treasurer; John H. Town, of Libby, vice-president and manager; and John M. Gleason, of Spokane, secretary. Work has not yet started on the building of a concentrator, but officials of the Company say that one will be built.

The Faith, Hope & Charity Mining Co. has a crew of men at work on its Bear creek property, 20 miles south of Libby, under E. N. Cory, of Spokane, the owner of the claims. There is an orebody on the property about 10 ft. wide carrying gold, silver, and lead. The upper adit, which was driven about 1000 ft., has been abandoned and a new one started 1000 ft. lower.

H. G. Lougee, of Portland, Oregon, recently visited the Montana Silver-Lead Mining & Milling Co.'s property, 15 miles south of Libby, in which he is largely interested.

Libby, August 17.

NEVADA

Churchill County

During July the Nevada Hills mill treated 3676 tons of ore averaging $15.62 per ton, the recovery being $52,489. Costs totaled $29,094, leaving a profit of $23,394. Recovery by concentration was 26.3%, and by cyanidation 65.1%, a total of 91.4%. Departmental costs were: mining, $3.52; milling, $2.97; marketing, 74c.; taxes and interest, 10c.; and general, 68c.; a total of $8.01 per ton, less 10c. per ton for miscellaneous earnings. Depreciation is given as $20,000, and net resources are valued at $111,734.

Clark County

(Special Correspondence.)—Development work at the Yellow Pine mine has been actively carried on while the mill was idle, and large additional ore reserves have been developed. A continuation of the main orebody has been cut on the No. 6 level, south of a fault that displaced the ore on every level in the mine. At the present time a cross-cut has cut 24 ft. of high-grade mixed lead and zinc ore, and the face of the cross-cut is all in ore. The improvements to the mill have been completed, and it has been in operation since August 20. Regular shipments of 60 tons of carbonate of zinc concentrate and 18 tons of lead-silver concentrate are being made daily.

Good Springs, August 28.

(Special Correspondence.)—While the destruction of the 40-stamp mill at the Quartette mine by fire was a severe blow to Searchlight, the effects will be of a temporary nature only. Hardly had the flames subsided when men were started overhauling the Cyrus Noble plant, and power wires were strung to the main shaft of the Quartette to drive the pumps. Quartette ore will now be hauled to the Cyrus Noble mill for treatment until the completion of the new Quartette mill. At the time of the fire there was about $8000 worth of bullion on the plates and in the mortar-boxes, and an effort is now being made to recover this. The copper plates are being prepared for shipment to the smelter, and all the ashes in the immediate vicinity of the plates are being sacked and these will be smelted to recover the gold content.

Searchlight, August 28.

Lincoln County

(Special Correspondence.)—At the town of Atlanta, 45 miles north of Pioche, the Atlanta Consolidated Gold Mining Co. has just completed the installation of a new surface plant and head-frame, and sinking has been resumed. The plant consists of a 110-hp. boiler, an 8½ by 12-in. Lidgerwood hoist, and a 7 by 8 vertical high-speed engine driving sample-grinding machinery, and a 10-kw. direct-current generator for lighting, pumping, and ventilating. A compressor and machine drills will probably be installed. The orebody is a replacement of the lime on a contact between lime and porphyry-andesite, containing gold and silver of value, and from the width and extent of the mineralization promises to be both large and valuable.

Atlanta, August 23.

Mineral County

The Aurora Consolidated Mines Co. is installing, among new electrical apparatus at its mines at Aurora, two 2-ton 250-volt electric mining locomotives, one 450-hp. motor, and 25 smaller motors ranging from 2 to 150 hp., 14-kw. and 50-kw. motor-generator sets, three 500-kva. water-cooled transformers, switchboard panels, and accessories. The order for all the equipment has been placed with the General Electric Company.

Nye County

The Belmont main shaft is to be sunk from No. 14 to No. 15 level at once. Developments on the Belmont, Favorite, Shaft, and Mizpah Fault veins are highly encouraging. A winze from the 750-ft. level of the Extension mine is opening good ore. B. F. Edwards, vice-president of the West End company, states that the condition of the mine warrants the mill being increased to 200 tons daily capacity. On the 1000-ft. level of the Halifax, the vein is 40 ft. wide of payable ore. Ore production of Tonopah mines during the past week in August was 12,512 tons valued at $281,950.

Storey County

The Mexican Gold & Silver Mining Co. has filed its bullion tax statement for the quarter ended June 30, as follows:

Ore treated, tons	1,581
Gross yield	$92,640
Mining, transport, and treatment	59,252
Bullion tax	1,386

White Pine County

Underground operations by the Consolidated Copper Mines Co. on the Giroux group have been suspended, and all the employees have been paid off and discharged. It is understood that no more ore will be hoisted by the Company, from the Brooks-Morris group at least, for some time, as the ore required to be shipped to the Steptoe plant at McGill under the terms of the treatment contract can be supplied from the Ora claim for the present.

Three steam-shovels and a number of donkey engines have been shipped to Ely for the Copper Mines company, and are expected to arrive soon. Meanwhile the Giroux ore from the Ora claim will be mined by one of the Nevada Consolidated shovels.

NEW MEXICO

Socorro County

The main shaft of the Ernestine Mining Co. has reached a depth of 150 ft. below the old workings. Levels are being driven at regular intervals to intersect the good orebodies opened in the upper zones. The Deadwood mill, the pioneer custom-ore treatment plant in this district, is receiving a large tonnage from development companies in addition to that from its own mine.

The clean-up of the Socorro Mining & Milling Co. for the first half of August produced 18 bars of gold and silver bullion and several tons of high-grade concentrate. The faces on the 800 and 900-ft. levels are reported to be in good ore. The Maud Mining Co.'s new shaft has reached a depth of a little over 500 ft. Good ore is being mined and sent to one of the custom mills. Development work in East End Tunnel Group of the Oaks Co. is producing some good ore, which is being treated at one of the local plants.

SOUTH DAKOTA

Lawrence County

(Special Correspondence.)—Connections have been made between workings from the DeSmet shaft of the Homestake and the deep shaft of the Columbus, which was recently acquired by the Homestake. The DeSmet is the most northerly shaft of the Homestake. Prior to breaking through, the Columbus shaft was drained by skips and pumps. It is understood that this work is largely of an exploratory nature, and upon the results of development work to be undertaken at once will depend the future operations.

Among recent changes at the Trojan mill has been the installation of an Ingersoll-Rand single-stage compressor,

with cylinder 10 by 14½ in., belted direct to a 30 hp. motor. This machine furnishes air for agitation of slime at a pressure of 22 lb. The superintendent, Mr. Ellis, hopes to reduce this below 20 lb., and thus effect a saving in power consumption. The old compressor, which was a smaller machine, was removed to the blacksmith-shop, where a Leyner drill-sharpener and Leyner drill-temperer have recently been added to the equipment. Grading is

HIGHLAND HOIST, HOMESTAKE MINE.

completed for the new addition to the mill which will house thickeners, solution-storage tanks, and a tube-mill, as well as some additional agitation vats.

Deadwood, August 26.

UTAH

Salt Lake County

The Alta Consolidated company for some time has been driving toward the contact in which is expected the best orebodies occur. It was while investigating the surface showings along the contact, a few days ago, that A. O. Jacobson, the superintendent, discovered some old workings which may prove valuable. Investigation showed that this old work had been done on the contact and the early operators had abandoned the work after opening what has all the appearance of being an important orebody. Four feet of shipping-grade ore has been opened so far. An average sample of the four feet assayed 1.6% copper, 4.2% lead, 41.4 oz. silver, and $1.60 gold, while it contains a high percentage of iron.

Tooele County

B. L. Cutler, A. M. Perkins, and J. E. Yenny have obtained a two-year bond and lease on the Carrie Mack property, 16 miles from Wendover, and active work has been started. The Carrie Mack is one of the old producers of this state, its output running in the past as high as 888 oz. silver and 64.5% lead. Mr. Cutler and associates believe that they will have the mine back in the production column within a short time.

CANADA

British Columbia

During July the Nickel Plate mine produced bullion worth $65,653, making a total to date of $5,104,373.

Ontario

The Buffalo Mines, Ltd., reports as follows for July:

Ore treated, tons	6389
Average assay-value per ton, ounces	37.30
Silver recovered, ounces	202,996

During July the McKinley-Darragh-Savage Mines Co. treated 224 tons of ore per day, yielding 224,628 oz. Veins No. 40 and 42 have been opened on the 150-ft. level and show high-grade ore. Equipment to drain Kerr lake is practically complete, and the pumps should soon be at work.

At the McEnaney mine, Porcupine, the drift on the 100-ft. level for 23 ft. opened 6½ ft. of ore averaging $130 per ton. The August mill return is expected to be about $50,000.

Mining at the Alexo nickel ore mines, at Iroquois Falls, is being done by open-cutting. At the bottom of the shaft is 4 ft. of ore which averages about 8% nickel, while on one side of the vein there is 3% ore. The August output will be about equal to that of July, namely, 800 tons of ore.

Personal

Professional men are invited to send news of their engagements and travels. Such news is interesting to friends.

R. D. George is at Jackson, California.

Charles S. Herzig, of London, is at Butte.

James Douglas has returned from Europe.

R. E. Cranston has returned from Colombia.

Robert Linton was in San Francisco Tuesday.

B. B. Thayer has returned to New York from Butte.

L. G. Huntley returned to Pittsburgh from Alberta.

S. Severin Sorensen was in San Francisco this week.

George Moore has returned to New York from Colorado.

W. B. Ruggles is visiting the iron ranges of Minnesota.

Kirby Thomas has returned to New York from Wyoming.

C. E. Heald, Jr., is now in charge of Heald's School of Mines.

Howard D. Smith has returned from a short trip to Juneau.

E. A. Cappelen Smith has returned from a holiday in Europe.

Harlan H. Bradt will be at Columbia University during the winter.

P. R. Bradley and Edmund Juessen have been to Calaveras county.

J. Morgan Clements passed through San Francisco on his way from Oregon to Los Angeles.

John D. Ryan, president of the Amalgamated Copper Co., is making one of his periodical visits to Butte.

F. P. Mills, formerly manager of the Giroux Copper Co., has resigned and is spending a holiday in California.

Karl Eilers, who is inspecting the plants of the American Smelting & Refining Co., in the West, was in San Francisco last week.

Donald Ferguson returned to Goldfield from Central America, but sailed for London and Paris on the *Lusitania* September 3.

L. D. Ricketts and John Greenway will leave about the middle of September for a trip to inspect the Black Sea copper properties.

Max W. Atwater, formerly superintendent of the Butte & Superior, is to succeed Al Frank as manager for the Ohio Copper Co. at Bingham.

Willet G. Miller was given the honorary degree of LL.D. at a special convocation of the University of Toronto, held following the International Geological Congress.

Paul Weiss, director of the Bureau of Mines, of France, who has been attending the International Geological Congress at Toronto, is returning to Paris by way of Montreal.

Richard M. Edwards, president of the Corbin Copper Co., is in Montana on a tour of inspection of the Company's interests. He is accompanied by Sidney Jennings, of Salt Lake City.

The Old Freibergers in America will hold the complimentary dinner in honor of Richard Beck at the Engineers' Club in New York on September 9, instead of at Scranton, as announced in our issue of August 23.

George H. Garrey, chief geologist of the American Smelting & Refining Co., and W. H. Grant, E. K. Soper, F. C. Calkins, and J. E. Thomas, who have been associated with him on examination work, recently returned from Mexico.

J. W. Donaldson Aiken has severed his connection as consulting engineer for several Burma companies, and is on his way to Los Angeles by way of London. At Los Angeles, after September 30, his address will be: care Col. W. C. Moss, Huntington Park.

William S. Mann, metallurgist for the New York & Honduras Rosario Mining Co., San Juancito, Honduras, has accepted the position of general superintendent for the Socorro Mines, Ltd., Valle de Las Angeles, Honduras, C. A., and expects to take up his new duties on August 1.

New York Metal Market Review

As a result of labor troubles in the Lake district mines, copper advanced steadily in August. Early in the month buying was heavy, but it became less active as the month wore on. Lead moved upward also, as a result of the strike in Missouri; but, bad as the outlook was, buying was not all that might have been expected. Spelter advanced steadily, but throughout most of the month was dull. Antimony was quiet from first to last and prices underwent little change. Tin movements were unusually small, with fairly heavy buying at intervals. Aluminum presented little of interest, with activity lacking and the change in prices showing a decline.

COPPER

At the beginning of August, Lake was quoted at 15.37½c. per lb. cash, and electrolytic at 15.12½c. cash. On August 29, Lake was quoted at 16.12½c. cash and electrolytic at 15.87½c. cash, or 16c. 30 days delivered. The latter quotations were strong, but had been preceded by light buying. The upward movement was due to the unsettled condition of labor in the Lake Superior district. The first few days of the month saw little foreign business because of the bank holiday in London which closed the exchanges from August 1 to 5. On August 6 consumers showed interest in the market, then came in strong, and in the ensuing week buying was heavy, mostly on American account, although Europe was active also. The activity caused prices to advance, and, on August 7, 15.75c. cash was quoted for Lake and 15.50c. cash for electrolytic. By the middle of the month Lake reached 16c. and electrolytic touched 15.75c. cash. The heavy buying was attributed to apprehension over the strike situation, and to the sentiment created by the Copper Producers' Association report for July. Lake copper was hard to find throughout the month, several of the agencies finding need for all their stock in taking care of deliveries on contracts. Activity dwindled about the middle of the month, but quotations remained firm. On August 28, when electrolytic advanced to 15.87½c. cash, renewed buying in large volume was expected. Up to August 29 business was light, with the strike at the mines a serious factor more than ever, despite efforts to operate with other than regular employees. The lack of demand in the third quarter of the month brought out some re-sale lots at 15.62½c., but these were soon withdrawn. The exports from August 1 to 29, inclusive, were 32,932 tons. The July exports were 29,096 tons, making a total of 223,232 tons exported in the first seven months of 1913. The July imports were 18,000 tons. The average price paid for copper in the Naugatuck valley in July was 14.75 cents.

LEAD

The lead market was much disturbed by strike troubles, and the situation near the close of August had not cleared. The month opened with quotations at 4.50c. New York and 4.37½c. St. Louis. At the end of the month quotations were 4.75c. to 4.80c. New York. St. Louis was stronger relatively than New York throughout the month. In the second week rumors were heard of the approaching strike in Missouri, while the Mexican situation also tended to influence the situation. The strike was declared August 15, and several refineries were compelled to shut down at once. Some of them withdrew from the market. For a few days prior to and after the declaring of the strike, business was good. On the day the strike became effective the American Smelting & Refining Co. withdrew from the market for a few hours, and then announced an advance from 4.50c. New York to 4.75c. New York. At this time it was understood that extremely large quantities could not be had at this figure, nor would the Company promise deliveries far into the future. The sentiment of the trade was that the strike meant a long and bitter contest; but, despite this, buying was not greatly stimulated. In the third quarter of the month the large interests were adhering to 4.75c. New York and 4.62½c. St. Louis, but independent brokers made sales at higher prices. August 21, for instance, sales were made at East St. Louis at 4.80c., although on August 23 the St. Louis price dropped to 4.70c. because of a mistaken belief that the miners might waive recognition of their union. On August 25 sales were made at 4.80c. New York, and more metal than was available could have been sold at this price. August 29 the big interests had made no further advance.

SPELTER

Business in the early part of the month was reported as fair, though the transactions were not large. Quotations then stood at 5.60c. New York and 5.45c. St. Louis. Prices early showed an advancing tendency which was maintained. With the advances came a somewhat better business. About the middle of the month there was some good buying of high-grade spelter by the brass mills, and this, together with the Western strike troubles and higher prices of ore, accelerated the upward movement in prices. The mid-year statistics of the Government, which became available in the month, explained the slump in spelter in the first half of the year. It appeared that producers' stocks had increased from 4522 tons on January 1 to 21,856 tons on July 1, while consumption had dropped from 181,326 tons in the last half of 1912 to 153,073 tons in the first half of 1913. Production in the first half of 1913 increased slightly. By August 29 prices had advanced to 5.90c. to 5.95c. New York, and 5.75c. to 5.80c. St. Louis. Despite the firmness, the market was quiet on that date.

ANTIMONY

This metal was dull and the net change in August was the loss of a few points only, quotations August 29 being 7.75c. to 8c. for Hallett's, 8.35c. to 8.40c. for Cookson's, and 7.37½c. to 7.50c. for Chinese and Hungarian grades. Inasmuch as all the production is abroad, and large stores are in bonded warehouses, practically all of the buying of futures involved antimony in bond, the buyers expecting the benefit of a lower tariff.

TIN

From August 1 to 27 the fluctuations of tin were unusually narrow, considering the record of the metal for sudden variations in price. On four or five days there was at least fair buying. August 5, about 300 tons were sold in lots for spot delivery, and as far ahead as October and on the following day about 300 tons again were sold for delivery in from 45 to 60 days. On August 26 there was activity in which between 200 and 250 tons changed hands. August 28 and 29, about 400 tons was sold. Sales were made on August 1 at 40.60c., August 6 at 41.50c., August 12 at 41.75c., August 18 at 41.45c., August 26 at 41.95c., August 28 at 43.50c., and August 29 at 42.85c. Arrivals of tin up to and including August 29 were 3634 tons, and there was afloat on that date 1555 tons. July statistics showed that the American consumption of tin in that month amounted to 3900 tons, totaling 27,600 tons since January of this year. This is a decrease of 1800 tons compared with the first seven months of 1912. The total visible supply at the close of July was 12,063 tons, an increase of 962 tons for the month, but a decrease of 1283 tons as compared with July 31, 1912. Deliveries of tin in August were 3600 tons. In stocks and landing at the end of the month was 1408 tons.

ALUMINUM

With aluminum, as with antimony, a feature of the past few weeks has been the large quantity of metal in bonded warehouses awaiting the proposed lower tariff duties. Business could not be called brisk at any time in August, and at times it was called stagnant. Prices for prompt shipments fell off. August 7 quotations were 22.75c. to 23.25c. for domestic and 18.50 to 18.75c. for foreign in bond. Twenty days later, domestic was quoted nominally at 21.50 to 22.50c., and foreign in bond at 18.25 to 18.50c. Toward the end of the month, greater interest was shown in futures, but sellers and buyers were slow in getting together. On August 27 an amendment to place aluminum on the free list was offered in the United States Senate and was referred to the Finance Committee. The House bill proposes a duty of 2c. per pound. Under the circumstances consumers naturally are cautious when dealing in futures.

The Metal Markets

LOCAL METAL PRICES

San Francisco is not a primary market for the common metals except quicksilver. The prices quoted below therefore represent sales of small lots and are not such as an ore producer could expect to realize. Ore contracts usually call for settlement on the basis of Eastern prices, less freight and treatment charges. The prices quoted are in cents per pound, except in the case of quicksilver, which is quoted in dollars per flask of 75 pounds.

San Francisco, September 4.

Antimony	12—12½c	Quicksilver (flask)	
Electrolytic Copper	17¼—17½c	Tin	46—47½c
Pig Lead	5.00—5.05c	Spelter	7¼—7½c

Zinc dust, 1400 lb. casks, per 100 lb., small lots $9.50—9.75; large $7.50—8.00

EASTERN METAL MARKETS

(By wire from New York.)

NEW YORK, September 3.—The copper market is strong and has an upward tendency. Electrolytic copper has advanced ¼c. to 16½c. per pound. The London market is reported as firm, with spot at £72 10s. up 10s.; futures £72, up 11s.6d. All of the producers are asking the equivalent of 16¼c. for electrolytic copper. The lead market remains firm but quiet, qoted at $4.75. The London quotation is £21, up 2s.6d. The spelter market is quiet but firm. Few sales are reported. The metal is quoted at $5.80. The London market is reported as quiet and the metal is quoted at £21 12s.6d.

SILVER

Below are given the average New York quotations, in cents per ounce, of fine silver.

Date.		Average week ending	
Aug.	28	July	23
"	29	"	30
"	30	Aug.	7
"	31 Sunday	"	14
Sept.	1 Holiday	"	20
"	2	"	27
"	3	Sept.	3

28	59.62		23	58.79	
29	59.62		30	59.28	
30	59.50		7	59.29	
31 Sunday			14	59.12	
1 Holiday			20	59.16	
2	59.62		27	59.46	
3	59.62		3	59.60	

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	56.25	63.01	July	60.67	58.70
Feb.	59.06	61.25	Aug.	61.32	59.32
Mch.	58.37	57.87	Sept.	62.95	....
Apr.	59.20	59.26	Oct.	63.16	....
May	60.88	60.21	Nov.	62.73	....
June	61.29	59.03	Dec.	63.38	....

COPPER

Quotations on copper as published in this column represent average wholesale transactions on the New York market and refer to electrolytic copper. Lake copper commands normally from 1-5 to 1-4c. per lb. more. Prices are in cents per pound.

Date.		Date.	
Aug.	21	Aug.	28
"	22	"	29
"	23	"	30
"	24 Sunday	"	31 Sunday
"	25	Sept.	1
"	26	"	2
"	27	"	3

21	15.50		28	15.58	
22	15.50		29	15.60	
23	15.50		30	15.60	
24 Sunday			31 Sunday		
25	15.50		1	15.70	
26	15.50		2	15.75	
27	15.55		3	15.90	

Average week ending

July	16	13.81	Aug.	13	15.53
"	23	13.97	"	20	15.59
"	30	14.58	"	27	15.51
Aug.	6	14.92	Sept.	3	15.69

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	14.09	16.54	July	17.19	14.21
Feb.	14.08	14.93	Aug.	17.49	15.42
Mch.	14.68	14.72	Sept.	17.56	....
Apr.	15.74	15.22	Oct.	17.32	....
May	16.03	15.42	Nov.	17.31	....
June	17.23	14.71	Dec.	17.37	....

The mid-monthly report of James Lewis & Sons, Liverpool, dated Augst 18, includes the following: The improvement in prices is mainly due to a continuance of the strike at the Lake Superior mines; but this is not expected to last much longer. The conclusion of the war in the Balkan states also induced purchases on behalf of both consumers and speculators, considerable sales of manufactured copper being made for India and elsewhere. As a result of enlarged milling equipment shortly expected to be in operation, the quantity of ore treated by the Arizona Copper Co. is expected to be increased from 1500 to 2500 tons per day, representing an increased production of about 11,000 tons of copper per year.

The arrivals in England and France during the fortnight were 11,061, and the deliveries 11,235 tons. The arrivals here and in Swansea from the United States have been 1469 tons bars, etc., and 812 tons ingots, etc., equal to about 2268 tons fine, in London 75, and in France 2413 tons fine. Arrivals of Chile in Liverpool and Swansea have been 1327 and deliveries 1182 tons, and from other countries 1715 and 1880 tons fine, respectively. The Chile charters for the past fortnight are advised as 1900 tons, including 1125 tons to the United States.

Total European stocks amount to 29,615 tons of copper, while imports since the beginning of the year were 139,512 tons fine.

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.		Date.	
Aug.	21	Aug.	28
"	22	"	29
"	23	"	30
"	24 Sunday	"	31 Sunday
"	25	Sept.	1
"	26	"	2
"	27	"	3

21	4.75		28	4.75	
22	4.75		29	4.75	
23	4.75		30	4.75	
24 Sunday			31 Sunday		
25	4.75		1	4.75	
26	4.75		2	4.75	
27	4.75		3	4.75	

Average week ending

July	16	4.33	Aug.	13	4.48
"	23	4.34	"	20	4.68
"	30	4.40	"	27	4.75
Aug.	6	4.50	Sept.	3	4.75

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	4.43	4.28	July	4.71	4.35
Feb.	4.03	4.33	Aug.	4.54	4.60
Mch.	4.07	4.32	Sept.	5.00	....
Apr.	4.20	4.36	Oct.	5.08	....
May	4.20	4.34	Nov.	4.91	....
June	4.40	4.33	Dec.	4.20	....

ZINC

Zinc is qaoted as spelter, standard Western brands, St. Louis delivery, in cents per pound.

Date.		Date.	
Aug.	21	Aug.	28
"	22	"	29
"	23	"	30
"	24 Sunday	"	31 Sunday
"	25	Sept.	1
"	26	"	2
"	27	"	3

21	5.58		28	5.63	
22	5.58		29	5.63	
23	5.58		30	5.63	
24 Sunday			31 Sunday		
25	5.58		1	5.63	
26	5.63		2	5.63	
27	5.63		3	5.63	

Average week ending

July	16	5.08	Aug.	13	5.45
"	23	5.10	"	20	5.51
"	30	5.20	"	27	5.60
Aug.	6	5.40	Sept.	3	5.63

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	6.42	6.88	July	7.12	5.11
Feb.	6.50	6.13	Aug.	6.96	5.51
Mch.	6.57	5.94	Sept.	7.45	....
Apr.	6.63	5.52	Oct.	7.36	....
May	6.68	5.23	Nov.	7.23	....
June	6.88	5.00	Dec.	7.09	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California, being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending			Aug.	21	.40
Aug.	7	.41	"	28	.40
"	14	.41	Sept.	6	.40

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	43.75	39.37	July	43.00	41.00
Feb.	46.00	41.00	Aug.	42.50	40.50
Mch.	46.00	40.20	Sept.	42.12	....
Apr.	42.25	41.00	Oct.	41.50	....
May	41.75	40.25	Nov.	41.50	....
June	41.30	41.00	Dec.	39.75	....

TIN

New York prices control in the American market for tin, since the metal is almost entirely imported. San Francisco quotations average about 5c. per lb. higher. Below are given average monthly New York quotations, in cents per pound:

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	42.53	50.45	July	44.25	40.70
Feb.	42.96	49.07	Aug.	45.80	41.75
Mch.	42.58	46.95	Sept.	48.64	....
Apr.	43.92	49.00	Oct.	50.01	....
May	46.95	49.10	Nov.	49.92	....
June	45.76	45.10	Dec.	49.80	....

The Stock Markets

SAN FRANCISCO STOCKS AND BONDS

(San Francisco Stock and Bond Exchange.)

BONDS

September 3.

Listed.	Bid	Ask	Unlisted.	Bid	Ask
Associated Oil 5s	$ 97	99	Natomas Dev. 6s	$ —	1[illegible]
E. I. du Pont 4½s	83½	—	Pac. Port. Cement 6s	99	—
Natomas Con. 6s	—	78½	Riverside Cement 6s	77	79
Unlisted.			Standard Cement 6s	91½	—
Ass. Oil 1st ref	77	—	Santa Cruz Cement 6s	80	—
General Petroleum 6s	57	57½			

STOCKS

Listed.	Bid	Ask	Unlisted.	Bid	Ask
Associated Oil	42	42½	Mascot Copper	1½	2½
Amalgamated Oil	90	—	Noble Electric Steel	2	4
E. I. du Pont com	—	135	Natomas Consol.	5	[illegible]
Pac. Cst Borax, com	—	100	Pacific Port. Cement	61	—
Pacific Crude Oil	25c	—	Riverside Cement	45	—
Sterling O. & D.	70c	95c	Santa Cruz Cement	—	36½

NEVADA STOCKS

(By courtesy of San Francisco Stock Exchange.)

San Francisco, September 4.

Atlanta	$ .15	Mizpah Extension	$ .40
Belcher	.26	Montana-Tonopah	1.10
Belmont	7.05	Nevada Hills	.84
Big Four	.33	North Star	.68
Cash Boy	.07	Ophir	.21
Florence	.21	Pittsburg Silver Peak	.45
Goldfield Con	1.95	Round Mountain	.40
Goldfield Oro	.08	Sierra Nevada	.05
Halifax	1.32	Tonopah Extension	2.05
Jim Butler	.55	Tonopah Merger	.68
Jumbo Extension	.12	Tonopah of Nevada	4.75
MacNamara	.12	Union	.10
Mexican	1.15	West End	1.32
Midway	.43	Yellow Jacket	.22

COPPER SHARES—BOSTON

(By courtesy of J. C. Wilson, Mills Building.)

September 4.

	Bid	Ask		Bid	Ask
Adventure	$ 1	2	Mohawk	$ 41	42
Allouez	36½	36¾	North Butte	27½	[illegible]
Calumet & Arizona	65	66	Old Dominion	50½	51½
Calumet & Hecla	410	420	Osceola	81	82½
Centennial	13½	13¾	Quincy	61	62
Copper Range	39	39½	Shannon	6¾	7
East Butte	12½	12¾	Superior & Boston	2¾	2¾
Franklin	3	3½	Tamarack	28½	29
Granby	67	67½	U. S. Smelting	36	36½
Greene Cananea	6¾	7	Utah Con.	9	9½
Hancock	17	17½	Victoria	1	1⅛
Isle-Royale	19½	19¾	Winona	1	1½
Mass Copper	2¾	3	Wolverine	43	44

NEW YORK QUOTATIONS

(By courtesy of E. F. Hutton & Co., Kohl Building.)

September 4.

	Bid.	Ask.		Bid.	Ask.
Alaska G. M.	18¼	18⅝	Mason Valley	6	7
Braden Copper	6⅝	6¾	McKinley-Dar.	1¾	1⅞
B. C. Copper	2¼	2⅜	Mines Co. Am.	2⅛	2⅜
Davis-Daly	1⅞	2⅛	Nipissing	8¾	9
Dolores	2	4	Ohio Copper	¼	⅜
El Rayo	[illegible]	[illegible]	San Toy	18	22
Ely Con.	7	7⅛	Sioux Con.	1	[illegible]
First Nat.	2½	2¾	So. Utah	⅛	¼
Giroux	1⅛	1⅜	S. O. Calif.	182	185
Greene Can.	6¾	7	Tri Bullion	⅛	¼
Hollinger	15	15¾	Tuolumne	¾	⅞
Iron Blossom	115	125	United Copper	¼	¾
Kerr Lake	3½	3⅝	Wettlaufer	17	19
La Rose	2¼	2⅜	Yukon Gold	2	2⅛

LONDON QUOTATIONS

(By cable, through the courtesy of Catlin & Powell Co., New York.)

September 4.

	£	s.	d.		£	s.	d.
Alaska Mexican	1	17	6	Kern River Oilfields	0	[illegible]	9
Alaska Treadwell	8	5	0	Mexico Mines	5	7	6
Alaska United	4	0	0	Messina	[illegible]	11	3
Arizona	2	1	3	Oroville	0	7	6
California Amalg	0	2	6	Pacific Oilfields	0	2	6
California Oilfields	6	5	0	Rio Tinto	79	15	0
Camp Bird	0	17	6	Santa Gertrudis	1	0	0
El Oro	0	15	0	Stratton's	0	2	6
Esperanza	1	0	0	Tanganyika	2	11	3
Granville	0	11	3	Tomboy	1	6	3

AUSTRALIAN

September 4.

	£	s.	d.		£	s.	d.
British Broken Hill	1	17	6	Mount Boppy	0	15	0
Broken Hill Prop.	1	16	9	Mount Elliott	5	7	6
Golden Horse-Shoe	3	0	0	Mount Lyell	1	5	0
Great Boulder Prop	0	13	9	Mount Morgan	3	10	0
Ivanhoe	3	1	3	Waihi	2	6	3
Kalgurli	1	17	6	Waihi Grand Junc	1	1	3

DIVIDENDS

	Per share.	Total.
Chino Copper	$0.75	$ 626,775
Nevada Consolidated	0.37½	749,389
Ray Consolidated	0.37½	543,662
Utah Copper	0.75	1,187,000
Bunker Hill & Sullivan	...	65,400
Tonopah Belmont	0.25	375,000
Tonopah Extension	0.05	47,500
Calumet & Hecla	6.00	600,000
Goldfield Consolidated	0.40	1,423,659
American Smelting & Refining:		
Preferred 'A' stock, per cent		1¾
Preferred 'B' stock, per cent		1¼

GOLD AND SILVER TRANSACTIONS

New York

Exports of gold from New York for the week ended August 23, as officially reported at the Custom House, were $500; of silver, $664,786, mostly to London. Since January 1 the totals are: gold, $68,743,196; silver, $32,216,685; as against $32,508,133 gold and $35,651,210 silver for the same time last year. Imports of gold at New York during the week were $465,224, and silver, $64,385. Since January 1: gold, $13,096,286; silver, $6,375,605; as against $15,026,315 gold and $6,324,342 silver for the same period in 1912.

London

During the week ended August 14 about £500,000 arrived in the form of bar gold, of which £183,000 was reserved for India. In the absence of any other external demand of consequence, the bulk of the remainder will be acquired by the Bank of England. The following amounts were received by the Bank: August 7, 8, 11, 12, and 13, bar gold worth £505,000, and the following amounts in sovereigns: from Egypt, £50,000; South America, £525,000; Argentina, £670,000; Uruguay, £252,000; Brazil, £260,000; and France, £5000. Withdrawals in sovereigns were £240,000 for Europe, £50,000 for Peru, and £200,000 for Egypt.

During the week the net influx reached the substantial total of £1,877,000. The net import of gold into India for the month of July was approximately only £234,933.

The tone of the silver market has been steady, and prices have been fairly well maintained, according to Samuel Montagu & Co., writing on August 14. This was only to be expected, considering that both the Indian bazaars and China have been buyers almost daily. The Indian enquiry seems to have set the pace, for the demand for China, though fairly substantial, cannot be called keen, except when the bazaars seemed likely to secure the supplies, which, so far as those from producers were concerned, still continue limited. There is, however, an inclination on the part of Indian speculators to let out some of their stock at, or slightly above, the prices now ruling. An Indian currency return cabled on August 9 showed a decrease in the note circulation of 110 lacs,* and a decrease in the holding of silver rupees of 100 lacs. The period for financing the jute crop has now arrived, and has caused the change in the figures recorded above, for the only method of obtaining silver currency in large amounts is to present notes for payment. This movement from the treasury holding of silver is quite in the natural course of events. Last year the return of August 17 showed a decrease of 110 lacs for a similar reason, and, no doubt, as in previous years, a considerable portion of the silver coin required to finance this crop will return to the treasuries at a later date.

*A lac is a Hindu term equal to 100,000 rupees. One rupee equals 32 cents.

Current Prices for Ores and Minerals

(Corrected monthly by Atkins, Kroll & Co.)

The prices are approximate, subject to fluctuation, and to variation according to quantity, quality, and delivery required. They are quoted, except as noted, f.o.b. San Francisco. Buying prices marked *.

	Min.	Max.
Antimony ore, 50%, ₱ ton	*$22.00	$25.00
Arsenic, white, refined, ₱ lb	0.03½	0.04
Arsenic, red, refined, ₱ lb	0.08	0.08½
Asbestos, chrysotile	100.00	350.00
Asbestos, amphibole	5.00	25.00
Asphaltum, refined, ₱ ton	11.50	20.00
Barium carbonate, precipitated, ₱ ton	42.50	45.00
Barium chloride, commercial, ₱ ton	42.50	45.00
Barium sulphate (barytes), prepared, ₱ ton	20.00	30.00
Bismuth ore, 15% ₱ ton	*250.00	upward
Chrome ore, according to quality, ₱ ton	10.00	12.50
China clay, English, levigated, ₱ ton	15.00	20.00
Cobalt metal, refined, f. o. b. London, ₱ lb	2.50	
Coke, foundry, ₱ 2240 lb	14.50	15.50
Diamonds:		
Ballas according to size and quality, ₱ carat	70.00	
Borts, according to size and quality, ₱ carat	2.00	15.00
Carbons, according to size and quality, ₱ carat	55.00	60.00
Feldspar, ₱ ton	5.00	25.00
Firebrick:		
Bauxite, ₱ M	175.00	
Magnesite, ₱ M	190.00	275.00
Silica, ₱ M	50.00	55.00
Flint pebbles for tube-mills, ₱ 2240 lb	19.50	22.50
Fluorspar, ₱ ton	10.00	175.00
Fullers earth, according to quality, ₱ ton	20.00	30.00
Gilsonite, ₱ ton	35.00	40.00
Graphite:		
Amorphous, ₱ lb	0.01½	0.02½
Crystalline, ₱ lb	0.04	0.13
Gypsum, ₱ ton	7.50	10.00
Infusorial earth, ₱ ton	10.00	15.00
Magnesite, crude, ₱ ton	5.00	7.50
Magnesite, dead calcined, ₱ ton	20.00	25.00
Magnesite, brick (see firebrick).		
Manganese ore, oxide, crude, ₱ ton	10.00	25.00
Manganese, prepared, according to quality, ₱ ton	30.00	70.00
Mica, according to size and quality, ₱ lb	0.05	0.30
Molybdenite, 95% MoS_2, ₱ ton	400.00	450.00
Monazite sand (5% thoria), ₱ ton	150.00	200.00
Nickel metal, refined, ₱ lb	0.45	0.60
Ochre, extra strength, levigated, ₱ 100 lb	2.25	3.25
Osmiridium, ₱ oz	50.00	55.00
Platinum, native, crude, ₱ oz	30.00	45.00
Silex lining for tube-mills ₱ 2240 lb	35.50	37.50
Sulphur, crude, ₱ ton	20.00	25.00
Sulphur, powdered, ₱ ton	35.00	45.00
Sulphur, 80%, ₱ ton	16.50	18.50
Talc, prepared, according to quality, ₱ ton	20.00	50.00
Tin ore, 60%, ₱ ton	500.00	550.00
Tungsten ore, 65%	425.00	450.00
Uranium ore, 10% min.	25.00	per unit
Vanadium ore, 15% V_2O_5, ₱ ton	150.00	180.00
Wolframite (see tungsten ore).		
Zinc ore, 50% up, ₱ ton	*15.00	20.00

Current Prices for Chemicals

(Corrected monthly by Braun-Knecht-Heimann Co.)

Prices quoted are for ordinary quantities in packages as specified. For round lots lower prices may be expected, while in smaller quantities advanced prices are ordinarily charged. Prices named are subject to fluctuation. Other conditions govern Mexican and foreign business.

	Min.	Max.
Acid, sulphuric, com'l, 66°, drums, ₱ 100 lb	$0.75	$1.00
Acid, sulphuric, com'l, 66°, carboy, ₱ 100 lb	1.00	1.50
Acid, sulphuric, C. P., 9-lb. bottle, bbl., ₱ lb	0.13	0.18
Acid, sulphuric, C. P., bulk, carboy, ₱ lb	0.09½	0.12
Acid, muriatic, com'l, carboy, ₱ 100 lb	1.60	3.00
Acid, muriatic, C. P., 6-lb. bottle, bbl., ₱ lb	0.15	0.20
Acid, muriatic, C. P., bulk, carboy, ₱ lb	0.10½	0.15
Acid, nitric, com'l, carboy, ₱ 100 lb	6.00	6.50
Acid, nitric, C. P., 7-lb. bottle, bbl., ₱ lb	0.16	0.22
Acid, nitric, C. P., bulk, carboy, ₱ lb.*	0.12½	0.15
Argols, ground, bbl., ₱ lb	0.10	0.20
Borax, cryst. and conc., bags, ₱ 100 lb	3.00	4.35
Borax, powdered, bbl., ₱ 100 lb	3.38	4.50
Borax glass, gd. 30 mesh, cases, tin lined, ₱ 100 lb	10.50	13.50
Bone ash, 60 to 80 mesh, bbl., ₱ 100 lb	5.50	6.50
Bromine, 1-lb. bottle, ₱ lb	0.55	0.65
Candles, adamantine, 14 oz., 40 sets, ₱ case	4.60	4.80
Candles, adamantine, 14 oz., 60 sets, ₱ case	5.25	5.45
Candles, Stearic, 14 oz., 40 sets, ₱ case	5.00	5.20
Candles, Stearic, 14 oz., 60 sets, ₱ case	5.70	5.90
Clay, domestic fire, sack, ₱ 100 lb	1.50	2.00
Cyanide, 98 to 100%, 100-lb. case, ₱ lb	0.20½	0.24½
Cyanide, 98 to 100%, 200-lb. case, ₱ lb	0.20	0.24
Cyanide, 129%, 100-lb. case, ₱ lb	0.27½	0.28½
Cyanide, 129%, 200-lb. case, ₱ lb	0.26½	0.27½
Lead acetate, brown, broken casks, ₱ 100 lb	9.50	10.50
Lead acetate, white, broken casks, ₱ 100 lb	10.50	10.75
Lead acetate, white, crystals, ₱ 100 lb	12.50	13.25
Lead, C. P., test., gran., ₱ 100 lb	13.00	15.00
Lead, C. P., sheet, ₱ 100 lb	15.00	18.00
Litharge, C. P., silver free, ₱ 100 lb	11.50	13.50
Litharge, com'l, ₱ 100 lb	8.00	9.50
Manganese ox., blk., dom. in bags, ₱ ton	20.00	25.00
Manganese ox., blk., Caucasian, in casks, ₱ ton (85% MnO_2—4% Fe)	36.00	47.50
Nitre, double ref'd, small cryst., bbl., ₱ 100 lb	7.00	8.00
Nitre, double ref'd, granular, bbl., ₱ 100 lb	6.50	7.50
Nitre, double ref'd, powdered, bbl., ₱ 100 lb	7.25	8.00
Potassium bicarbonate, cryst., ₱ 100 lb	12.00	15.00
Potassium carbonate, calcined, ₱ 100 lb	7.50	9.00
Potassium permanganate, drum, ₱ lb	0.10½	0.13
Silica, powdered, bags, ₱ lb	0.03	0.05
Soda, carbonate (ash), bbl., ₱ 100 lb	1.50	1.75
Soda, bicarbonate, bbl., ₱ 100 lb	2.25	2.75
Soda, caustic, ground, 98%, bbl., ₱ 100 lb	3.15	3.50
Soda, caustic, solid, 98%, drums, ₱ 100 lb	2.65	2.85
Zinc shavings, 850 fine, bbl., ₱ 100 lb	11.50	2.50
Zinc sheet, No. 9—18 by 84, drum, ₱ 100 lb	10.00	1 00

*Extra charge for packing nitric acid for shipment to conform to regulations.

Mineral Paint Production

The production of the natural mineral pigments in the United States in 1912, as reported to the U. S. Geological Survey, amounted to 74,657 short tons, valued at $561,693. Compared with 1911, this was an increase of 11,918 short tons, or slightly less than 19%; the increase in value was $62,872, or about 12.6%. The increase in quantity was shared by all the natural pigments enumerated in the table below, except umber and sienna. The production was as follows:

Pigment.	Short tons.	Value.
Ochre	15,269	$149,289
Umber and sienna	805	21,975
Metallic paint	28,347	181,352
Mortar colors	9,272	87,595
Slate and shale, ground	20,964	121,482

The total yield of zinc oxide (80.34% zinc), leaded zinc oxide (6 to 20% lead sulphate), and sublimed white and blue lead, amounted to 106,497 short tons, worth $9,507,895. The chemically manufactured pigments were as follows:

Pigment.	Short tons.	Value.
Basic carbonate white lead:		
In oil	120,591	$16,041,100
Dry	26,242	2,642,361
Red lead	21,120	2,571,702
Litharge	29,111	3,194,194
Orange mineral	545	88,245
Lithopone	24,220	1,702,119
Venetian red	6,306	116,511
Totals	228,135	$26,356,232

Imports were valued at $296,031.

Costs of driving the Sunrise adit of the Mountain Top Mining Co., Ouray, Colorado, 7½ by 6½ ft., a distance of 1974 ft., during the past fiscal year, are as follows:

COST PER FOOT

Labor:			
Shift bosses	$1.224	Steel and tools	0.034
Machine men	2.172	Oil and miscellaneous, underground and surface	0.137
Shovelers	2.785		
Blacksmith	0.411		
Mechanics, etc.	0.764		
Miscellaneous labor.	0.405	Total supplies	$5.479
Bonus	0.733	Superintendence	$0.805
		Sundries	0.177
Total labor	$8.494		
Supplies:		Indirect costs	$0.982
Power and light	$1.136	Total cost at mine	$14.950
Explosives	2.945	Overhead charges, including management, office, taxes, etc.	1.556
Candles	0.081		
Track, complete	0.324		
Ventilating pipes	0.577		
Drill parts	0.118		
Coal	0.127	Total cost per foot	$16.512

Decisions Relating to Mining

Specially reported for the MINING AND SCIENTIFIC PRESS.

GAS LEASE—'DOMESTIC PURPOSE' CLAUSE CONSTRUED

A gas lease providing for the furnishing of gas free to the lessor for domestic purposes was held not to entitle him to gas sufficient to operate a large flambeau light in the open air in front of his residence.

Hall *v.* Philadelphia Co. (West Virginia), 78 Southeastern, 755. May 27, 1913.

DRILLING FOR OIL NOT MINING

Drilling a well in search of oil or gas is not mining within a constitutional provision abrogating the common-law 'fellow servant' doctrine in cases of injuries to employees of mining companies.

Kreps *v.* Brady (Oklahoma), 133 Pacific, 216. June 24, 1912.

PROCEDURE TO OBTAIN PATENT VERIFICATIONS

The verification of an application for patent to a mining claim by an attorney-in-fact for the claimant, at a time when the claimant himself is both resident and physically within the land district, is unauthorized and entry allowed upon such application invalid.

C. C. Drescher, 41 Land Decisions, 614. March 7, 1913.

MORTGAGEE IN POSSESSION MAY WORK MINE

Where mining property is mortgaged to secure bonds issued by the corporation owning it, both the corporation and its lessees have the right to work the mine reasonably and properly, even though this results in its exhaustion; the rights of the parties being similar to those of a life tenant and reversioner.

Young *v.* Haviland (Massachusetts), 102 N. E., 338. May 24, 1913.

ADVERSE POSSESSION—REQUIREMENTS FOR PATENT

It is not necessary to entitle a mining claimant to patent under section 2322, Revised Statutes, that such claimant shall personally have been in adverse possession of the claim for the period fixed by that section; it is sufficient thereunder that the claimant and his grantors shall have held and worked the claim for such period.

Paul B. Warnekros, 41 Land Decisions, 653. March 15, 1913.

PUMICE DEPOSITS—LOCATABLE

Land of little value for agricultural purposes, but which contains extensive deposits of finely divided pumice or volcanic ash, suitable for use in the manufacture of roofing materials and abrasive soaps, and having a positive commercial value for such purposes, is mineral land and not subject to disposition under the agricultural laws.

Bennett *et al. v.* Moll, 41 Land Decisions, 584. December 19, 1912. Rehearing denied April 22, 1913.

MINE-OWNER'S NEGLIGENCE—DEFENSE ABROGATED

A statute which provides that the defense of 'assumption of risk' and 'contributory negligence' shall not be available to a mine owner who has failed to comply with the safety-appliance and inspection laws, is a suit brought by the widow of an employee who was killed in an accident resulting from such lack of precaution on the mine owner's part, has been held constitutional.

Burgin *v.* Missouri K. & T. Ry. Co. (Kansas), 133 Pacific, 560. July 5, 1913.

PLACER CLAIMANT CONTESTING HOMESTEAD ENTRY

Upon contest of a homestead entry by a placer applicant, if the affidavit of contest contains averments sufficient to apprise the homestead claimant of the nature of the case and to enable him to prepare his defense without danger of surprise, it is immaterial that the affidavit does not contain charges as to the mineral character of each ten-acre subdivision, based upon personal knowledge; but upon trial of the case it will be incumbent upon the mineral claimant to establish the actual discovery or disclosure of mineral upon each location involved, and that the area in conflict is prima facie mineral in character, containing placer deposits; the contest may then be sustained as to such ten-acre subdivisions as are shown to be mineral in character.

Crystal Marble Quarries Co. *v.* Dantice, 41 Land Decisions, 642. March 14, 1913.

OIL LEASE INVALID WITHOUT CONSENT OF CO-TENANT

A land-owner by deed granted a one-fourth undivided interest in and to the oil and gas under the surface, and subsequently executed an oil lease to other parties, who went into possession and drilled four wells. It was held, upon suit of the owner of the one-fourth interest for an injunction and accounting, that the owner could confer no rights upon the lessee without consent of the person whom by deed he had made his co-tenant. Injuction against the lessee and accounting granted.

South Penn. Oil Co. *v.* Haught (West Virginia), 78 Southeastern, 759. February 4, 1913.

COAL LEASE WORKS SEVERANCE—TAXES

A lease of "all the merchantable anthracite coal in, upon or under" certain described tracts constituted a sale of the coal in place, and operated as a severance of the same from the surface, thereby creating a divided ownership between the surface and the minerals. In the absence of any express covenant, the lessee is liable for the taxes on the coal, and if the lessor pays them under protest he may recover the amount thereof in an action against the lessee. He cannot recover, however, such taxes as he may have paid voluntarily under a mistaken belief as to his liability.

Millard *v.* Delaware L. & W. R. Co. (Pennsylvania), 87 Atlantic, 601. March 31, 1913.

OIL AND GAS LEASE—GENERAL EFFECT OF

Oil and gas, until severed from the realty, are as much a part of it as coal or stone. So long as they remain in the ground, outside of an artificial receptacle at least, as the casing of a well or pipe-line, they must be treated as a part of the realty underneath the surface where they lie. The owner of the surface is the owner of the oil and gas beneath it, but, if they escape into the land of another he ceases to be the owner of them. Where a lessee contracted with plaintiff for the lease of certain oil lands and afterward paid royalties to certain intervenors who claimed under a mineral locator of the lands, the lessees are not estopped, in a suit by the original lessor for rent, to attack the lessor's title. They were, however, denied relief on a counter-claim for the amount of initial payment to the lessor, as an oil lease does not covenant that oil and gas will be delivered, but merely that the lessee may enter, prospect for, and remove the same. An oil and gas lease is construed most strongly against the lessee and in favor of the lessor.

Rives *v.* Gulf Refining Co., (Louisiana), 62 Southern, 623. May 26, 1913.

MINING CONTRACT—HELD NOT TO BE OPTION

A contract for the sale of certain mining claims provided that the first party agreed to sell and the second parties agreed to buy claims described in the agreement. Total purchase price was to be $30,000, of which $25,000 was to be paid as royalties from the output of the mines. No time was set for the commencement or prosecution of work. The second party did not go into possession, it was alleged, nor work the properties. Suit was brought for the total purchase price after lapse of a reasonable time. The court held that this was a binding agreement, not an option; that the fact that the contract called for royalties did not affect its nature as a contract of sale; that it was implied that the claims sold contained minerals, and if they did not, the burden was on the purchaser to prove it as a defense; that it was understood that work must be commenced within a reasonable time by the purchaser.

Pritchard *v.* McLeod (Alaska), 2051 Federal, 24. May 5, 1913.

Company Reports

GREAT BOULDER PROPRIETARY GOLD MINES, LTD.

This Company owns 85 acres in the heart of the 'Golden Mile,' Kalgoorlie, Western Australia, and from 1895 to 1912, inclusive, has produced 2,401,419 tons of ore valued at $43,000,000, and paid $19,000,000 in dividends. The report, which consists of 38 pages and 13 plans of the mine, is of the usual excellent character of many English mining companies, and from the remarks of the general manager, Richard Hamilton, the following is abstracted.

There are three main shafts in this property, the Main 2844 ft., Edwards 2879 ft., and Hamilton 1978 ft. deep, all of which are equipped with hoists for handling ore and men. Development for the year was 2419, making a total of 110,487 ft. to date, while diamond-drilling, which has always been a strong feature in prospecting at this mine, amounted to 1252 ft., a total of 48,020 ft. to date. From the report it is shown that drifts, winzes, and cross-cuts have opened ore in over 50 different places, and the following table shows the existing orebodies in reserve at the various levels:

Level.	Length of ore remaining in backs, feet.	Average width, feet.	Average assay value, dwt.
300	285	6.4	6.0
500	173	6.6	30.0
600	175	7.0	8.0
600 (west vein)	145	7.2	9.0
700	480	8.5	21.0
800	265	10.5	34.0
900	459	12.5	32.0
1000	540	11.8	17.0
1100	500	10.1	23.0
1200	475	11.3	18.0
1300	1336	12.2	15.8
1400	1158	11.9	14.0
1500	1270	12.0	12.0
1600	1167	12.3	11.0
1750	1093	12.7	7.4
1900	1510	15.1	10.0
2050	1405	14.4	9.0
2200	1392	15.1	15.4
2350	1290	13.3	9.5
2500	960	10.1	9.8

The grand total of all ore reserves is 652,916 long tons averaging 14.59 dwt. per ton.

At about 2550 ft. the lode passed into the Horse-Shoe property, and that Company has since been developing this deposit partly through connections made with the Boulder mine. Connection has been made at the 2050 and 2500-ft. levels with the Golden Horse-Shoe main shaft. This has materially improved the ventilation in the Boulder mine.

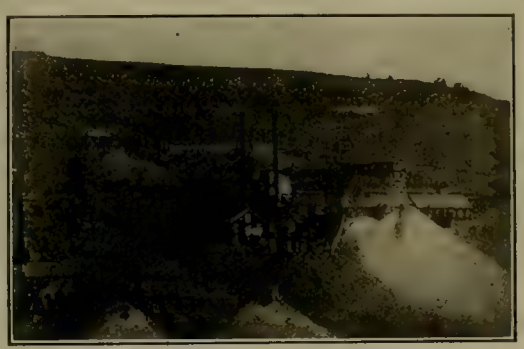
Except the lens of ore found at the 500-ft. level between Edwards and Lane shafts, no fresh orebody has been discovered during the year. Diamond-drill holes have been put down to a depth of 270 ft. below the 1950-ft. level, Hamilton shaft, without finding any sign of ore. Up to the present time 56 bore-holes, averaging a horizontal length of over 300 ft. each, have been driven into the formation east of the main lode and the lode at Hamilton shaft. Many of these holes cover the distance between the lodes and the eastern boundary, and have been put in at various depths below the surface from the 100 to the 2800-ft. level. The horizontal bore to the eastern boundary from the 1800-ft. level, Hamilton shaft, passed through 6 ft. 6 in. of ore worth $8.50 per ton at 145 ft. from the eastern boundary, and 7 ft. of ore worth $1.50 at 2 ft. from the boundary. The other holes did not discover any ore worth working.

Bore-holes at the Main and Edwards shafts have reached a depth of 3000 ft. below the surface on the western boundary without finding any ore. When permission is given by the Golden Horse-Shoe company, allowing the Boulder the drill from the former's 2800-ft. level, other bore-holes will be drilled in an easterly direction to test the country underneath the Boulder main ore-shoot, and from the 500-ft. level between Edwards and Lane shafts more drilling will be done. Prospecting work at the 2650 and 2800-ft. levels has not discovered any profitable ore.

The treatment plant, which consists of crushers, Krupp and Griffin mills, Edwards and Merton roasting furnaces, grinding pans, thickening plant, mechanical agitators, and Ridgway vacuum-filters, dealt with 193,451 tons of ore yielding $2,726,000. Dividends paid amounted to $1,258,000. The Company had at December 31, 1912, cash and bullion in transit valued at $796,000, and reserve fund account of $168,000.

THE EL PASO CONSOLIDATED GOLD MINING CO.

The Company was incorporated under the laws of Colorado in 1893 and owns gold-mining property on Beacon hill, Cripple Creek, Colorado. The authorized capital is $2,500,000, in 500,000 shares of $5 each, all issued and fully paid. The net operating earnings for the year were $243,429. While this figure covers the earnings of the fiscal year, the production of ore on Company account from the formerly submerged levels, which were made accessible through the drainage of the mine by direct connection with the Roosevelt drainage tunnel, only covered



EL PASO MINE.

a period including the last six months of the year. The total development was 6039 ft., more than a mile of driving through the hardest kind of Pike's Peak granite. The mine has been proved to a depth of 1350 ft. by opening its orebodies from the Roosevelt drainage tunnel. The year 1913 was begun with the mine completely drained. During 1912 dividends to the amount of $122,500 were paid. The stock owned by this Company in the Cripple Creek Drainage & Tunnel Co. now amounts to $43,000, and is being amortized at the rate of $24,000 per year. The Colorado Mines, Railways & Utilities Corporation has been formed, under the laws of Delaware to purchase the Golden Cycle stock held on option. The financial statement of the El Paso G. M. Co. shows that its mining property is valued at $2,589,112, cash on hand amounts to $132,056, and the surplus of assets over liabilities is $492,103. Total earnings for the year were $849,305, and the net operating earnings were $238,757. Mining costs were $186,912, and shipping and selling $233,022. Four dividends of $24,500 each were paid during the year.

THE BATOPILAS MINING COMPANY

The Batopilas Mining, Smelting & Refining Co., Ltd., of London, was organized in 1909 to acquire on lease for 25 years the property of the Batopilas Mining Co., of New York. The latter is a consolidation of ten mining companies, the capital is $9,000,000 in shares of $20 each, and there are $1,000,000 6% gold bonds. The Batopilas Mining Co. owns 225,000, or 85% of the shares of the London company. The property comprises silver mines near the town of Batopilas, in the Andres del Rio district, Chihuahua, Mexico. The report for 1912 states that the properties of the Company have been the only mines in that part of Mexico that have not at some time during the past two years suspended operations. The report of Walter M. Brodie, the consulting engineer, gives the total production as 504 bars, or 516,669 oz. Most of this is

from the San Miguel mines. Of the silver produced, about 43% came from the coarse metallic silver in the ore, 17% from the finer metallic silver in the ore, 10% from the tailing of the higher-grade ore, and 30% from the low-grade ores. Some of the veins in the San Miguel group were worked over a hundred years ago, and although there is no ore in sight in the Batopilas mines, the promise for the future can only be calculated from former results. The tonnage of ore for 1912 was: high grade, 812.3175 tons; low grade, 32,261 tons; a total of 33,073.3175 tons. The average price realized for bullion was 54.29c. per fine ounce, an increase of ¾c. per ounce over 1911. A deficit of $17,409 for 1911 was reported, but for the first six months of 1912 there is an estimated profit of over $25,000. Owing to the disturbed conditions in Mexico, the freighting of supplies and shipping of ore have often been very hazardous, ant at times it has seemed as though the plants would have to shut down.

HORN SILVER MINING COMPANY

The Horn Silver Mining Co., of Frisco, Utah, has a capital account of $10,000,000. The report for 1912 gives details of a cave-in during October, necessitating the expenditure of over $20,000 for repairs and preventing mining operations and shipments of ore for over two months. The shipments during the year were 6999 dry tons of mine lead ore, 2031 of mine zinc ore, 6334 of tailing, 4483 of slag, and 30 tons of second-class ore, having an average value of $6.88 per ton. The operating expense averaged $6.06 per ton, yielding a net profit of $16,606, or 83.5c. per ton. The ore reserves have been increased during the year. The profit and loss account for the year ended December 31, 1912, is as follows:

Ore mined by Company	$120,543
Ore mined by lessees	17,031
Total value	$137,574
Refunds, interest, store profit	13,407
Total income	$150,981
Mining, royalty, taxes, smelting, New York expenses, etc.	140,829
Balance	$ 10,152

THE TRI-BULLION SMELTING & DEVELOPMENT CO.

The Company owns mines at Kelly, New Mexico, in Graham county, Arizona, and in Jefferson county, Montana, producing lead, zinc, and copper. The capital stock is $5,034,653, with 1,000,000 shares of common stock and 6930 3/5 shares preferred, at a par value of $5. The gross income from mining for the year was $319,487; the costs at the mines were $173,336. There was a net profit in mining of $71,307. The shipments during 1912 aggregated 14,117 tons, and consisted of 9243 tons of zinc concentrate yielding $217,718, 2060 tons of lead concentrate yielding $60,401, 1552 tons of zinc carbonate yielding $26,855, 965 tons of iron middling yielding $598, 31 tons of zinc sulphate yielding $842, and 266 tons of copper ore yielding $1544. In addition, $1425 worth of copper ore has been mined and is ready for shipment and ore worth $40,917 is in transit. Expenditures on mining were $70,178, and on milling $83,390. Apparently only the properties at Kelly, New Mexico, are being operated. During the year the Silver Bell and the Nit group of claims have been acquired. Development on these was so satisfactory that a rope tramway is in process of construction for the transport of these ores to the mill.

CORBIN COPPER COMPANY

This Company was organized in 1908 under the mining laws of Michigan. The capital stock is $3,750,000, in 150,000 shares of $25 each, and 130,000 shares have been issued. The Company owns 57 mining claims in Jefferson county, Montana, and is exploring under lease and bond nine claims at Rochester, Madison county, Montana. It also has an option to purchase three mining claims in Butte, the Gambrinus, Belcher, and Welch. Development work has been done from the Bonanza adit, and 7740 cu. ft. of ore was stoped above the adit level and milled, netting $1249, and five cars of ore were produced from the Rosalie adit, netting $1571. The ore contains gold and copper. The year 1912 closed with a deficit of $62,502. At Rochester, a steam hoist capable of sinking 500 ft. has been erected, the shaft has been re-timbered from the 200-ft. level down to 230 ft., and the shaft sunk to the 300-ft. level. A cross-cut is also being driven north on the 225-ft. level. At Glenbeg, nine claims were located and the necessary assessment work done. In the Warm Springs district, $2000 was expended on a group of five claims.

MT. MORGAN GOLD MINING COMPANY, LTD.

This Company operates a well known property in Queensland, Australia, and the report of the general manager, B. Magnus, covers the year ended May 31, 1913.

Development in the Mt. Morgan mine covered 660 ft. from the 317 to 1050-ft. level. Eight diamond-drill holes were completed in the year, making a total of 3413 ft. On the 850-ft. level, hole No. 45, going horizontally in a southwesterly direction from the south end of No. 10 cross-cut, at 565 ft. went through 40 ft. of ore suitable for concentrating. Another drill-hole is now in progress to cut this body at a point 200 ft. above and 80 ft. to the northwest. As it will be many years before it will be necessary to mine what ore is found there, it is not the intention to do much more work on this at present.

The preparatory work in the mine to open it for the supply of concentrating ore is now in progress, and it is expected that early next year the mine will be able to supply an additional 600 to 700 tons per working day.

A reëstimation of those blocks of ore which are not taken into account in the published reserves, because they are either too highly silicious or too low in metal value for profitable smelting, has been made. From these figures, the quantity which can be profitably handled as a concentrating ore is such that, to exhaust it and the smelting ore simultaneously, we will require to treat a minimum of 500 tons of concentrating ore per day. With the concentrator running and the exact data available to base calculations upon, the Company will then be in a position to take into account the published reserves this quantity of ore, which until now has been omitted therefrom, as being unprofitable under present treatment conditions. Ore reserves amount to 1,365,000 tons of high and 1,982,000 tons of medium-grade ore.

At the Many Peaks property, which supplies copper-bearing pyrite for the smelter, development covered 1469 ft. In the central working on the 570-ft. level, the westerly cross-cut has proved a width of 90 ft. of ore, and a northerly drift, a length of 75 ft., the face of this last being still in ore. Twenty-five per cent in volume of this body is waste material.

At the Mannor limestone quarries, 99,022 tons was mined, of which 78,621 tons was used as flux and the rest sold. A modern lime-burning plant is being installed. The coal property being developed is opening satisfactorily.

The smelter treated a total or 322,098 tons of ore and miscellaneous products, yielding 9280 tons of copper and 118,488 oz. gold. Many improvements were made to the existing plant. Specially lined converters were installed, but the present power-plant is not capable of supplying sufficient air, in fact it has given considerable trouble during the year.

Results of the year's work may be shown as follows:

Revenue from 9280 tons copper and 126,083 oz. gold	$5,424,000
Total expenditure	$3,691,000
Dividends paid	$960,000
Depreciation	$115,000
Totals to date:	
Ore chlorinated, tons (plant shut down)	3,757,263
Ore smelted, tons	1,511,885
Gold from chlorination, ounces	3,462,298
Gold from smelters, ounces	591,410
Copper production, tons	43,207
Total revenue	$91,872,000
Dividends	$39,000,000

Concentrates

HEATING SOLUTIONS has not proved advantageous at the Waihi mills, New Zealand, where the ore contains about $8 gold and 3½ oz. silver per ton.

A HOISTING ACCIDENT at the Mysore mine, India, on August 22, resulted in the death of 50 miners (probably native) when a cage dropped to the bottom of a shaft.

MILLS in South Dakota during 1912 consumed 14,095 lb. of quicksilver, 139,657 lb. of potassium cyanide, and 439,974 lb. of sodium cyanide in the treatment of 1,893,836 tons of ore.

ARMOR PLATE is to be made by the Carbon Steel Co., of Pittsburgh, for the United States Government. The contract is for 3900 tons at $187.04 per ton, a reduction of $96.99 on the last contract.

LOCKS at the Panama canal have useful dimensions of 1000 by 110 ft. by 40 to 41½ ft., while those of the Kaiser Wilhelm canal, Germany, are 1082.6 by 147.6 ft. by 45.1 ft. The respective length of each canal is 45 and 61.3 miles.

FROM THE TREATMENT OF PITCHBLENDE at St. Joachimsthal, 2.2 gm. of radium was recovered, valued at $196,504, by the Austrian Government in 1912. In 1911 the production was 2.6 gm., valued at $211,120. None was shipped from this district to the United States. Uranium and uranium colors are also being produced in increasing quantities at St. Joachimsthal, in conjunction with radium.

TO PROTECT the many miners working in the coal mines, the last Oklahoma legislature passed a law requiring all such mines to install telephones. They are to be placed every 1000 ft. in the mines and connected to the surface. By this arrangement there will never be a man over 500 ft. from a telephone, which, in case of an accident or explosion, will make it possible to get in communication with the surface almost instantly.

TRANSPORT of ore and concentrate from the Ben Harrison mine, Oregon, to the railroad at Whitney, a distance of 21 miles, costs $8 per ton by wagon haul. To reduce this expense, a gasoline tractor of the caterpillar type has been ordered. It is a six-cylinder, 100-hp. machine, running at from 2 to 6 miles per hour. The tractor will carry 5 tons, and two trailers 10 tons each. To deal with snow in the winter, a snowplow will be attached to clear the road.

THE total annual consumption of oil for fuel, including that used in the manufacture of gas, in California, is between 50,000,000 and 55,000,000 barrels, equivalent to approximately 1,500,000 tons of coal, or about twice as much as the coal consumed within the state. The total consumption of coal in 1912, estimated from the rail and water receipts, was about 770,000 short tons. Less than 500,000 tons of coal was consumed in the vicinity of San Francisco.

MAGNETITE beds occurring in sandstone formation have been discovered in the Blackfoot Indian Reservation, in northwestern Montana, by Eugene Stebinger of the United States Geological Survey. The mineral averages $27.3% iron and 8.3% titanium oxide near the Croff ranch, and on the other side of the Milk river, 33.2% iron and 10.6% titanium oxide. This high titanium content renders these ores unfit for use, according to present metallurgical practice, although it is believed that ores of this type may eventually be successfully smelted.

ORE at the Ophir mill, Virginia City, Nevada, is now being treated direct by cyanidation without previous concentration. This method seems to give good results, provided the ore is given a sufficiently long treatment, but the result of a longer treatment is, of course, a reduction of the capacity of the plant. The cost of marketing concentrate ranges from 80c. to $1.50 per ton of ore treated, according to the grade of ore and concentrate. The superintendent, Walter Techow, is inclined to think that the most economical process is a part reduction of the original value of the ore by concentration, removing about 40 to 50% and leaving the rest for the cyanide plant.

CAPITAL invested or to be invested in hydro-electric power in Japan is as follows:

	Yen.*
Local prefectures	417,688
Cities	87,684,687
Towns	369,120
Private	412,055
Companies	373,236,377
Total	462,119,927

*One yen = 49.8 cents.

The power to be obtained is estimated at 778,231 kilowatts.

HOISTING ENGINES situated at and below horizon No. 8 in the Morro Velho mine, Brazil, are to be driven by electricity instead of compressed air. It is estimated that the saving in power by this change would be sufficient to drive machine-drills for the whole of the rock drilling, thus saving a number of hand-drills. With regard to drilling, actual experience at this mine has shown in the case of the machine-drill on a bar, one man does the work of five hand-drillers, and with the telescope hammer-drill one man does the same work as 4¼ hand-drillers. The actual saving in cost is 2.38 and 18.02c. per foot drilled, respectively, but in the rock broken, the comparison becomes much more favorable for the large machine-drill on bar, on account of the larger and deeper hole, and heavier charge of explosive it will take.

RADIUM is a metallic element that is transmuted at a much more rapid rate than is uranium. Considering equal weights of uranium and radium element, in a year 0.00000000014 of the total quantity of the uranium and 0.00035 of the total quantity of radium will decay. The ratio of the quantity of radium to the quantity of uranium decaying is 2,500,000. From this it may be seen that for equal weights of the two elements there will be enormously more rays from the radium than from the uranium, since a larger proportion of all the radium atoms undergo a transmutation in any given interval of time. Radium bromide ($RaBr_2 2H_2O$) contains 53.6% of radium element; radium chloride ($RaCl_2$) contains 76.1%; radium sulphate ($RaSO_4$) contains 70.2%; and radium carbonate ($RaCO_3$) contains 79 per cent.

METHODS for the prevention of the tremendous waste that usually accompanies the 'coming in' of wells producing large quantities of oil or gas by natural flow fall naturally into two classes, preventive and remedial. The first has to do with keeping under control whatever gas or oil may be encountered in the process of drilling; the second relates to the capping or subduing of wells 'blown out' or 'gone wild,' according to Ralph Arnold and V. R. Garfias of the Bureau of Mines. It is interesting to note the following general conditions affecting flowing gas and oil wells in California, for they have an important bearing on the success of either class of operations: (1) The gas from 'gassers' and the gas that generally accompanies the oil is not injurious to health, hence workmen without being harmed may labor near the well; (2) owing to the tremendous velocity of the stream of gas, the part immediately over the casing head is like a smooth column, and may be approached with safety; (3) the sand usually expelled under tremendous force with the oil or gas often wears out the casings, but this wearing action generally takes place only throughout the uppermost 30 or 40 ft. and opposite or near the place where the gas enters the well, thus leaving the main part of the entire length of the strings practically sound; and (4) the great volume and tremendous pressure of the gas and oil make the use of the best fittings a necessity. Some of these, being of special sizes, are made to order.

Mineral Production of North Carolina

During 1912 the North Carolina Geological and Economic Survey continued its coöperation with the United States Geological Survey in the collection of statistics of the production of all the minerals and ores (including clay products) which were mined in North Carolina during that year. These statistics will be published in connection with more elaborate data later in the year. The output was as follows: gold, $166,014; silver, $2985; copper, $10,521; lead and zinc, $25,694; iron, $186,264; abrasives, $10,914; mica, $256,549; precious stones, $5655; talc and pyrophyllite, $63,304; mineral waters, $24,284; stone, $1,085,267; sand and gravel, $19,737; clay products, $1,605,470; and miscellaneous, $29,929; a total of $3,492,587.

Metal Production of Wyoming

The total value of the production of gold, silver, and copper in the state of Wyoming in 1912 was $26,947, a decrease of $7460 from that of 1911, according to Charles W. Henderson of the United States Geological Survey. The gold yield increased somewhat, but the output of copper and silver decreased. There were 17 producing mines, of which 8 were lode and 9 were placer.

The quantity of ore sold or treated was 2439 short tons, as compared with 3491 tons in 1911. The output of silicious ore increased from 1447 tons in 1911 to 2284 tons in 1912, but that of copper ore decreased from 2044 tons in 1911 to 155 tons. Lode mines yielded $21,469 in gold, 263 fine ounces of silver, and 27,570 lb. of copper. Placer gold production amounted to $766 in 1912, as compared with $7041 in 1911. The copper yield, usually of chief importance in this state, represented only 17% of the state's total in 1912, gold representing 82.5% of the value. Since 1867 the total value of all metals was $5,294,434.

Coal Mining in Pennsylvania

The combined production of anthracite and bituminous coal in Pennsylvania amounted in 1912 to 246,227,086 short tons, valued at $346,993,123, against 235,218,230 tons, valued at $321,537,250, in 1911, according to E. W. Parker, of the U. S. Geological Survey, who compiled the figures in cooperation with the State Topographic and Geologic Survey Commission. The increase in quantity was 11,008,856 short tons, or 4.7%, and the gain in value $25,455,873, or 7.9%. In 1911 the larger percentage of increase in value was due to an increase in the production of anthracite and a decrease in the output of the lower-priced soft coal. The total quantity of bituminous coal produced in the state in 1912 was 161,865,488 short tone, valued at $169,370,497, and that of anthracite coal 84,361,598 short tons, valued at $177,622,626. In 1912 both anthracite and bituminous values were increased in larger ratio than the increase in tonnage. On account of the suspension of operations on April 1 the production of anthracite in 1912 was less than in 1911 by 5,448,633 long tons in quantity and by $2,670,021 in value. The production of bituminous coal, on the other hand, increased 17,304,231 short tons in quantity and $23,215,545 in value. The average value per ton increased for both grades, anthracite from $2.17 to $2.36 per long ton and bituminous coal from $1.01 to $1.05 per short ton. The production of bituminous coal in Pennsylvania in 1912 exceeded that of anthracite by 77,503,890 short tons, or 93%, but the value of the latter exceeded that of the former by $8,252,129.

A somewhat unusual comparison is presented in the statistics covering the labor employed in the anthracite and bituminous coal mines of Pennsylvania in 1912. Notwithstanding the decrease in the production of anthracite, more men were employed in the anthracite mines in 1912 than in 1911, whereas in the bituminous mines the production showed a material increase with fewer employees. The number of men employed in the anthracite mines in 1912 was 174,030, against 172,585 in 1911. The bituminous workers numbered 165,144 in 1912 and 168,199 in 1911. The average number of working days in the anthracite region, however, decreased from 246 in 1911 to 231 in 1912, while in the bituminous mines the average working time increased from 233 days in 1911 to 252 days in 1912. The average yearly production per man in the anthracite region in 1912 was 434 long or 486 short tons, and in the bituminous fields 980 short tons. The total number of men employed in the coal mines of Pennsylvania in 1912 was 339,174, against 340,859 in 1911.

Metal Production of South Dakota

The total value of the production of gold, silver, and lead in South Dakota for 1912, as reported from 40 productive mines, 19 of which were placers, amounted to $8,019,371, according to Charles W. Henderson of the United States Geological Survey. This is the largest production in any one year, the output being $229,183 above the previous maximum mine yield of $7,790,188 in 1908 and $468,613 larger than that of 1911. The gold output was 381,745.02 fine oz., valued at $7,891,370, over 98% of the total value. The increase in gold yield for the year was 21,841.12 fine oz. in quantity and $451,496 in value. The production of silver also increased from 203,755 to 206,460 fine oz. Smelting ore from South Dakota in 1912 contained 22,845 lb. of lead, against 64,311 lb. in 1911. Placer gold increased from 584.03 fine oz. in 1911 to 663.95 oz. in 1912. Some of the placer gold was sold for use in the arts.

The total quantity of ore mined and treated in 1912 was 1,901,726 short tons, averaging 0.20 oz., or $4.14 in gold, as compared with 1,946,127 short tons, averaging $3.817 in 1911, and with 1,523,929 short tons averaging $3.543 in 1910. There were 1,893,836 tons treated in the mills of the state, yielding as bullion $7,734,806 in gold and 179,335 fine oz. of silver, valued at $110,291, a total value of $7,845,097, or an average recovery per ton of $4.08 in gold and of $0.058 in silver, as compared with $3.77 in gold and $0.05 in silver in 1911. The quantity of crude ore shipped to smelters amounted to 7890 tons, having an average content in gold of 0.8758 oz., or $18.10 per ton, and of 3.43 oz. in silver. The production by counties was as follows:

	Custer.	Lawrence.	Pennington.
Mines producing	5	19	16
Tonnage	75	1,901,310	341
Gold	$1187	$7,875,401	$14,782
Silver, ounces	[illegible]	206,356	101
Lead, pounds	.....	22,845	.....
Total value of metals	$1189	$8,003,338	$14,844

Total production of gold and silver in South Dakota from 1876 to 1912, inclusive, was $170,634,838 and $4.011,679, respectively.

Pottery Production

The value of the pottery products of the United States in 1912 was $36,504,164, the largest yet reported, exceeding that of 1911 by $1,985,604, or 5.75%, and that of 1910 by $2,719,486, or 8.05%. Only one variety decreased in value in 1912—stoneware—which declined $200,330, or 4.87%. With the exception of stoneware, every product reached its maximum in 1912, the variety showing the largest gain being sanitary ware, which increased $870,797, or 12.38%. The largest proportional gain was in porcelain electrical supplies, which increased $695,215, or 16.43 per cent.

The value of white ware, including china, but excluding sanitary ware and porcelain electrical supplies, was $17,006,736 in 1912, as compared with $16,424,236 in 1911, an increase of $582,500, or 3.55%. These articles constituted 46.58% of all pottery products in 1912, and 47.58% in 1911. If the value of sanitary ware and porcelain electrical supplies be added, the value for 1912 would be $29,836,307, or 81.73% of all pottery products, an increase of $2,148,512, or 7.76% over the figures for 1911.

Chinaware showed an increase of $119,320, or 5.80%. The value reported for 1912 was the highest ever recorded.

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EDITORIAL

PASSAGE of the tariff bill by the Senate will be welcomed even by those opposed to the changes made. The latter have been certain for some time, and there has been no real gain from the prolonged discussion that has waged. Under the new act, the rates on metals will be generally lower and numerous additions are made to the free list. Among these are steel ingots; ferro manganese; wrought iron slabs and blooms; pig iron, cast iron pipe; cement; limestone; antimony ore; rock asphalt, asphaltum, and bitumen; and many others. We have already discussed the probable effect of some of these changes.

ANOTHER mining journal has suspended publication, *Mines and Methods*, a lively little monthly printed at Salt Lake City. We have not often been able to agree with *Mines and Methods*, but we did enjoy reading it, for much real ability went into its editing. The trouble was that it answered no economic need, and was an organ rather than a real technical journal. Success in the field of publication must rest on a bigger and broader basis than a personal quarrel and the desire to criticize, soundly or unsoundly, a particular group of mine promoters. The world rewards liberally those who give service, but it resents being used to further personal fortunes.

AMONG the characteristics of modern development is a constantly increasing use of artificial light, and the preëminence of electric lighting, already buttressed by its convenience and the quality of light afforded, seems to be firmly established by the announcement by two well known German makers of electrical equipment that before the end of this year they will be able to supply incandescent lamps which use only one-half watt per candle-power. The ordinary carbon filament lamp requires three to four watts per candle-power, and the best tungsten lamps about 1¼ watts per candle-power. As a result, we hope, there will be fewer mashed fingers and other injuries in dark places.

A FEW years ago when a boycott of all American products was being urged by some of our disgruntled neighbors on the other side of the Rio Grande, it was discovered that to make the boycott complete, there would have to be substituted some standard of exchange for the much sought 'gringo' made currency, and as a result the boycott enthusiasts were stumped. However, that this will be no handicap in the future is evidenced by the fact that almost every 'rebel' chieftain is at present a self-

constituted bureau of printing and engraving, and home industry banknotes are becoming more plentiful than *tortillas* and *frijolles*. The latest addition to the new-freedom money is reported from Parral, where the 'rebels,' having appropriated a press from the Tecolotes company, are minting a new currency under the supervision of two American soldiers-of-fortune. It is stated that the 'mint officials' are now investigating various properties in the district as a source of bullion and the Palmilla is being looked upon with favor.

DEPARTURE from San Francisco Wednesday of Mr. Francis Burton Harrison, the new Governor General of the Philippines, marks the beginning of an era in the Islands that will be watched with great anxiety at home and abroad. Mr. Harrison is the appointee of an administration pledged to give independence to the Islands. As to this main purpose there is no real or large dissent in the United States, but there are sharp differences of opinion as to when and how the change is to be brought about. Those most familiar with conditions hold stoutly to the belief that real independence could not now be maintained if granted, and many feel that even agitation of the matter is unwise, since by promoting unrest it complicates the situation. The Islands will be given independence at the earliest moment that the people of the United States can be sure the act will prove a blessing rather than a curse to the Filipinos. The danger is that the change may come too soon. The new Governor General is a man of high character, of wide experience, and proved ability. He will have peculiarly difficult decisions to make. We trust that the excellent record already made by officials in the Islands may be maintained and that he may find the right solution for his many difficulties.

MINING engineers as well as geologists have a lively interest in all that relates to ore deposits, and to them there was no session of the recent International Geological Congress that was of more interest than the one devoted to discussion of the various problems of ore deposition. It was notable that the most active participants in the discussion were North Americans, though there were honorable exceptions. In the United States and in Canada the geologist has been coming into his own rapidly these past few years, and nowhere is more study devoted to the problems of mining geology. The excellent work done abroad, however, should not be overlooked, and we take especial pleasure in printing this week the scholarly address read to the Congress by Mr. Paul Krusch, of the mining school at Berlin, one of the leaders of modern research as relates to ore deposits. It will be noted that Mr. Krusch uses the differences between gel and crystalline ores in making discriminations in a way new to us. His pronounced leaning toward the secondary origin of ores is also notable, the more so because in this, after the pioneer work of Mr. L. de Launay, Europeans were a bit slow to follow their American confreres. Next week we will print an extract from the remarkable paper on 'Butte Ore Deposits,' in which Mr. Reno Sales marshals the evidence against the secondary origin of much of the chalcocite at Butte. In the meantime, Mr. Krusch's paper may be read as an expression of the best continental thought on the general subject.

Canada as an Iron Producer

The rapid growth of the Dominion of Canada as a producer of iron and steel is exhibited in the statistics of output for 1912, which have just been given out. Shipments of iron ore from Canadian mines during 1912 were 192,753 tons, while 1,802,826 tons of imported ore was smelted in Canadian blast-furnaces. The output of steel was 853,031 tons, to which figure it has grown from 26,084 tons in 1902. It is expected that the 1913 output will exceed 1,000,000 tons.

Iron ores are found in many parts of Canada, but only in Nova Scotia, Ontario, and Quebec have they so far proved of economic importance. However, Canada is a rapidly growing country, and many deposits now available are quite likely to be made the basis of profitable industry when conditions shall warrant. As is natural, the deposits first worked occur in the regions which were first settled. The bog iron ores of the lower St. Lawrence near Three Rivers were described as early as 1681, their exploitation began in 1733, and has been continuous to the present day. The rapidity with which these curious deposits form is one of their most remarkable characteristics, some of them being deposited so rapidly as to form practically a continuous supply. Attempts were made to smelt the ores of Ontario in 1800 and 1820, the first successful furnace being at Normandale, where the bog ores of Norfolk county were handled. More recently iron ores have been discovered scattered over the whole pre-Cambrian area of the province. The largest producer is the Helen mine near Michipicoten, where the ore, hematite and limonite in a porous concretionary like slate, associated with a good deal of pyrite, lies in or on a bank of silicious siderite in a closely folded syncline. These ores are regarded as chemical precipitates. Another large producer is the Moose Mountain, Ltd., about 25 miles north of Sudbury, where disseminated magnetite is magnetically concentrated and shipped to the Lake furnaces. There are enormous reserves here and steady progress is being made in solving the peculiarly complex technical and industrial problems that stand in the way of their utilization.

Nova Scotia, though a close second to Ontario in steel production, does not produce much ore; the output in 1907 being less than 90,000 tons. The deposits, though widely scattered and of great variety, are commonly small and can scarcely be made the basis of profitable industry. The coal mines of Nova Scotia, which yield nearly one-third of the total output of Canada, have made it possible to smelt imported ores on a large scale, the output of steel in 1912 having been only 1321 tons less than that of Ontario. The most important plant in Nova Scotia is that of the Dominion Iron & Steel Company, in which Mr. F. S. Pearson was the leading spirit.

Iron ore also occurs in the vicinity of Kootenay

lake and a deposit on the south shore of Kamloops lake has yielded some output. On Texada island, on the west coast, magnetite occurs and has been mined to some extent. Generally speaking, however, the western part of Canada is not yet ready to engage in iron ore production, though steel-working plants already exist in Alberta, and a new one has recently been constructed near Red Cliff. The iron and steel industry is one of the foundation stones of national prosperity, and our neighbors of the country of the maple leaf are to be congratulated on the progress they have made in its development.

The Bromo-Cyanide Process Litigation

A patent case of much interest to metallurgists was recently decided at Perth, Western Australia. It was the suit of the London & Hamburg Gold Recovery Company, Limited, which controls the Sulman-Teed and Goepner-Witter bromo-cyanide patents *versus* the Golden Horse-Shoe Estates Company, Limited, operating at Kalgoorlie, the claim being for damages for infringement of the plaintiff's patents. The case has attracted considerable interest on account of the many delays since action was first started, the technical nature of the subject, and the strong counsel and able metallurgists appearing for both sides. Justice McMillan gave his reserved judgment on June 26, and details have recently been received. It will be recalled that in wet-crushing mills, ores containing tellurides of gold, silver, and other minerals, are not amenable to treatment in ordinary solutions of potassium or sodium cyanide with satisfactory extraction, except with the addition of an accelerator; a haloid compound of cyanogen such as bromide of cyanogen being found to work best. By adding this, the rapidity of the solution of tellurides is greatly increased. The reaction is as follows:

$$BrCN + 3KCN + 2Au = 2KAuCN_2 + KBr$$

which is a pure cyanidation reaction. No oxygen is necessary, since it takes no part in the reaction. These among other points were established by Mr. H. Livingstone Sulman in a paper he read before the Institution of Mining and Metallurgy in 1898. Mr. Ludwig Diehl experimented on Kalgoorlie sulpho-telluride ores for a considerable time, and at last devised the treatment known as the 'Diehl process.' This process is a combination of several steps, namely, wet-crushing by stamps with or without amalgamation, concentration, classification, fine grinding in tube-mills (Mr. Diehl being the first to use these mills in the reduction of gold ores, this being at the Hannan's Star mill in 1899), agitation of the slime with bromo-cyanide and potassium cyanide, and separation of gold solutions in filter-presses. The combination of processes, but principally the fine grinding and use of bromo cyanide, led to satisfactory recoveries, and the wet-treatment plants at Kalgoorlie adopted the process.

In operation, an agitator is filled with thickened slime, the ordinary strength of KCN is made up, and the pulp agitated for several hours. In this part of the mill is a small wooden mechanical mixer into which is run a certain quantity of water and sulphuric acid which is then stirred about an hour. Mixed bromo salts, potassium bromide and potassium bromate, are then added to the dilute acid in the mixer and stirred for some hours. At the same time a quantity of strong potassium cyanide solution is added to the mixture. No haphazard work will suffice in making up the bromo solution, and for every charge there is a particular solution. The temperature of the mixture must also be watched. There is a maximum strength of bromo-cyanogen solution that must not be passed, or else there will be decomposition of the joint solvents, BrCN and KCN, with liberation of brown para-cyanogen. When the bromo-cyanide mixture is ready, it is run into the agitator, and after the requisite contact with the slime, lime is added and the slime is filter-pressed. Precipitation is on zinc shaving as usual. A detailed description of this process, written by Mr. E. W. Nardin, was published in the *Mining and Scientific Press* of October 24, 1908.

In his decision, Justice McMillan stated that two patents came into question in the action, namely, the Sulman-Teed, and Goepner-Witter, Western Australian patents No. 601 and 3145, respectively. Regarding the Sulman-Teed patent, the defendants had urged every objection open, but some of these depended upon the construction placed upon the specifications. It was urged that Mr. Gaze, of Westport, New Zealand, was the real inventor of the 1894 process. The Judge ruled that the Gaze patent was not, as claimed, a patent for the manufacture of the halogen compound of cyanogen, but that the latter was intended to be used with potassium cyanide, however obtained, as a solvent for gold and silver. Another objection was that, according to the cyanide practice at the date of the patent, since lime was added in excess, and percolation was used, the new solvent could not be successfully adopted. The evidence of experiments forced the Judge to the conclusion that until the Diehl process was evolved, bromo-cyanide was a failure. As used by Gaze the solvent was a short-lived one, and caustic alkali destroyed the bromide. Therefore, he declared the Gaze patent invalid.

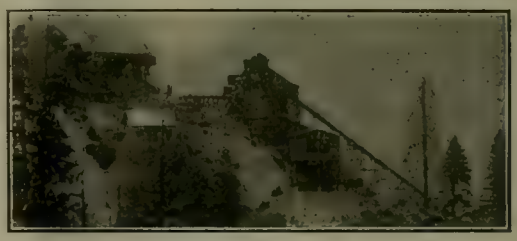
The second patent, the Goepner-Witter, was for the manufacture of bromo-cyanogen by mixing a bromate, a bromide, an acid, and an alkali cyanide. The defendants stated that there was nothing new in that. Evidence was conflicting, but the Judge decided that the process constituted an invention. It was then objected that this had been anticipated by the Sulman-Teed patent and the Morgans patent, but the defendants could not satisfy the Judge to this effect, he holding that the Goepner-Witter patent was valid and the defendants had infringed. Justice McMillan said that great praise was due to the work that had been done by Mr. Diehl at Kalgoorlie. Both sides have since appealed to the Privy Council in England, the plaintiffs against the invalidation of the Sulman-Teed patent, and the defendants against the validity of the Goepner-Witter patent. While not used by many mining companies in the world, the bromo-cyanide process is of great value on certain ores, as has been proved in the successful treatment of Australian tellurides.

The Trinity-Balaklala-Vulcan Mines, Shasta County, California

By W. H. Storms

The seemingly almost hopeless problem of smelter fumes at the smelters of Shasta county, California, appear at last to be in a fair way of being solved. After the expenditure of a large sum of money, and repeated trials, the Mammoth Copper Co. equipped its smelter at Kennett with an extensive 'bag-house,' and other necessary apparatus, and its large plant has now been in apparently successful operation for several months past. This is certainly most encouraging, and indicates that the smelter-fume trouble can be overcome elsewhere by the employment of similar means, but there is evidently another way to handle the fume difficulty, for the First National Copper Co., whose property (the Balaklala mine and other claims of that group) is situated seven

BALAKLALA SMELTER.



MAIN TERMINAL, BALAKLALA.

miles west of Kennett, is now engaged in the rehabilitation of its smelter at Coram, a short distance below Kennett, on the Southern Pacific railroad. It is proposed, so it is announced, to put in operation at this plant what is called the Hall process, which is also claimed to render the noxious fumes from the smelters harmless to both vegetation and animals. Whether this process is all that has been claimed for it remains to be seen. It has received a favorable report from A. L. Walker, who studied the test plant at Brooklyn, N. Y., and large-scale tests at Coram should be under way before October. Results will be awaited with interest.

The Copper Belt of Shasta County

The continued successful operation of the Mammoth mine and smelter and the work now going on at Coram will undoubtedly direct the attention of copper people to the mines of this district. A great deal has already been written of the copper belt of Shasta county, but there always appears to be something new and important to add in connection with them. I had an opportunity, not long since, to go over the Trinity, the Balaklala, and Vulcan properties, spending several days on the ground, and found the geology of these mines most interesting. These several properties, each comprising a large group of claims, are contiguous, the Trinity claims lying north and east of the Vulcan, and the Balaklala group south of it, and extending southeast of the most southerly of the Trinity claims. These mines are 7 miles west from the smelter town of Kennett, and may be treated geologically as a single property. They are in the heart of the copper belt of this part of Shasta county. The Iron Mountain mine which is essentially similar to the mines here to be described, is four miles to the south, the Stowell about two miles southeast, and the Mammoth three miles northeast. In addition to these large mines there are numerous prospects, some of which give promise of becoming great some day. Few of the mines of this region give pronounced superficial evidence of the great sulphide orebodies lying beneath. True, the Iron Mountain had a large limonite gossan, but it was practically destitute of copper and in its early history was equipped with a mill and was worked with some success as a silver mine, no one evidently having a suspicion at that time of the vast masses of copper sulphides lying beneath the iron outcrop. This lack of superficial mineralization at most of the mines has made prospecting in the region both difficult and expensive. In this connection the diamond-drill has proved to be a most important factor in the development of the district, not only in prospecting from the surface but from the underground workings, and it is certain that this method of searching for orebodies in this district will become even more common, as it is recognized as the most sensible and least expensive way to search for the hidden bonanzas of this region.

Geology

The rocks of this vicinity have afforded a subject for much discussion among geologists. H. W. Fairbanks, who was one of the first competent men to scientifically investigate this region, described the rocks generally (11th Report State Mineralogist) as a very acid quartz-porphyry. J. S. Diller, of the United States Geological Survey, has distinguished two series of eruptive rocks in this district—an older greenish rock, which he has called meta-andesite, and a lighter colored, usually distinctly porphyritic rock, which he has called meta-rhyolite. L. C. Graton, also of the United States Geological Survey, apparently is willing to accept Mr. Diller's classification of the older rocks, (the meta-andesite), but suggests for the more acid rock the name alaskite-porphyry for the reason that the so-called rhyolite of Diller shows neither glassy base nor any indication of devitrification, either of which is a distinguishing characteristic of rhyolite. It is unimportant, from a commercial point of view, however,

whether this rock be called rhyolite or alaskite, for it can readily be recognized both on the surface and underground by the abundance of quartz phenocrysts always present. The rock is both fine-grained and coarsely granular, but always presents characteristic facies which distinguish it from the andesite.

The Ore Deposits

In this portion of the Shasta copper belt, which is one of the most important in the United States, the development of the mines seems to have made clear several important facts. The most significant of these are: First, that the great orebodies occur exclusively in the acid rock—the rhyolite of Diller, or alaskite of Graton. Second, that the mineralization has taken place in zones of shearing and brecciation, and is the result of impregnation and replacement of the original constituents of the rock, and that this alteration from rock to ore has proceeded in places on an astonishing scale. Huge masses of iron-copper sulphide occur where was originally only barren rhyolite. Having a knowledge of these facts the natural inference to be drawn from it is simple. It is to be inferred that mineralization has progressed to the greatest extent where the shearing and brecciation has been the most pronounced. An inspection of the mines of the region fully sustains the above conclusion. A fine illustration is presented in the open-cut on the Windy Camp orebody of the Balaklala mine. This body of ore lies beneath the surface of a spur of the hillside formed by the two branches of Windy Camp gulch. The ore comes within a few feet of the surface but does not reach it. The overlying rock is the white rhyolite slightly stained by iron oxide. The rhyolite is rather massive and gives little indication in its physical appearance of the close proximity of a large body of valuable ore just below. As soon as the ore is entered, however, the condition of brecciation and shearing of the rock mass is plainly seen, for this structural feature is still well preserved in the body of the ore itself. Here the two conditions may be inspected side by side—the massive unmineralized rhyolite above, the sheared mass below, now completely altered to ore. This exposure of one of the principal orebodies of the Balaklala mine teaches a very valuable lesson. It shows how the ore has formed in the sheared and crushed zone of the originally barren rhyolite, and it also indicates how close mine workings may pass to a valuable body of ore and miss it, its presence being, perhaps, entirely unsuspected. This emphasizes the need of systematic prospecting in the search for unexposed orebodies.

The Meta-Andesite Rocks

The meta-andesites are found over a large area in this region. They represent a thick series of ancient flows, tuffs, and more rarely conglomerates, with an occasional dike. These old rocks are all of what may be considered as practically a contemporaneous period. In them are found gold-bearing quartz veins (the Uncle Sam and Gladstone are types), and it is from these, and from seams and pockets of gold in these rocks that the placers of the neighboring gulches derived their gold. The placers have been worked quite extensively, and are practically exhausted. These ancient andesites have been intruded by an immense mass of the acid rhyolite above referred to, and which is now the main ore carrier of the region. The north fork of Squaw creek marks the line of contact between the great eastern mass of meta-andesite and the ore-bearing rhyolite. The latter rock, in its passage from below, has torn away great strips from the older andesite and has included them in the rhyolite. I

SMELTER OF MAMMOTH COPPER COMPANY.

observed one of these great fragments particularly, in the Vulcan property, which is otherwise principally in the rhyolite area. This mass of andesite is not less than 3000 ft. long, fully 200 ft. wide, though varying somewhat, and extends downward no one can say how far. This large dike-like mass of andesite is important in the Vulcan property, as it appears to occupy a definite place with reference to the mineralization of the rhyolite in this vicinity. A knowledge of this fact will be of undoubted value to the owners in directing prospecting in the ore-bearing rhyolite.

Trinity and Vulcan Mines

In the Trinity mine the ore lies wholly in the rhyolite and east of the andesite strip, but in close proximity to it at the west end of the Trinity orebody. In the Vulcan ground the largest gossans and surface indications of mineralization are also found on the east side of the andesite strip, the conditions there being practically a duplicate of those in the Trinity. The largest orebody thus far found in the Trinity mine and which has been developed by adits and further explored by diamond-drill, apparently passes across the property line into the Vulcan. West of the andesite strip on the Vulcan are other indications of ore in depth. Some of these are of large size and may cover very extensive deposits of sulphide ore. Several adits have been run in the Vulcan ground, both east and west of the andesite strip, but these workings, owing to a lack of knowledge and an appreciation of the conditions present on the part of the owners, have been of little usefulness in developing ore, though some of the adits may be utilized later for both drainage and transportation when the property is more extensively developed. One of these adits is 1400 ft. in length, and may have passed near bodies of ore, but little indication of their proximity is to be seen in the long adit. Diamond-drilling may be done to advantage from this adit, as footage would be gained by setting a drill here.

Diamond-Drilling

As previously stated, the most satisfactory method of prospecting this region is by means of the diamond-drill. This is the method that has been employed at all of the large mines of the district, from the Iron Mountain to the Mammoth. At some of the mines there is little other development. The Stowell, I am told, has been extensively prospected in this manner, but has limited development otherwise. At the Balaklala numerous diamond-drill holes have been bored with highly satisfactory results. The same may be said of the Trinity, the Mammoth, and others. At the Vulcan several diamond-drill holes have been put down and ore found in each of them, but the holes are all of limited depth, being about 300 ft. each. Just across the cañon of Squaw creek (south fork) two holes have been bored in the Balaklala to a depth of 1500 ft., I was told, and good ore found. Wherever drilling is undertaken in this region the work should be done systematically and thoroughly, or the money will be wasted. It is an easy matter to drill holes here to any depth within the capacity of the drill and find no sign of ore. The orebodies appear to lie at a rather low angle, dipping, if at all, slightly to the westward. Faults occur and these are liable to dislocate the bodies of ore. For this reason down holes rather than flat ones are advisable. One of the holes on the Vulcan is flat. It passed through 27 ft. of sulphide ore, but it is not known whether this is a flat sheet of small dimensions or a portion of a large orebody. One vertical hole, at a depth of 249 ft., passed through a body of ore carrying 4½% copper. I was informed that the great orebody of the Trinity mine abutted upon the andesite strip previously referred to. As the mine was not open to inspection, I was unable to verify this assertion, but have no good reason to discredit the statement.

Diamond-Drill in Underground Exploration

The diamond-drill has been employed in the underground workings of the Trinity, for upward holes have been drilled near the most westerly line of the mine workings and 20 or more feet of solid ore found. Whether this ore extends unbroken into the Vulcan I am unable to say, for there is some indication at the surface of the occurrence of a fault near the west line of the Trinity. If this fault actually occurs it will, I think, be somewhat to the advantage of the Vulcan, as it would bring the orebody nearer to the surface, and thus render it more easily accessible. About 1000 ft. west of the line of this suspected fault (the evidence at the surface is obscure) are indications of a second fault, parallel with the first. The heavy iron outcrops are still west of this latter fault, and above the line which it is supposed to follow. If this assumption is correct, then the Vulcan-Trinity ground is cut by a series of parallel step-faults, similar to those known to occur at the Iron Mountain mine, and any orebodies found in any one of these blocks of ground would consequently be cut off by the fault, only to reappear in the next block to the westward and at a higher level. The whole situation is extremely interesting and full of possibilities of ore occurrence at a number of places in addition to those mentioned above. Faults of similar character are described as occurring between the Iron Mountain and Hornet mines, four miles south of the Trinity.* Here, what appears to have been at one time a continuous body of ore is broken and separated into a number of blocks, in the same manner as those in the Vulcan-Trinity ground. On the Vulcan there are at least five separate areas where indications at the surface, as far as they can be relied upon, seem to mark the presence of ore in depth. The correctness or falsity of this conclusion can best be proved by the diamond-drill. In some of the larger mines of the district, miles of diamond-drill holes have been bored, and while the numerous holes have not in every instance discovered ore, it is acknowledged by the mine managers there that the diamond-drill is by far the best method of searching for ore and for determining the approximate shape and value of the deposit. On the Vulcan property an adit has been driven a few feet above Squaw creek. There is mineral the entire length of this tunnel, and that part of it near the face makes by far the better showing, and yet little is known of the size and value of this particular mass of ore. Diamond-drilling would have given much more information and at less expense.

Surface Indications

The search for bodies of ore in a region like this, where the srface indications, for the most part, consist of what the miners call 'copper blossom,' which is the name by which they know the various masses of iron-stained rock of the region, makes this work difficult. These copper blossoms do not consist of solid iron oxide, which is even here distinguished from the 'blossom' and is called gossan, as it generally is elsewhere. There are a number of these gossans in the district, some of them large, like that at the Iron Mountain; but there are also large and valuable bodies of ore developed where no gossan occurs, as at the Balaklala orebody in Windy Camp gulch previously referred to. The Trinity has a great iron gossan that outcrops on the side of a steep hillside. This exposure is practically a cliff, due to the erosion of the south fork of Squaw creek. The rock overlying this mass of ore is rhyolite of dazzling whiteness, with no sign of copper minerals and little of iron. Had not Squaw creek cut down through the rocks at this place, the Trinity orebody might never have been discovered, for there is no encouragement in the appearance of the rhyolite above it to lead one to hope that ore might be found below. The big gossan, however, was sufficient to attract the attention of the most casual observer, and the development of the mine soon revealed valuable ore. Just north of the principal workings of the Trinity mine a gulch known as Skookum enters the cañon of the south fork of Squaw creek. Up near the head of this gulch, which is only about 3000 ft. long, there is a large area of brecciated and iron-stained rock, the 'copper blossom' of the prospector. There is no sign of copper to be seen at the surface,

*Donald F. Campbell, in *Mining and Scientific Press*, January 12, 1907.

but at one point, on the Hiyou claim of the Vulcan group, an adit has been run into the crushed-rock mass and, within 10 ft. of the surface, sulphide ore carrying some copper was discovered. It is not probable that the ore found at this place is normal ore, for without doubt much of the copper it originally contained has been leached. A similar area occurs over the long adit driven from Squaw creek into the Vulcan ground, and it would not be at all surprising later to learn that this adit has been run underneath the ore horizon of that locality. If the faults heretofore referred to as probably occurring, do actually exist, it is almost a certainty that this adit has been run under the ore. Here is a fine opportunity to employ the diamond-drill in a systematic manner. On the Balaklala west of the Windy Camp orebody, similar conditions exist, that is, large 'copper blossoms' occur, and the indications, such as they are, point to the existence of more ore in that direction. A little tunnel work has been done in that vicinity and some good ore found, but thus far in only small amount. The fact that ore is present at all is looked upon as an encouraging sign by the miners of the district, for they have so frequently seen large masses of ore developed where the superficial indications were not encouraging, to say the least, that they have gained much confidence in their own judgment of indicative conditions. This is the one thing that impresses the mine geologist in this district—the finding of large masses of ore by the employment of the diamond-drill where the superficial indications would not seem to warrant drilling at all. This is the case from the Iron Mountain to the Mammoth, and is particularly to be observed on the Balaklala, in the Windy Camp orebody. Not that the latter occurrence is unusual in the district, for it is not, but for the reason that the geological conditions are so clearly exposed in the open-cut at that mine. The occurrence of the great Trinity orebody under the unmineralized white rhyolite is another, and it is such occurrences as these that have given the mine managers of the district the courage to bore miles of holes with the diamond-drill, in territory that ordinarily would be considered not only as unfavorable, but as having no chance for ore whatever. Of the many holes bored in the district, a large number have passed through ore, and some of the largest orebodies of the district have been discovered in this manner.

Economic Conditions

The region in which these copper deposits occur is one of high and steep but not, generally speaking, rugged hills. The transportation problem has been solved by the construction of good wagon-roads and trails for ordinary purposes, and by the building of narrow-gage railroads or wire ropeways, or a combination of both, for the carrying of ore from the mines to the smelters. The serious obstacle in the way of the extensive development and operation of the mines of this region has been the disposition of the smelter fumes. This has resulted in the closing of the various plants from time to time, the Mountain Copper Co. even going so far as to abandon its smelting plant at Keswick and construct a new and better one at Bay Point, in Contra Costa county. The Mammoth Copper Co., in order to perpetuate the great industry that had been started by it, began a series of experiments. The result of the efforts in that direction is seen in the large addition to the Company's smelting plant at Kennett. This great bag-house took months to build and cost half a million or more dollars, and has required numerous changes and additions since it was first thought to be complete; but it now seems to meet every requirement, as far as rendering the fumes harmless is concerned, and there is accumulating at the smelter thousands of tons of dust from the bag-house that is said to contain a good percentage of zinc in the form of sulphate. This material is thus far without commercial value, but efforts are being made to solve this metallurgical problem. With the success of the Mammoth company, and the promised equal success of the Hall process to be installed at the smelter of the First National company, the copper district, from Iron Mountain to the Mammoth, will take on new life and the output of copper in California will no doubt be largely increased as a direct result of these new processes.

Mining in Morocco

Morocco is reported to be a country rich in mineral resources. Mining development will take place when the mountainous regions of the country have been sufficiently pacified to permit operations. It is likely that mining interests will be eventually consolidated under an amalgamation of the several syndicates now in operation. The Union des Mines and the Mannesmann group have recently combined, but at present there are still several independent companies making surveys and staking out claims in various parts of the country.

There is no mining code in Morocco, and pending the promulgation of the code, which is under preparation, the position of the prospecting syndicates is somewhat ill defined. Mineral areas are located, surveyed, and the denouncement filed by the prospector at his legation. Upon the promulgation of the mining code an international board of arbitration will sit to adjudge, according to priority, the claims thus filed.

It is reported that the tentative draft of the mining regulations for Morocco, which has been drawn up by the Spanish inspector-general of mines and the director of the public works department in the French zone in Morocco, has been finished. These regulations are said to differ considerably from those drawn up in 1910 by the delegates of France, England, Germany, and Spain. The extent of the concessions for experimental works will be granted by the square metre. The tax will in some cases be raised, but will be uniform for most of the concessions.

It is rumored that questions of rights arising before the promulgation of the mining regulations will be settled by special tribunals appointed by the French and Spanish governments in their respective zones, instead of by the tribunal at Lausanne, as was originally proposed.—*Daily Consular Report.*

Nickel Smelting by the Mond Process

By A. P. Coleman

*The carbon monoxide process of refining nickel, by which a volatile compound of nickel is produced and afterward decomposed, thus depositing the metal, was discovered by Carl Langer while working on other problems in the laboratory of Ludwig Mond. Having found a method of refining the metal, Mond naturally looked for a deposit of nickel ore, and in 1899 bought what was then called the McConnell mine, on the north half of lot 8, con. IV, of Denison township, about 3 miles northeast of Worthington in Ontario. Smelting works were established beside the 'Soo' branch of the Canadian Pacific railway, two miles south of the Victoria mine, as the deposit was named, and a cable tramway was constructed to transport the ore 11,000 ft. from the mine to the smelter. In 1900 the Mond Nickel Co. was formed, with a capital of £600,000, to take over the mine and smelter, and in the following year bessemer matte was being produced under the management of Hiram W. Hixon. The roast yards were at first near the smelter and village, but after a fire at the landing station of the ore, necessitating more or less reconstruction, the roast beds were removed to a flat half way between the mine and the smelter. Trouble with the refining works at Clydach, near Swansea, Wales, caused delays on this side of the water also, but ultimately the Mond process was brought into good working order, and the Company began to look for new sources of ore, since the Victoria mine is not a very large deposit.

OLD MOND SMELTER, VICTORIA MINES.

After testing some small deposits, such as the North Star and the Little Stobie, in 1907, a larger one was purchased toward the east end of the main nickel range and named the Garson mine, from the township in which it occurs, on lot 5, con. III. C. V. Corliss, who had been mine superintendent, became manager on the resignation of Mr. Hixon in 1908, and O. B. Hall was made mine superintendent. During this year the Garson mine began shipping ore to the Victoria mines, by the Canadian Northern railway to Sudbury, and then by the 'Soo' branch of the Canadian Pacific to the smelter. By this time the Victoria mine and smelter were equipped with electric power, from Wabageshik falls on Vermilion river, nine miles to the southwest; and the Garson mine was operated with current from the Wanapitei river.

In 1910 diamond-drilling was done to test the Cochrane and McVittie property, which covers a corner of the great Frood deposit, and this was purchased to furnish an additional supply of ore. The Mond company has the distinction of working the deepest mine in Ontario, and in spite of rather small ore deposits the Company is prospering, having recently built much larger smelting works, doubling the size of its refinery at Clydach.

New Smelting Plant

[1]As a reflex of the present prosperous condition of the Company, a new smelting plant has been built near Coniston, where 3700 acres has been acquired for the purpose. The new site is much nearer the present chief producing mines of the Company, is but a short distance from one of the electric-power plants of the Wanapitei power company, and has an ample water-supply. The plant is designed for a capacity of 2000 tons of ore per day, and is in general similar to the plant of the Canadian Copper Co., with the exception that no reverberatory furnaces are used. It is probable that when the supply of fine ore and flue-dust reaches its maximum, a Dwight-Lloyd sintering machine will be installed to handle it. The mine ore, containing nickel and copper in about the proportion of 2.6% nickel to 1 of copper, and with a 25% sulphur content, is roasted in heaps, the roasting yards being so placed that the sulphur fumes will not cause trouble. When the sulphur content is reduced to 11 or 12%, the roast heaps are reclaimed with steam-shovels and the ore loaded into cars which transport it to the smelter bins. The ore, limestone, and coke are drawn out through hoppers into charging cars, and weighed in the usual way, and are then dumped directly into the blast-furnaces. These are 50 in. wide and 20 ft. long. Using a height of charge above the tuyeres of 11 ft., and a blast pressure of 30 to 40 oz., about 500 tons per day is smelted, making a slag that runs 30 to 40% SiO_2. Space has been provided for four blast-furnaces, two are already constructed, and one is in blast. The plant has only been in operation two or three months, so that working conditions are still some-

*Excerpt from 'The Nickel Industry,' Bulletin 170, Canada Department of Mines, Mines Branch.

[1]The description of the new smelting plant has been supplied by the Editor.

what abnormal and the coke consumption is accordingly high. The furnace yields 70 to 80 tons per day of matte containing about 20% of copper and nickel combined. This is tapped off from the settlers into pots handled by the crane and is dumped into the Pierce-Smith converter, where it is blown to a matte containing 80% copper and nickel combined. As a result of closing down the old plant and starting the new, a large amount of difficult material requires to be handled, and the converter is made to do as much smelting work as possible. It is therefore worked to capacity in spite of the apparently small tonnage of matte treated. The converter slag is poured directly into the blast-furnace settlers.

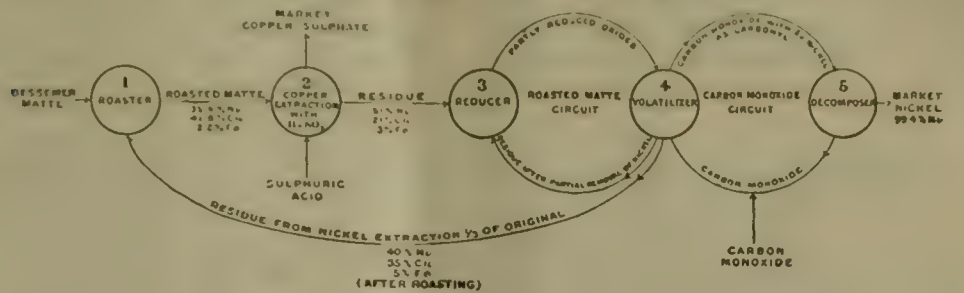


FIG. 1. DIAGRAM ILLUSTRATING THE OPERATIONS INVOLVED IN THE MOND PROCESS.

Financial Statement

The following statement has recently been made as to the financial conditions of the Company: The original capital of the Company was £600,000, divided into £250,000 of 7% cumulative preference £5 shares, £300,000 ordinary, and £50,000 deferred shares of £1 each, without debentures or other prior charges. The ordinary shares carried a preferential dividend of 7%, thereafter sharing with the deferred shares in surplus earnings. In 1908 the capital was increased to £850,000 by the creation of 50,000 cumulative preference shares, of which 30,000 were issued, raising the preference share capital to £400,000. It was not until 1905 that the profits of the Company provided any return to the ordinary shareholders, since when they have gone up by constant increases, and the returns for the past three years have been:

	Year to April 30:		
	1909.	1910.	1911.
Net profit	£111,320	£114,107	£140,803
Preferred dividend, 7%	22,716	26,367	26,367
Ordinary dividend	42,751	42,375	45,906
Ordinary rate, per cent.	15	15	16¼
Deferred dividend	22,800	22,600	26,131
Deferred rate, per cent.	48	48	55½
Balance of year	23,053	22,765	42,399
Brought in	29,923	32,976	20,741
For reserve, etc.	52,976	55,741	63,140
To reserve	20,000	35,000	35,000
Carried forward	32,976	20,741	28,140

In 1906 the ordinary shareholders first received a dividend over their stipulated 7% when 10% was paid, followed by 12.5% in 1907, 15% for the next three years, and now 16.25% for the past twelve months, while the holders of deferred shares received 18% in 1906, 33% in 1907, 48% for the next three years, and now 55.5 per cent.

The Mond Process

The matte produced at Coniston is shipped to Clydach, a suburb of Swansea, Wales, for final treatment by one of the most ingenious processes imaginable. It was discovered in 1889 by Carl Langer, working in conjunction with Ludwig Mond, that carbon monoxide, passed at a temperature not exceeding 80°C. over a finely divided nickel, combined with the metal to produce a gas, nickel carbonyl, which could be decomposed again at a temperature of 180°C., thus depositing the nickel. The process was patented and an experimental plant was erected in 1892, at Smethwick near Birmingham, to test it. As described by Roberts-Austen in 1899, the process was developed during some years of patient work, in which the plant had several times to be reconstructed to make it a practical success.[2]

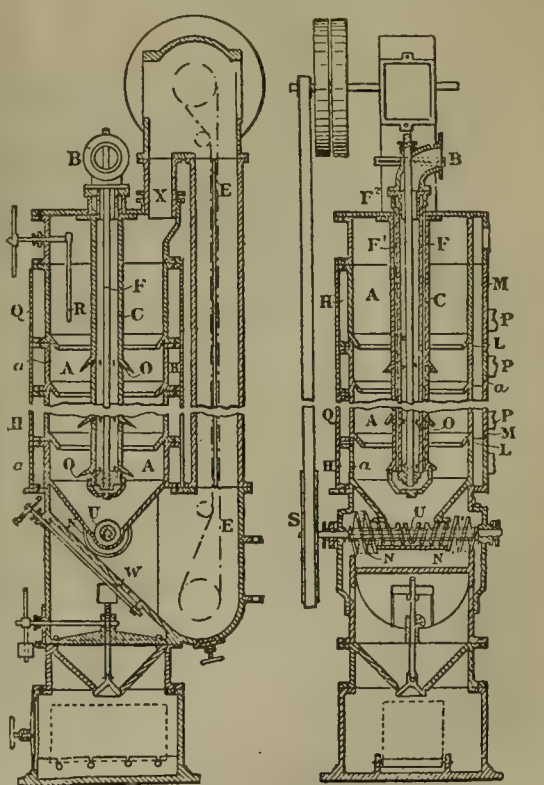


FIG. 2. VERTICAL SECTIONS THROUGH THE DECOMPOSER.

[2]Minutes of the *Proceedings* of the Institution of Civil Engineers, Vol. CXXXV, p. 29.

Operations Necessary for Production of Nickel

Essentially five operations are required in order to produce the nickel: (1) dead roasting to drive out as much of the sulphur as possible; (2) the extraction of about two-thirds of the copper by sulphuric acid, the resulting sulphate of copper being sold in that form; (3) the reduction of the nickel and remaining copper to the metallic state by water gas or producer gas rich in hydrogen in an apparatus called a 'reducer', the temperature of which is under perfect control, so that 400°C. is never exceeded; (4) from this apparatus the substance, now reduced to the metallic state, is taken through air-tight conveyors and elevators into another apparatus called a 'volatilizer', in which it is subjected to the action of carbon monoxide gas at a temperature not exceeding 80°C.; (5) the nickel carbonyl thus produced passes into the 'decomposer,' a tower or horizontal retort heated to 180°C., so as to release the nickel in the metallic state.

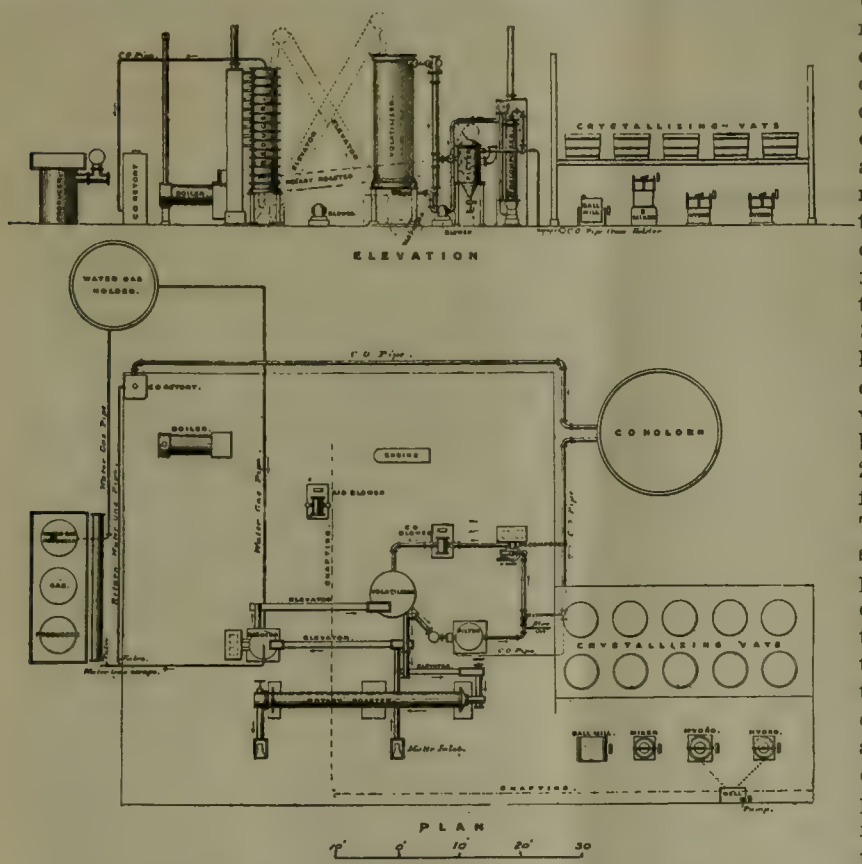


FIG. 3 AND 4. GENERAL ARRANGEMENT OF MOND PROCESS PLANT.

Time of Operation

The process is not complete in one passage through the five stages, however, and the materials are made to circulate for a period varying from 7 to 15 days between stages (3) and (4) until about 60% of the nickel has been removed as carbonyl. The residue from this operation, amounting to about a third of the original calcined matte and not differing much from it in composition, is returned to the first operation and follows the same course as before.

In operation (5) the carbon monoxide is released and is returned to the volatilizer to take up a fresh charge of nickel. When the operations are in progress the carbon monoxide gas and the partly reduced oxides of nickel and copper are continually revolving in two separate circuits which join and cross each other in the volatilizer (4). The nickel is deposited on granules of ordinary commercial nickel which are automatically removed after reaching a certain size. The product contains between 99.4 and 99.8% of nickel.

Roberts-Austen describes the process as he observed it at Smethwick as follows: "The material under treatment during my visit was of Canadian origin, and had been received as calcined matte containing 35.4% of nickel, 41.8% of copper, and about 2% of iron. This material was first passed through a ball-mill and dresser with a 60-mesh riddle, and was then treated in quantities of 3 cwt. in a small lead-lined mixer with 200 lb. of ordinary sulphuric acid which had previously been diluted with about 20 cu. ft. of mother liquor from previous operations. These appliances are shown in the right-hand portion of the plan and elevation, Fig. 2. The temperature of the mixture soon rises by the action between the copper oxide and the sulphuric acid, and is kept, by means of a steam jet, at a temperature of about 85°C., for half an hour. From this mixer, the charge is run out into a centrifugal hydro-extractor, provided with a filtering cloth, in which the solution of copper sulphate is separated from the solid residue containing the nickel. After the filtration of the charge is finished, the speed of the hydro-extractor is increased.

Crystallization of Copper Sulphate

"The solution containing the extracted copper runs from the hydro-extractor into a well, from which it is pumped into the crystallizing vats shown in Fig. 3. After a period of about 8 to 10 days, the crystals of copper sulphate are taken out of the vats and the mother liquor is mixed with fresh acid and is again used for the extraction of copper. As already mentioned, a small amount of nickel and a little iron are also dissolved in the sulphuric acid during the copper extraction, so that the mother liquor from which the copper sulphate has crystal-

lized becomes gradually contaminated with these two metals. It is therefore necessary to replace some of the mother liquor from time to time by fresh water, and to recover the nickel from the solution. The simplest method is to evaporate the solution to dryness and to roast the nickel and copper sulphates so obtained. The oxidized material is again introduced into the main process. The copper sulphate crystals from the crystallizing vats are charged into a second hydro-extractor, where they are washed with a little clean water to remove all acidity; they are then dried and are ready for packing. The copper sulphate thus obtained is sufficiently pure for market, as it contains only 0.05% of nickel and 0.048% of iron.

Residue from Copper Extraction

"The residue from the copper extraction is taken from the hydro-extractor and stored in a bin until a sufficient quantity has been collected to make up a charge of 5 to 6 tons for the nickel extracting plant. It now contains 52.5% of nickel, 20.6% of copper, and 2.6% of iron. The material is charged by hand at the rate of half a ton per hour into a feeding hopper, described as the matte inlet in the lower part of the plan, Fig. 3, which communicates, through a rotary valve, with the conveyor, consisting of a tube enclosing a revolving spiral, which transports the material to an elevator. This lifts the material to the top of the reducing tower, and discharges it through another rotary valve into this reducing tower.

"The reducer and the volatilizer (shown in the centre of Fig. 3 and 4), in which the treatment with carbon-monoxide takes place, are fully described in Mond's patent, No. 23,665, December 10, 1895. The reducer consists of a vertical tower about 25 ft. high, containing a series of shelves, which are hollow so as to admit of their being raised to a temperature of 250°C. by producer gas. The roasted matte falling on these shelves from above, is stirred and made to descend from one shelf to that below it by rabbles actuated by a central vertical shaft. Water-gas passes up the tower to effect the reduction of the material. There are about fourteen of these shelves or trays in the tower. The five lower shelves are not heated by producer gas, but are cooled by a stream of water in order to reduce the temperature of the roasted and reduced matte to the temperature at which the volatilizer is worked.

Volatilizing Tower

"The volatilizing tower resembles the reducer, but

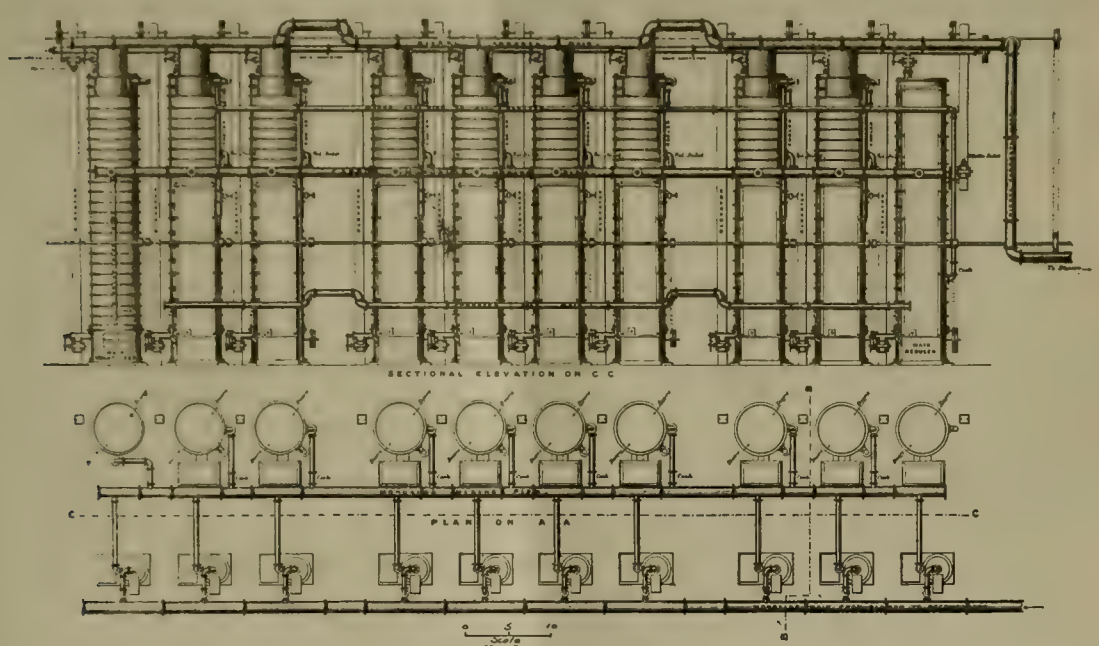


FIG. 5. ARRANGEMENT OF REDUCERS AND VOLATILIZERS FOR EXTRACTION OF NICKEL.

the shelves are not hollow, as there is no necessity to heat them. The reduced nickel requires a temperature of only 50°C. to enable it to combine with carbon monoxide and form a volatile compound, and the matte and gas are sufficiently hot to maintain this temperature. In the plant at Smethwick the volatilizer was made the same size as the reducer, but in the new plant it is somewhat smaller.

"The decomposer has been devised with much care, and has, in its present form, only recently been patented. The nickel is deposited in it, from its gaseous compound with carbon monoxide, on granules of ordinary commercial metal. The arrangements by which this is effected are very ingenious, and may be described almost in the words of Mond's latest patent. The object is to obtain metallic nickel from nickel carbonyl in the form of pellets, which are specially suitable for the production of nickel alloys. For this purpose gases containing nickel carbonyl are passed through granulated nickel, which is kept at the temperature required for the decomposition of the carbonyl, about 200°C. The nickel which thus separates from the carbonyl becomes deposited on the granulated nickel, which consequently increases in size. In order to prevent cohesion of the granulated nickel, it is kept in motion. When a number of the pellets have at-

tained a convenient size, they are separated by sifting without interrupting the depositing operation, the smaller granules being returned to receive a further deposit from the nickel carbonyl. A convenient form of apparatus for effecting the process described is shown in Fig. 2, which represents vertical sections of the apparatus on planes at right angles to each other. A is a cylindrical vessel, preferably built up of short cylinders, a a, bolted together; it contains a central tube, C, provided with gas outlet holes, O, through which the gas containing nickel carbonyl, entered at the gas inlet, B, passes into the vessel which is filled with shot, or small granules of nickel. The gas permeates through the interstices between these granules, and is brought into intimate contact with them, and when the nickel carbonyl is decomposed, the nickel is deposited on the granules. The gases finally escape through the outlets, L, into the gas exit pipe, M.

Movement of the Granules

"In order to prevent the granules from cohering, they are kept slowly moving by continuously withdrawing some of the granules from the bottom of the cylindrical vessel, A, by means of a right and left-handed worm conveyor, U, which delivers the granules into two sifting drums, N. The smaller granules fall on to the inclined plane, W, and collect at the base of the elevator, E, which conveys them again to the top of the cylinder, A, and feeds them through the feeding-hole, X. In order to avoid the deposition of nickel from the nickel carbonyl in the central tube, C, it is kept cool by causing water to circulate down the tube, F, and up through passages, F, formed in the central tube, to the water outlet F^1. The cylindrical vessel, A, is surrounded by a wrought iron casing, Q, which forms heating-spaces, H, communicating with heat flues, P, which are so arranged that the temperature of each cylinder can be separately regulated by dampers, so as to maintain the temperature of the granules of nickel contained in the vessel, A, at about 200°C., at which temperature the nickel carbonyl is decomposed. With a view to ascertain whether the cylinder, A, is full of granules, a rod, R, is fixed to the spindle of an external handle, which can be turned partly round, so that if the operator feels resistance to the motion of the R, it is certain that the granules extend to that height. The appliance used for depositing the nickel originally consisted of a series of retorts lined with tin steel sheets, on which the nickel was deposited in layers. It was found, however, that the metal so obtained was very difficult to cut.

"A magnified section of a granule of nickel shows a core of nickel with a crystalline and convoluted structure surrounded by concentric layers. The central core is ordinary commercial nickel, and the layers are nickel deposited from its carbonyl. In some cases granules of deposited nickel are found without any central core. These have grown from minute fragments of deposited nickel which have become detached during the course of deposition. The water gas used in the reducer is generated in gas producers, three of which are shown on the left of the plan, Fig. 3. Anthracite is used to decompose the steam, and the water gas is collected in a gas holder, whence it is taken to the reducing tower, to which reference has just been made. This gas contains, on entering the reducer, about 60% of hydrogen.

Water Gases

"The reducing operation is so regulated that only a small quantity of hydrogen remains in the escaping gas, as a rule not more than 5 to 10%. This waste gas is subjected to the action of a fine water spray which condenses the steam generated by the combustion of the hydrogen in the water gas. Part of this waste gas is used for making the carbon monoxide required in the volatilizer, by passing it through the CO retort charged with incandescent charcoal, Fig. 4, which reduces the carbon dioxide contained in the waste gas, and this increases the amount of carbon monoxide in it. The gas issuing from this retort contains about 80% of carbon monoxide, and is stored in another gas-holder, which communicates with the main circuit of the carbon-monoxide gas. This main circuit of the carbon monoxide passes through the volatilizer already referred to, where the nickel is taken up. The carbon monoxide, now charged with nickel, passes through a filter to separate the fine particles of matte dust from the gases, then through an apparatus called the decomposer and so described in the figure. In this decomposer the nickel taken up in the volatilizer is deposited. The gas now deprived of its nickel passes to the CO blower, Fig. 4, which sends the carbon monoxide to the volatilizer in order that it may take up a fresh charge of nickel.

Circulation of Nickel-Bearing Material

"The solid material from which the nickel is being extracted is kept circulating through the reducer and volatilizer for a period varying between 7 and 15 days, during which time the oxides are gradually reduced to the metallic state and the nickel is volatilized. When the material originally charged in has had the bulk of its nickel extracted, it is run out through a rotary calciner roaster, Fig. 4, which converts the metals into oxides, so that they may be treated for the second time with sulphuric acid and carbon monoxide. The ratio between the nickel and copper in the residue from the nickel extraction is practically the same as in the calcined matte, with which the operations were started, but the amount of iron has increased by the removal of the copper and nickel, as the following figures show: Original matte contains, nickel 35.27%, copper 41.87%, iron 2.13%. After the first treatment of copper and nickel extraction, the quantities are: nickel 35.48%, copper 38.63%, iron 4.58%; and after the second copper and nickel extraction: nickel 35.83%, copper 35.56%, and iron 7.82%. The amount of nickel extracted in these two cases was, after the first treatment, 61%, and after the second treatment 80% of the nickel present in the original matte. It must be remembered, however, that in the second treatment only one-third of the original amount remains to be treated, while the final residue is only one-tenth. To avoid the formation of iron

carbonyl, the temperature in the reducer has to be kept very low, and if this is done, the nickel extracted from a matte originally containing as much as between 6 and 10% of iron will not contain more than 0.5% of iron. If the amount of iron in the residue rises above this percentage, the extraction of the nickel is very much delayed, on account of the low temperature which must be maintained in the reducer. It is necessary, in such a case, to resmelt the residue before proceeding with the extraction of the nickel and copper. The following are analyses of the deposited nickel:

	I. (%)	II. (%)
Nickel	99.8200	99.4300
Iron and Al_2O_3	0.1000	0.4300
Sulphur	0.0068	0.0099
Carbon	0.0700	0.0870
Insoluble residue	.....	0.0260

"Fig. 5 and 6 show a front elevation, plan, and cross-section of a plant designed to produce 1000 tons of nickel per year. The plant is so arranged that the matte is continuously charged into the first reducer and traverses the whole set of appliances. When the matte issues from the last volatilizer the first nickel extraction is finished. The matte is reroasted and submitted to the second copper and nickel extraction. There are ten appliances, consisting of one large reducer, eight combined reducers and volatilizers, and one large volatilizer. They are so arranged that the matte has first to pass through the large reducer, and is then lifted by means of an elevator and conveyor into a volatilizer (erected on the top of the next reducer). It passes through the volatilizer into the upper portion of the reducer and in traversing this it is further reduced. It is then lifted again to the next volatilizer, and so on until it finally reaches the larger volatilizer at the end of the whole series, and, after passing through this, it is discharged into the roasting furnace. The conveyor on the top of the volatilizers into which the elevators discharge, is common to the whole set of volatilizers and reducers, so that, in case any portion of the plant has to be disconnected, the rotary valve through which the material is discharged from the conveyor into the volatilizer is stopped. The material then passes on through the conveyor into the next volatilizer. The two gases, carbon monoxide in the volatilizers and water gas in the reducers, are kept separate by rotary valves of the same construction as in the small plant. The water gas connections are so arranged that each reducer receives fresh gas from the main, with the exception of the first large reducer, through which the waste gas of all the other reducers is passed, so as to burn completely all the hydrogen in the water gas. The carbon monoxide passes through the volatilizers from a common main, and is collected, after it has passed through the filters, in a main leading to the blower. From the blower the carbon monoxide charged with nickel passes through a set of decomposers, and again into the main which feeds the volatilizers."

The works at Clydach are equipped in the way described by Roberts-Austen, but with many more units, so as to produce 1700 tons of nickel, 7000 tons of copper sulphate, and 800 tons of nickel sulphate, including a little nickel-ammonium sulphate. Langer states that the nickel now produced is 99.98% pure and is sold in the shot form to the Armstrong company for armor plate, and to smaller firms of steel workers and producers of german silver and nickel plate. Some is sold also to Arthur Krupp, and to a pure nickel goods company at Berndorf near Vienna. The works show none of the roughness and disorder of the usual metallurgical plant, but are as clean and as scientifically managed as a laboratory, everything being accurately adjusted, and the temperatures of the different parts being frequently taken and recorded. The gases employed

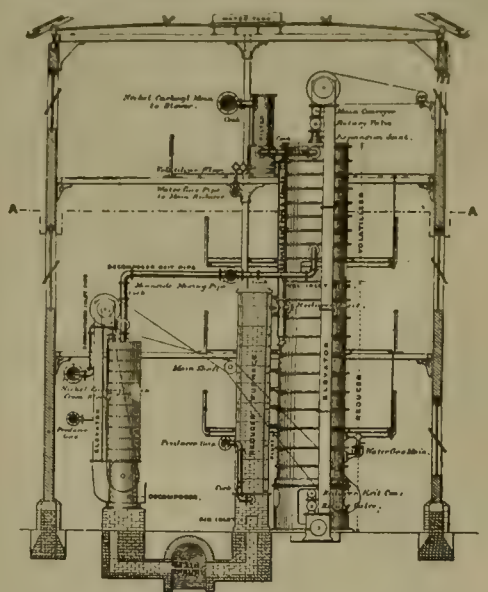


FIG. 6. CROSS-SECTION OF REDUCERS AND VOLATILIZERS.

in the process are very poisonous, but so much care is taken as to joints and fittings that for eight years there have been no cases of poisoning.

The plant is run continuously except for a stop of three weeks in the year to clean flues and repair machinery; and the demand for nickel has increased so much that plans are made to double the present works. Clydach, being in the midst of the Welsh anthracite and steam-coal fields, supplies at a minimum of expense the varieties of coal needed for the production of carbon monoxide and for other purposes in the running of the plant, and also gives a convenient distributing point for the sulphate of copper and other products resulting from the process. I am under great obligations to the Mond company for permission to visit the Clydach works, and to Mr. Langer for his courtesy in taking me through them.

Tin production of Bolivia in 1912 amounted to 42,305 short tons of black tin. The export duty on this was $1,086,911, Great Britain obtaining 93% of the tin exported. The tin mining industry in Bolivia is in the hands of a few interests, the principal owner being Sr. Don Simon I. Patiño. The principal mines are found in the department of La Paz, Oruro, Potosi, and Cochabamba.

Primary and Secondary Ores Considered With Especial Reference to the Gel and the Rich Heavy Metal Ores

By P. Krusch

*The first to apply the principles of colloid chemistry to the study of ores was Cornu. In a paper published in the *Zeitschrift für praktische Geologie*, he dealt at length with the concept of metallogenetic type ores, previously advanced by me, and separated the ores of the several heavy metals into 'gel' and 'crystalline' ores. According to the then existing state of knowledge, he was justified in the assumption that the gels could play a rôle only in the secondary transposition of the metallic content of ore deposits; in other words, that they could not form primary deposits. Building upon the results obtained by Cornu, I have shown in the second edition of 'Untersuchung und Bewertung von Erzlagerstätten' (1911) that there are also primary colloidal ores, which are the products of original concentrations of ore. Since that time I have further occupied myself with the chemical and petrographic investigation of these ores. At this time I will indicate briefly the lines along which we are working at the Institute of Ore Deposits in Berlin, and will present some results of general importance.

Definition of Gel Ores

For the colloidal, originally amorphous ores that are produced from the so-called 'sols' resulting during weathering, I employ the term 'gel' ores. Even if by subsequent alteration they have become cryptocrystalline, they nevertheless differ markedly from the ores of similar chemical composition deposited in an originally crystalline condition. The colloidal ores may at some time after their deposition pass over into the crystalline state; for example, the gel ore polianite is commonly cut by younger veins of pyrolusite, and the gel ore limonite is filled with blebs and veinlets of crystallized iron hydrate. These are mainly transformations brought about by the agency of water. Perhaps more important are the facts, quite generally applicable to all gels, that increase of temperature and mechanical disturbance are often sufficient to cause a gel to become crystalline throughout its entire mass.

The recognition of the crystalline equivalents of the gel ores by Cornu has greatly clarified our knowledge of the origin and composition of the oxidized and hydrated ores of iron and manganese. The gels have the property of acting adsorbtively upon solutions of the heavy metals, among others. This peculiarity often makes the recognition of their chemical composition a matter of difficulty. It is frequently impossible, therefore, to establish whether a gel ore represents a single definite chemical compound or is a mixture of two; that is, a gel forms one constituent and the adsorbed heavy-metal content the other. For these I desire to propose the terms 'gel groundmass' and 'adsorbed permeation compound'. To this kind of gel ores, for example, belong the silicated nickel ores, which I am investigating at present in association with Beyschlag, in preparing the monograph on the nickel ore deposits of Frankenstein in Silesia. They are composed, as was already suspected previously, of a non-metalliferous gel, which forms the gel groundmass, and a nickel compound which constitutes the adsorbed permeation substance. Details will shortly be published by Mr. Kraft, one of Kemp's students who has been studying under my direction the relation between the deposits of amorphous magnesite and those of nickel silicate ores.

*Read before the International Geological Congress and translated by Adolph Knopf.

Adsorption Processes

The reverse phenomena was already known to Cornu that gel ores adsorb non-metallic substances, as, for example, manganese gel ore adsorbs barium and potassium compounds. Interesting experiments, undertaken by one of my students at my suggestion, are now in progress at the Berlin Mining School in order to determine the physical and chemical conditions necessary for these adsorption processes. The adsorption phenomena accompanying the permeation of a substance are excellently observable in thin sections. As I was able to establish in many instances, they are intimately associated with profound metasomatic processes, which may lead to a complete replacement of the original substance. Adsorbtion and metasomatism, therefore, go hand in hand; the first process is an extraordinarily favorable preparatory step for the second; both are so closely connected that one must speak of the whole process as 'adsorption metasomatism.'

Inasmuch as it is the processes of weathering that produce the gel ores and weathering is different with different latitudes, it is probable that the occurrence of the gel ores will show corresponding differences in this regard. I will recur to this point later. However, I must emphasize here that this question is most intimately related to the study of the secondary transposition of metals, which, as a matter of fact, is wholly determined by weathering. A systematic and exhaustive investigation of the differences in ores occurring in the different degrees of latitude is much to be desired, and would add much to our knowledge of the mode of formation of the gel ores.

Gel Ores Produced by Descending Solutions

Up to the present, unimpeachable results have been obtained only with the gel ores produced by descending solutions. Hydrosols are produced by the processes of weathering, and from them the gel ores originate. All the ores cited by Cornu are of such surficial origin. They are particularly common in the zone of oxidation, but are not, however, as Cornu assumed, restricted to that zone. Cornu's results can be stated summarily thus: Gel ores are amorphous oxide or hydrate ore-masses; they the of earthy, ocherous, or partly consolidated struc-

ture, and are restricted to the zone near the earth's surface.

The newer investigations are concerned mainly with the question of the depth at which these gel ores occur. The answer depends closely upon what changes occur in a descending solution that originated in the zone of weathering. In this connection it is necessary to distinguish in general between non-sulphide and sulphide ores. No easily reducible solutions will be found from the former; the most important distinctive criterion between the heavy-metal solutions in the zones of oxidation and cementation fails; there is absent, moreover, the reducing action of the primary sulphides that is absolutely essential to the processes of cementation. The properties of the solutions, however, remain unchanged in essence. The secondary transposition of metals can react at least down to ground-water level. In those regions which have undergone elevation as the result of tectonic causes and in which, therefore, the ground-water level has been relatively depressed, a very considerable vertical range may be brought about in an ore deposit throughout which rearrangement may take place. Inasmuch as in the case of gel ores originating from non-sulphide deposits the destructive action of high acidity of the solutions can not come into play, they may be formed throughout a very considerable vertical range.

Sulphide Orebodies

The conditions are more complicated in the case of orebodies rich in sulphides. In these, as for example, at Rio Tinto, there is a concentration of great masses of sulphur. If the total amount of sulphur, which upon weathering passes over into sulphuric acid, were to remain in the ore deposit, then the probability of the gels remaining undestroyed would not be great on account of the extreme acidity. Enormous masses of gel iron ore are nevertheless found in the gossan of these deposits. Great quantities of sulphuric acid have in fact been carried away. Sulphates are present in minute amounts only. The removal took place surficially, for the sulphur has remained intact at small depth. Proof of the action of acid is found in the signs of corrosion of the wall rocks, which now commonly consist of a skeleton of quartz.

Only a small part of the sulphate solution penetrated the orebody in depth and was reduced in the well known way by the undecomposed primary sulphides. To what depth is this gel ore, which is in fact exclusively iron gel ore, found? Only as deep as the action of oxygen is effective; in other words, they are restricted to the zone of oxidation. According to present knowledge, no gel ores are associated with typical cementation ores. The acidity of the descending solutions was probably too great for the preservation of the gels.

Finally, certain peculiar ore transformations, which persist to notable depths in the siderite veins of Siegerland without showing any evidence whatever of accompanying intensive processes of alteration, demand explanation. They are the development of metallic iron and specular hematite in fresh siderite. Bornhardt explained this in his monograph on the veins of Siegerland (1912) as having been produced by reagents that penetrated the veins from the surface. In times of great aridity, as in the Permian, concentrated salt solutions were formed at the surface, and because of their high specific gravity sank down along fractures to considerable depths, exerting an oxidizing action by virtue of their absorbed oxygen. The author himself points out that the absence of any residual salt solutions of such a character is noteworthy.

In opposition to this hypothesis I have adopted the opinion of Wölbing, according to which the hypothesis of colloidal solutions is more probable. This would explain the extraordinary phenomenon of the complete absence of any products of oxidation, which, if Bornhardt's assumption is correct, ought to be present in so easily oxidizable a substance as siderite. The oxygen-bearing colloidal solutions have, on the other hand, the peculiarity that they do not give up their oxygen to the older ores.

Not only does circulation of the solutions take place in such processes along fissures, but there is also an extensive permeation of great masses without large open spaces. The alterations then take place, not in vein form, but in pockets which apparently stand in no relation to fissures. Such permeation by solutions of higher specific gravity, sinking from above, may persist down deep below the ground-water level. Gel ores may in such cases be found in the primary zone hundreds of metres below the ground-water level; the depth to which they may extend depends principally on the specific gravity of solution.

The gel ores are not restricted to proximity to the surface of the earth, where they are most common, but also occur at considerable depth. They are most common in the zone of oxidation, but may also form within the primary zone.

Gel Ores Deposited by Ascending Solutions

Up to the present time I know of no unimpeachable example of the origin of gel ores by ascending solutions, and can therefore only discuss the possibility of their occurrence. The conditions obtaining during weathering are most favorable for their development. These include low temperature, low pressure, presence of oxygen, and others. Ascending solutions practically never possess these properties at any considerable depth, but only after they have come in proximity to the surface, where they have become influenced by the surface and the conditions existent there. In depth, therefore, the conditions are unfavorable for the formation of gels.

The theoretical possibility of the formation of gels from ascending solutions, however, is not to be denied. In this connection experiments conducted by Wölbing, of the Berlin Mining School, are highly instructive. He has kept a silicic acid gel, prepared by the action of hydrochloric acid on a sodium silicate solution, for several years at a temperature between 80 and 100°C.; it still preserves its gel character, although a certain splitting off of water has taken place. The proof is thereby furnished that certain gels may persist at a high temperature during a considerable time. The dura-

tion of the experiment is, of course, short in comparison with the history of the earth, and the temperature small compared to those prevailing at great depths.

Further, many gels may be formed at 100°C., but all, in particular the sulphide gels of the heavy metals, have the tendency to pass rapidly into the crystalline state.

The influence of pressure on gels, which is also an important factor in ascending solutions, has not been sufficiently studied experimentally. The experiments carried out by one of my students, Mr. Nicolai, show that the highest pressures attainable in the laboratory were insufficient to cause crystallization. In all experiments there is, above all things, one factor absent, which nature—and only it—has at its command, namely, geologic time.

Our present knowledge concerning gel ores formed by ascension may therefore be summarized thus: not one example is known and the conditions obtaining at depth are unfavorable to the formation of gels.

Are There Primary as Well as Secondary Gel Ores?

The terms primary and secondary ores here demand explanation. Primary ores are (a) those of original concentrations; (b) those newly developed by younger ascending solutions (internal metasomatism of ore deposits in part). Secondary ores originate exclusively from descending surface waters (internal vein metasomatism in part). Cornu recognized only the secondary gel ores.

In earlier papers I have already pointed out that there are also primary gel ores; for example, the ores of iron and manganese. Bauxite, which is generally produced by the replacement of limestone by solutions originating by weathering, also belongs to this class. In the primary ores of gel character, I must place also certain lateritic products in which such notable accumulations of iron ore occur that they have been deemed worthy of exploitation. I know of such deposits in Europe occurring at Jerzu in eastern Sardinia. Novarese of Rome called my attention to these highly interesting deposits. In these cases the processes of weathering alone bring about the concentration, and because the gel ores thus formed are original deposits, they must be regarded as primary.

The genetic conditions are somewhat different in the case of the silicated nickel gel ores, which must also be considered as primary. They are the finest example of lateral secretion in the narrower sense of that term, and originated, so far as detailed investigations at hand show, through weathering. At Frankenstein, Beyschlag and I were able to verify this genesis. Whereas, in the examples previously cited, the solutions have effected a concentration of ore only near the surface, in the nickel ores the action has taken place in depth, so that an intense alteration of the serpentine has ensued along fissures extending from the surface to considerable depths. This phenomenon is excellently shown at Frankenstein, where quartz and chalcedony veins traverse the serpentine. The deposition of the nickel gel ores took place in the form of veins, or as highly irregular impregnations that end downward with a trough-like form. The nickel content was originally held in olivine as a silicate, but this mineral can not therefore be called 'ore', and even during serpentinization no concentration of nickel took place. Furthermore, nickel is not—as assumed by many investigators—the most easily extractable constituent of serpentine; at Frankenstein I was able to obtain proof that the extraction of magnesite takes place considerably earlier. Later, under the influence of surface waters, the nickel-bearing solutions are formed, and from these the nickel ores are deposited. We must regard them as primary ores, which occur as a rule in the form of veins.

From these considerations it follows that primary gel ores may constitute workable deposits, and may even have been formed in close proximity to the surface or by descending solutions.

This result justifies the following conclusion: The gel ores, being products of weathering, must be subject to climatic control; that is, their composition, in deposits of recent origin, must stand in relation to the degree of latitude. I recall on this point the difference between our iron ores and laterite of the tropics in respect to the aluminum hydrate content; with the former it is almost exclusively enrichment of iron, and with the latter simultaneous bauxitization. A more careful and critical comparison of the composition of primary gel ores that have originated under different climatic conditions would yield results of great importance.

Origin of the Sulphides and Ores Rich in Heavy Metals

As is generally known, many of the heavy metals, for example copper, silver, and gold, form under favorable circumstances abnormally rich ores, associated with those of ordinary metallic content usually found in primary deposits. These are best known from studies of zones of cementation. These super-rich ores fall into three groups: (1) the rich sulphides, etc., of the heavy metals, such as argentite, pyrargyrite, covellite, bornite, chalcocite, etc.; (2) the native metals which have a weak affinity for oxygen, such as gold and silver; and (3) mixtures of the latter with the normal sulphides of the heavy metals, such as gold and pyrite, silver and galena, pyrargyrite and galena.

The genesis of these three groups is not exactly the same: the rich sulphides, as can be established unquestionably in thin section, commonly coat the older normal sulphides, whose fractures they also fill. In a later stage they completely replace their hosts, so that there is finally produced a rich sulphide whose metasomatic origin by cementation is only to be recognized under favorable circumstances during high magnification by the presence of mesh-structure or minute remnants of the older normal sulphides. If one has luck with the sections employed, all the transitional stages may be observed between thin coatings and the filling of cavities in the normal sulphides, through all possible stages of metasomatism to the massive bonanza ore, which no one without further investigation would regard as the product of metasomatism.

Particularly interesting phenomena were discovered by me in thin sections of copper ores. In most deposits the primary copper ore is a cupriferous pyrite or a mixture of pyrite with minor amounts of chalcopyrite. In the zone of cementation there is first produced, as a rule, rich chalcopyrite by metasomatism of the mixture, bornite in the next stage of transformation, and finally chalcocite; in other words, a series beginning with the ores poor in copper and ending with those rich in copper. During each replacement the solutions had to give up copper and take in sulphur. During this process there is not only a free circulation of the heavy-metal solutions in fissures and cavities, but there is also a permeation of large masses by solutions and the displacement of specifically lighter solutions by specifically denser.

Native Metals

The native metals with weak affinity for oxygen, constituting the second group, form especially fillings of cavities and occur as coatings on non-metallic minerals as well as on rocks that occur as gang material in the ore deposits. I have been unable so far to establish any instance of replacement of the host; the association with iron gel ore is, however, common, as this ore generally occurs on the boundary between the zones of oxidation and cementation.

The third group consists of mixtures of native metals with the normal heavy-metal sulphides, among which the commonest are gold with pyrite and silver with galena. For these also, I found in numerous thin sections only coatings and cavity fillings of the precious metals.

The last two observations concerning the absence of metasomatic processes are not to be taken that I deny the possibility of their occurrence; in any case, the evidence seems clearly to be that in these two groups metasomatism has not by far the importance it has in the genesis of the rich heavy-metal sulphides.

Origin of the Rich Secondary Sulphides by Descension

The principles of the origin of descending solutions of the heavy metals and their reduction by the primary metallic sulphides in the zone of cementation is today the common property of all economic geologists. The number of investigators who have concerned themselves with this question is too great for me to enumerate here. I will not neglect to point out, however, that de Launay belongs to the pioneers whose works have inspired my investigations, and that many a new path has been indicated by excellent learned men of this Continent. Nevertheless, the subject is far from exhausted.

I would like to discuss at this point the following questions that call for further explanation:

1. To what depths do such compounds occur?
2. Of what importance are tectonic features?
3. What is the influence of climate, denudation, etc.?
4. How is their formation adjoining fissures at great depth to be explained?

1. General experience shows that oxidized ores are formed as long as oxygen is present, and that the ores of cementation are formed somewhat lower down by reduction of the sulphides. As a rule, it is assumed that these transformations are brought about solely by solutions moving downward through open spaces, and it is customary, therefore, to regard the ground-water level as the lower limit of such transformations. Although oxygen is without question most essential for the production of oxidized ores, and its utilization precludes the further formation of such ores, the lower limit of the zone of cementation, on the other hand, is in need of revision. Not only circulating solutions, but also permeation play a rôle in ore deposits. Even if there are no large cavities in an orebody, circulation of the ground-water takes place, and the specifically lighter solutions are displaced by the specifically heavier. The solutions of heavy metals sinking through an orebody may therefore descend below the ground-water level, and may there, for example, produce metasomatic replacement of the primary ore.

Inasmuch as the displacement of a solution by a heavier one is a much slower process than circulation in open spaces, the ground-water level plays an important part in so far as it represents the lower limit of rapid alteration of the orebody which is being altered. It is not, however, the lower limit of alteration.

Tectonic Features

2. The tectonic features and ground-water level are intimately related; in fact, every structural dislocation causes a dislocation of the ground-water level. The dislocations may take place more or less rapidly. Secular elevation and depression cause slow but very considerable relative elevation and depression of the ground-water level; tectonic troughs and hursts usually bring about more rapid variations. The dislocations influence the open circulation of the solutions descending in ore deposits and thereby the minerals formed from them. Notable differences from normal phenomena can only be explained, however, when the tectonic features of a region have been thoroughly elucidated. It is, for example, of no avail to discuss the genesis of the rich silver ores of St. Andreasberg, which persist down to considerable depths, so long as it is impossible to determine whether the wedge lying between the two bounding shear zones—the tectonic block in which the silver veins all occur—is as a whole an elevated or depressed area. My conclusion is that the occurrence of cementation ores in depth points to depression; that the case is analogous to that at Butte, Montana.

3. The dependence of the secondary transfer of metals on denudation is generally recognized; the intensity of denudation determines the amount of oxidation and cementation ores. On the other hand, the differences in the development of the zone of oxidation due to climatic differences have not been adequately studied, as I have already pointed out. Careful investigations in this field would lead to important results, provided that genetically coeval deposits in different latitudes are compared in this respect.

Influence of Climate

As the intensity of denudation is determined by climate, these two factors can not be separated. The absence of notable oxidation processes at the Norwegian pyrite deposits, on the one hand, and the great development of gossan on the genetically coeval pyrite bodies of the Sierra Morena of Spain and Portugal, on the other, is not determined alone by the great difference in temperature, but in marked degree also by the difference in denudation. In Scandinavia glacial abrasion did not allow the accumulation of any large masses of oxidation products, whose development was further not favored by the low temperature; in Spain oxidation processes, favored by the higher temperature, have been but slowly disturbed by denudation.

4. The occurrence of typical oxidation and cementation ores in the primary zone has in particular instances aroused great interest. The occurrence of cementation ores in the primary zone is known to obtain where the secondary migration of metal has not yet progressed down to the ground-water level. Because of the changes of volume accompanying the cementation processes, fissures penetrating the primary ore are formed, along which the heavy-metal solutions descend; the cementation ores hence originate from descending solutions.

I have already alluded to the fact that cementation ores may form below the ground-water level, by the permeation of the primary ore and the concomitant displacement of the ground-water originally held by it. Investigations in Siegerland have shown that the new development of minerals need not take place in regular fashion, but may be localized in geochemically favorable situations. In this way are produced in the midst of unaltered material transformed masses without visible supply channels.

Oxidation and cementation ores may occur in systematic arrangement within fissures, which from some cause or other—commonly tectonic—have formed in the wall rock and have penetrated into the primary zone. The ground-water may be influenced in such a way by this fissure that the wall rock adjoining the fissure becomes dry. If subsequently meteoric waters penetrate the fissures to the dry zone, then their action will be like that of the atmospheric agencies. As long as oxygen is present, oxidation ores will form along both sides of the fissure and after depletion of the oxygen cementation ores will be produced at a somewhat greater distance. If the solutions were deficient in oxygen or carried heavy metals, then cementation ores alone would be formed. Processes of weathering can therefore take place under peculiarly favorable circumstances at considerable depth.

Origin of the Primary Ores of the Heavy Metals by Ascension

The studies concerning the metallogenetic type ores of the oxidation, cementation, and primary zones have considerably enlarged our knowledge of the occurrence of a great number of oxidized and sulphidized ores. A large number of laws are recognized that are not only important to science, but which in practice are invaluable in the examination and valuation of ore deposits. As I have gone into this subject at another place, I will not occupy myself with the possibility of the formation of rich heavy-metal sulphides under such circumstances that they must be considered primary.

Genesis of Rich Sulphides

The generally recognized essential factors in the genesis of rich heavy-metal sulphides in the zone of cementation are heavy-metal solutions free of oxygen on the one hand and reducing normal sulphides on the other. According to present experience, the active solutions are descending solutions, but the direction of flow should be without influence on the process of the formation of the minerals.

In what cases of primary ore formation do the two conditions cited above obtain in ascending solutions? I know of but two, namely: (a) mineral solutions that are ascending in consequence of the reopening of a vein; (b) mineral solutions in fissures that intersect older veins or other orebodies carrying sulphides. The highly important vein intersections belong to the latter class. As in both cases younger heavy-metal solutions come in contact with older reducing sulphides, the generation of rich heavy-metal sulphides is to be expected, and it is known, for example, that the intersections of veins are commonly notable for the richness of their ore. If, however, the mineralization of whole districts whose veins are characterized by the reopening of the older fillings is examined more carefully, noteworthy discrepancies become apparent. The first filling of the veins of Siegerland and the Rhine region is, as a rule, siderite carrying a small quantity of pyrite; in a later stage of vein formation the siderite was commonly replaced by quartz, and subsequently both were replaced by galena and sphalerite. Although the galena of the Rhenish veins is argentiferous, I have never been able to find on the pyrite any cementation ore of silver, but only common galena such as is characteristic of the primary zone.

The Rhenish Schiefergebirge Veins

In some of the veins of the Rhenish Schiefergebirge copper-bearing solutions followed their reopening; pyrite was formed such as is common in the primary zone, but the rich copper ores typical of the zone of cementation such as bornite and gray copper are not to be found, although they are abundant in the zone of cementation of the Rhenish veins. The conditions prevailing during that process must, therefore, have been different from those obtaining during cementation. This calls for further investigation.

The second development of minerals at the intersection of veins unquestionably produces some ores that resemble those of the zone of cementation. The richness in silver of many of the Freiberg deposits at vein intersections and the increase of precious metal at the intersection of gold veins is well known. But even in these cases the ores, on the one hand, have not the features of those typical of the zone of cementation, and, on the other, there is a noteworthy massing of minerals at vein intersections

that are not characteristic of the zone of cementation, such as galena, sphalerite, pitchblende, etc.

A similar state of affairs obtains when heavy-metal solutions of deep-seated origin and carrying no free oxygen come in contact with other reducing ore-minerals. Nautan in Lapland, Grasslitz-Klingental in Bohemia-Saxony, are highly instructive examples. At Nautan, copper-bearing solutions penetrated beds carrying magnetite and deposited chalcopyrite; at Grasslitz the older metallic sulphides, especially the pyrrhotite, acted as precipitants upon younger copper-bearing solutions, so that chalcopyrite was formed as blebs and impregnations. Neither bornite nor chalcocite was produced by these ascending solutions.

Primary Bornite and Chalcocite

I come now to the question of whether primary bornite and chalcocite occur at all. In the literature there are found references to such deposits; for example, those of southern Norway and South Africa. In such matters, however, much depends on who was the investigator; the results can only command the fullest confidence when the geologist has had the necessary experience in the problems of metallogenetic type ores, one of the most difficult in economic geology. Even then, microscopical examination alone is insufficient; the examination in thin section is absolutely indispensable. In this way I found that a south Norwegian chalcocite, apparently massive, showed nuclei of bornite when examined in thin section; the proof was thereby furnished that chalcocite was at least not an original ore, but that it had developed from bornite. Concerning the genesis of the bornite, the investigation is not yet complete. In all the occurrences of bornite and chalcocite personally examined by me, which my colleagues reported as probably primary, I could in all cases demonstrate their secondary origin; I am therefore extremely skeptical concerning all statements of the primary occurrence of these rich copper sulphides.

The reason that ascending solutions deposit in general sulphides poorer in the heavy metals than do the descending, must be sought in the different geochemical conditions prevailing during ore deposition; ascending solutions are commonly under high pressure, have a high temperature, and are as a rule extremely dilute; descending solutions, in contrast, have approximately the average temperature of spring water, are under ordinary pressure, and, because in constant contact with heavy-metal compounds, are relatively concentrated. The three last conditions must be more favorable for the production of heavy metal sulphides than the first mentioned.

Value of the Examination of Thin Sections

The significance of investigations by means of thin sections and their importance in the determination not only of scientific but also of important practical matters, is apparent from the previous paragraph. The credit of first pointing out the value of the microscope in the study of ore deposits belongs without question to Beck. In the last years the microscope has been employed more and more and is today an indispensable aid for the science of ore deposits. At present the examination by reflected as well as by transmitted light is inadequate; the diagnostic properties of the various ore minerals are known to but a limited circle of investigators. But it can already be surely foreseen that within a short time there will be elaborated a special petrography of ores which will build upon the methods employed in the microscopic investigation of rocks and metals.

Tube-Mill Liners at the Morro Velho Mill, Brazil

*The No. 6 Davidsen mill had extensive repairs, and new shells have been supplied to two others during the past fiscal year. On the whole, however, the plant has not been so troublesome as in previous years. The two new Chalmers & Williams mills arriving will be erected as soon as possible to do away with the old mills, which would otherwise have to undergo some extensive repairs if they were to continue working. The new mills are directly driven, and it is hoped they will show a considerable economy over the existing plant, which, it will be remembered, was nothing more than an experimental one. The fluted linings of manganese steel put in during December 1911, for the purpose of ascertaining if this hard but expensive metal would prove cheaper than the chilled iron cast locally, still appear to be in perfect condition. The wear has been exceedingly small, the ribs retaining their shape, which is not the case with the chilled metal, consequently the pebbles remain in place and the grinding effect of the moving stone is mainly borne by the pebbles and not by the metal. By appearance it would seem that the linings would last as long again as the period they have been working. Assuming this, the following comparison is possible: Manganese steel, life 952 days, costing 94c. per day, and chilled iron, life 289 days, costing $1.82 per day.

This leaves little doubt that the manganese steel is the right metal for the linings, and in the case of the rock-crusher jaws the comparison is even more favorable, but used as dies for the stamps it has not done so well. Further experiments will, however, be tried. Hard rock for the mills is secured nearby, and occasionally contains gold.

Mining concessions held in Korea at the end of 1912 totaled 646 lode, and 278 placer properties. The value of the exports of mining products from the territory during 1912, according to the report of the Mining Bureau, of the Government was as follows: gold, $4,689,285; silver, $16,000; copper, $1531; iron, $155,221; graphite, $82,309; coal, $166,522; total $5,110,868.

Coal shipments from Newcastle, New South Wales, Australia, during the first half of 1913 totaled 2,307,998 tons, valued at $6,171,700. This is an increase of 89,396 tons and $568,710 over the same period of 1912.

*Abstract from annual report of the St. John Del Rey Mining Company.

Metallurgical Tendencies in Western Australia

By W. A. MacLeod

*The following remarks on the above subject are prompted by the recent criticism on Australian progress by H. T. Brett, who lately revisited Kalgoorlie after several years' absence.

Before touching descriptively on some of the recent installations, I will first record on technical matters generally a few scattered impressions tending to show a most healthy state of progress in gold milling in this state.

Power

Reviewing the different power plants, I notice three distinct stages in the development of this most important matter. In stage one are complete modern types of steam plant, with all the necessary auxiliaries; in stage two, the gas producer operating on charcoal fuel; and in stage three the gas producer operating on wood fuel. When I say—and all figures substantiate the statement—that the costs by this third system are nearly one-half of those by the first,

CONCENTRATE ROASTING AND VACUUM-FILTER PLANTS OF OROYA LINKS COMPANY, KALGOORLIE.

it must be admitted that here at least are symptoms of a healthy progress, and I take no risk in prophesying that the next few years will see further great strides in this same direction. The installation of producers burning the wood direct, without the intervention of the old type of charcoal kiln, has been a great step in advance from the power point of view. To those acquainted with Westralian conditions, the position will be fully appreciated when I say that the total cost for power (including fuel, water, wages, and all sundries), on a 6000-ton all-sliming plan basis, is now 22c. per ton.

Grinding

Following the ore in the process of treatment, I have some comment to make in connection with the grinding-pan section. Within the last three years the ordinary 5-ft. grinding pan, by the addition of the Freeman pipe-classifier evolved at the Great Fingall mill, has been so altered that it now occupies a unique position as a secondary crusher. This classifier automatically removes an even graded finely ground product, and admits of a great increase in feed of coarse crushed ore to the pan. Following the principles of stage crushing, this pan occupies most fittingly the position intermediate between the stamps and tube-mills. I am not attempting at present to define the exact scope of the pan as contrasted with the tube-mill, but simply wish to point out that in pan practice a decided advance has been made by the use of the classifier referred to.

Classification, Thickening, and Filtration

Two plants in Western Australia recently erected by Bewick, Moreing & Co. have been so designed that the sand is first removed from the pulp by cone classifiers, the overflowing slime being separated by mechanical thickeners, and the sand, after being continuously agitated, rejoins the slime, both being then treated together in the one vacuum vat. These plants are not all-sliming, but carry out in practically one operation the dual requirements of slime and sand treatment, thus marking a distinct step in advance in treatment methods, the whole of the attention being confined to one point, minimizing the cost of equipment and running costs necessary with separate sand and slime treatment when these are deemed advisable.

The mechanical thickener referred to replaces the extensive nests of spitzkasten and other settling tanks formerly used for settling the slime and obtaining a clear overflow. It achieves the same purpose as the Dorr mechanical thickener used in other countries, is of simple construction, and can deal with clayey ores which otherwise would be almost impossible to settle thoroughly. The adoption of the mechanical thickener results in a great saving of water, and permits of continuing slime treatment. There is considerable improvement in classification of pulp at a number of mills. These remarks apply to the Lake View and more particularly to the Oroya Links (old Oroya Brownhill) mills, where a perfect system of classification is in use, and where concentrating practice is carefully attended to in principle and detail.

An inspection of the different vacuum-filtration plants shows that during the past six or seven years many improvements have been made in this direction. The original type of stationary vacuum-filter has been improved into the present up-to-date gravity or pump-filling types of West Australian vacuum-filter; and, further, the most recent development evolved at the Great Boulder has been the perfecting of the automatic Ridgway machine, which is now being used on many mines with great success. With this plant it is impossible for a careless operator to discharge unfiltered pulp, and stoppages of the power plant do not cause loss of pulp and unwashed cakes. The power consumption is lower than formerly, and, perhaps most important of all, the soluble gold loss is reduced to a minimum.

Some Recent Westralian Plants

In his comments, Mr. Brett proceeds to outline roughly some of the recent installations in South Africa and Rhodesia. It will be interesting, therefore, to consider some of the more recent installations in Western Australia.

*Abstract from the *Kalgoorlie Miner*.

In dry crushing, the Great Boulder Perseverance plant may be taken as a model from many points of view, and today stands as a type of excellent practice in this direction. It is a pleasure to add that the dust trouble has been greatly minimized, formerly considered an inherent and necessary evil in such plants.

The Oroya Links

I have already mentioned the Oroya Links in connection with its classification system, and it also calls for comment on account of its low working costs, about $3.84 per ton, which includes mining from a considerable depth in four distinct properties covering a longitudinal extent of nearly one mile.

Another most interesting example of advance in design of plant is that of the Victorious mine at Ora Banda, treating about 9000 tons per month at a cost of about $2.52 per ton. This plant is gas driven, consists of five Huntington mills, and Ridgway filter plant of three units. The costs are the more noteworthy as the bulk of the ore is obtained from ordinary stoping operations, and not open-cutting.

At the Mountain Queen, Bewick, Moreing & Co. have erected a gas-driven plant with Holman stamps and West Australian type of vacuum-filter, treating 5000 tons per month. On this small tonnage working costs of $3.36 per ton must be regarded as exceptionally low and indicative of great advance in methods of treatment. Here again the greatest part of the ore is obtained by stoping, the balance by open-cut work.

Quite recently the same firm has erected at the Queen of the Hills, Meekatharra, a similar type of plant, which, like that of the Mountain Queen, is of the combination type, treating sand and slime in the one vacuum unit.

As showing the great variety of practice, it is interesting to remark that the same firm, at the Yuanmi mine, installed a 20-stamp mill, all-sliming, with vacuum-filtration, the power plant being of the down-draught wood-gas type.

As another illustration in a different direction, I would refer to the Bullfinch plant, which is electrically driven. This plant consists of 20 stamps, tube-mills, and Ridgway filters.

Sons of Gwalia

Bewick, Moreing & Co. are now undertaking the remodeling of the Sons of Gwalia plant, with a capacity of 13,000 tons per month. The steam power plant for treatment is being entirely converted into down-draught wood-gas plant of the 'Commonwealth' type, and the method of treatment changed to all-sliming. This plant, when the alterations are completed, will typify the most recent advance in power and metallurgical practice.

The superintendent of the Gwalia Consolidated (under the management of the before-mentioned firm), has during the past six months been evolving a working plant for the extraction of gold by volatilization. The results of two-ton test samples were so satisfactory as to warrant the installation of a working unit, which is now complete, and it is anticipated that the results by the smaller test samples will soon be confirmed on the larger scale.

I think I have now adduced ample evidence to convince anyone who will take the least trouble to look into the matter that on comparing the gold-milling practice of seven years ago with that of today, many advances have taken place, and that the engineers responsible therefor have worthily upheld the status of the industry.

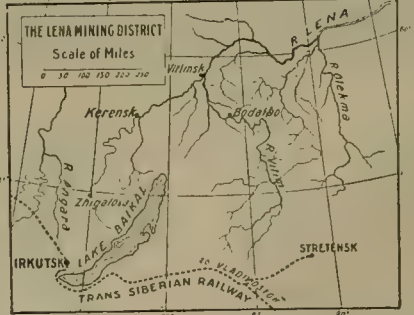
I was pleased to note in Mr. Brett's remarks that he referred to one mine in Rhodesia which was to be equipped with a large plant on West Australia lines, dry crushing, roasting, and cyaniding. I also noticed two references to installations of flotation processes, one referring particularly to the Minerals Separation. Although Mr. Brett's casual review of the position seems to have impressed him with the want of progress in gold mining generally, still it is gratifying to know that he evidently recognizes the advances made in Australia in flotation processes, of which Broken Hill is the home.

Mr. Brett mentions the case of the Shamva mine, a large low-grade property, worth $4.80 per ton. The plant on this property, when complete, will treat 50,000 tons per month, or nearly 2000 tons per day, and the cost of mining and treatment he estimates at $2 per ton. This at first sight appears, and no doubt is, excellent work, but it must be remembered that a similar property in Western Australia could be operated on practically the same figure, for we are already operating on tonnages of from 150 to 300 per day at a cost of $2.40 to $3.36 per ton.

Placer Mining in Siberia

The following interesting figures are taken from the last annual report of Lena Goldfields, Ltd., operating in Siberia:

During the fiscal year 1911-12 there was mined 549,244 cu. yd. of gravel averaging 9.486 dwt. per cubic yard, as against 861,438 cu. yd. averaging 10.002 dwt. in 1910-11. The total production of the different groups of claims worked, to October 1912,



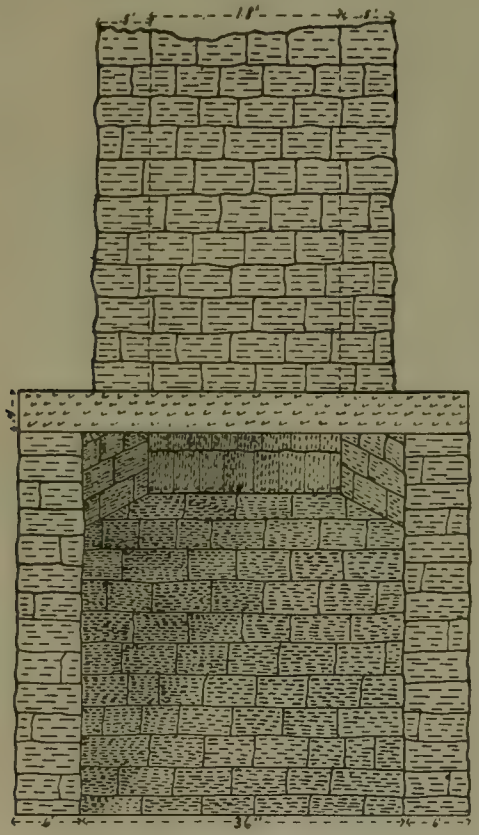
is given as 4,411,163 oz., valued at $79,584,000. In the Dogaldin property, 14 drill-holes were driven, and, according to the report of Charles M. Rolker, there is a gravel channel 210 ft. wide and 7 ft. deep, and may continue for 430,800 ft. in length. Reserves of gravel in a total stream length of 31,731 ft., in groups two and four, are 2,857,774 cu. yd., containing 1,162,945 oz. gold, which will leave a net profit of 266,031 oz. Costs in 1910-11 averaged $6.10 per cubic yard. About 5000 men are employed at the Lena Goldfields at the present time.

A Good Fireplace

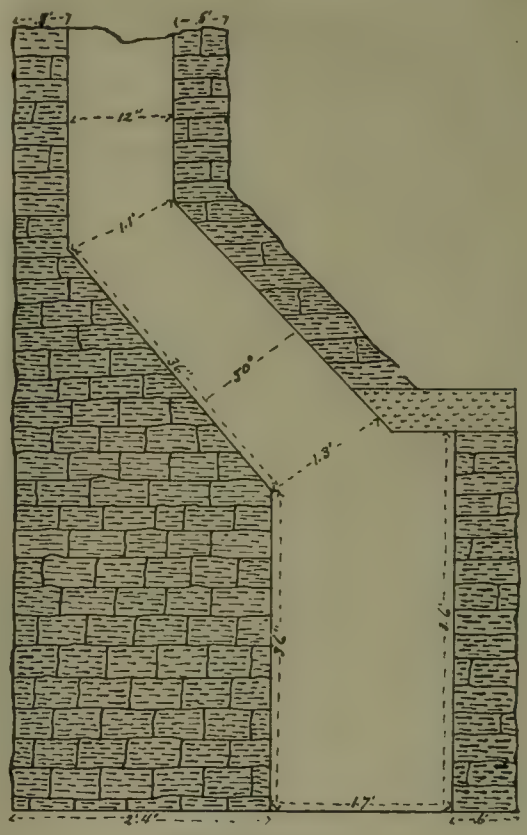
By J. D. Hubbard

Many times, on my journeys, when enjoying the hospitality of some miner, I have been asked: "Do you know a plan for an open fireplace that won't smoke?" I do, and here it is.

There are some human comforts in common to all and within the reach of everyone, and an open fireplace is one of them. Back in 1906 I was a member of the good old Bachelors' Club of Goldfield in the days when hope ran high and Ananias was obliged to hide for shame. In the large and comfortable dining and living room of the Bachelors' Club, when the last of the furnishings had been removed from that famous 'round table' to the domains of our most excellent cook, the 'grass' bachelors would gather around that famous fireplace, and with pipe and yarn pass a pleasant evening. Be it known there were two kinds of bachelors in that club. Some of them lived like comets, ate like ostriches, and slept like elephants, always fearful of 'missing something' on the street. They are nearly all dead now, I believe. But others of the type of placid 'Dad' Stewart were generally to be found around that fireplace in the evening. No matter if the wind blew from north, south, east, or west, that fireplace behaved itself, and only smoked from the top, which was right and proper. The original designer of the fireplace is unknown to me, but he knew his business.



FRONT ELEVATION.



SIDE ELEVATION.

That fireplace grew upon us so that I sat down one day after lunch with Charlie and George Kaeding, and we made measurements and drawings of it. Since then I have built several according to this plan and they were all successful.

But, in using the plan, be not like Fletcher's Chinaman out in Korea. He (the Chinaman) was shown the plan and ordered to build the fireplace. "Uh-huh," he grunted, and then proceeded to insult that plan, or rather the plan passed out of his mind entirely and he proceeded to build as his forefathers. The blueprint had about as much significance to him as the vertical projection of Halley's comet. When Fletcher's nice new paper was all spoiled by the smudge arising from the first 'blowing in', he sought me and made sundry personal remarks. According to the Oriental mind, a fireplace is no good unless it smokes all over, and the 'Chink' was proud of his success. On investigation I saw what was wrong. I again referred to the plan and asked Fletcher if he thought the result was justified. Fletcher looked at the plan, at the fireplace, and then at the grinning Chink, who built worse than he knew. I had to stop up my ears—and never saw that same Chink again. He has probably hid somewhere out in the Gobi desert.

Stick to the plan and you will have a fireplace that will cheer the heart and make the old pipe taste better.

The metric system is now in use in the Dominican Republic.

Discussion

Readers of the MINING AND SCIENTIFIC PRESS are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment. Insertion of any contribution is determined by its probable interest to the readers of this journal.

Mining Schools and Politics

The Editor:

Sir—In a recent number of the *Mining and Scientific Press* I saw an editorial on the relation between state schools and politics, in the course of which you took occasion to quote the Governor of Colorado as finding fault with the absence of members of his party on the faculty of the School of Mines of Colorado. From what I have seen of Governor Ammons, I was convinced that you had done him an injustice, and I called the matter to his attention. I am just in receipt of the enclosed letter from his Secretary, and I trust you will see your way clear to at least retract the statement made. I believe the Governor is a sincere friend of this school, and is far above taking such a position as indicated by your statement.

CHARLES A. CHASE.

Boston, August 25.

The letter referred to follows:

"State of Colorado: Executive Office.

"Denver, August 18, 1913.

"Charles A. Chase.

"Dear Sir—The Governor asks me to thank you for your letter of August 16, enclosing the article from the *Mining and Scientific Press.* He made no such statement as is credited to him in this article. It would perhaps be well to have the impression this article conveys corrected. The Governor thanks you for your interest in the matter.

"C. W. FAIRCHILD."

[We were in error in attributing this statement to the present Governor and regret greatly the slip that imputed it to him. Our own statement was made on the faith of an eminent and well informed engineer, but it should have applied to Mr. Ammons' predecessor in the chair. We are glad to learn that the present Governor is a friend of the School of Mines, and we hope he will make his influence felt for the good of the institution.—EDITOR.]

Ore

The Editor:

Sir—T. A. Rickard has defined ore as "metal-bearing rock, which, at a given time and place, can be exploited at a profit." Let me set that down as an opening statement. Next let me call attention to the fact that Mr. Rickard is the editor of a book entitled 'A Guide to Technical Writing' in which precision of language is strongly advocated. We know that the controlling spirit of your valuable paper generally practises what he preaches. The reprint of his lecture on 'The Valuation of Mines' is really too good an opportunity to be allowed to pass unnoticed. (It is not often that we get a chance of putting one over on T. A.) Bearing in mind his definition of ore, are we to assume that he is redundant in the second paragraph of his lecture, when he states that "we may define a mine as an excavation that yields profitable ore"?

In using the expression "profitable ore", Mr. Rickard is true to himself; he has used the correct expression to describe the commodity.

In the definition quoted above, he has joined forces with a great many other people who are assuredly trying to lay down a law which can never be accepted by the profession in general nor come into general use. The standard of profit is not the measure by which we know ore. The general acceptance of the term must always largely be governed by its geological significance, and while the question of profit does, and always will, enter into our use of the term, because all mining operations are carried on with a view to making a profit, at the same time, using the word in its commercial sense, we must remember that not all businesses are carried on at a profit, despite the desire to do so. There is no more reason why the word 'ore' should be limited by the temporary state of the 'profit and loss' account, any more than the commodities dealt in by the grocer, butcher, or other tradesman, should be limited in the same manner.

There is no gainsaying the fact that Mr. Rickard is one of the greatest exponents we have on the correct use of English, besides which he is a sturdy champion of the standard of profit-meaning for the word 'ore', and in the lecture above quoted, in several places he finds it necessary to qualify the term in a manner to make it intelligible.

His illustration of the ore at Earlston shows the impossibility of his making even himself clear by a striking adherence to his definition of the word 'ore.' The stuff at Earlston should be waste if his definition is right, but I submit that the substitution of the word 'waste' for 'ore', wherever it occurs in his description of the Earlston deposit, would leave most of his readers entirely in the dark as to what he was talking about.

At the top of page 769, he says: "The same *ore* in California or New Zealand on the basis of a correct sampling, would afford the making of a mine; in the desert of West Australia at that time it assured a first-class financial funeral."

There can be no doubt that if we continue to use the word 'ore' in the way we are in the habit of using it and the way Mr. Rickard has used it in 'The Valuation of Mines', and classify it as profitable, or unprofitable, as the case may be, no confusion can arise.

CHARLES S. HERZIG.

London, June 28.

The Editor:

Sir—Mr. Herzig's humor is not lost. To the serious side of his criticism I have this to say. The use of 'profitable' in connection with 'ore' is redundant to those who use the word in accordance with my definition, but all do not do so, and it is permissible to be redundant in the effort to be explicit. It is better to be redundant than to be misunderstood. In the definition of a mine as "an excavation that yields profitable ore," the word

profitable is also emphatic, in order to distinguish a mine from a hole in the ground which is fit for the last resting-place of a dead mule. By perversity and ingenuity combined it is possible to ridicule any definition. I challenge Mr. Herzig to proffer a definition of 'ore'; if he will, I can promise to make it look sheepish.

The significance of 'ore' is economic before it is geological. The idea of profitable exploitation is implicit; the gold in the sea does not make the ocean an ore deposit, simply because no means exists for extracting the metal profitably. It can be, and it has been, extracted unprofitably. As soon as a mineral aggregate or a metal-bearing rock is surmised to be exploitable, then it begins to resemble an ore; but it is only when that surmise takes form, in terms of time and place, that the geologic product assumes economic value.

T. A. RICKARD.

London, August 15.

Duty on Cyanide Salts

The Editor:

Sir—I have observed some effort being made in New York to create public sentiment in favor of the retention of a duty on sodium cyanide and potassium cyanide, which have been free-listed by the Senate in bill H. R. 3321.

Color is given to the view that there is an industry in the United States engaged in the manufacture of these materials which would be injured if the Senate proposals are carried out; but to the best of my knowledge there is no such industry, and if the figures as to the actual cyanide manufactured out of coal-tar residues in this country and its percentage compared with the amount of cyanide imported were given, I think the figures might prove enlightening. I am given to understand that large quantities of cyanide are imported in concentrated form and by the addition of common salt and other cheap and practically inert but allied materials, it is decreased in strength to a commercial strength of 0.98%, but this is not manufacture, it is merely 'doping.'

As viewed in the West, the effort to put sodium cyanide and potassium cyanide on the free list is welcomed for the reason that these chemicals are genuine raw materials, being used in one case in the generation of cyanogen gas for fumigating citrus fruit trees, and in the other case for gold recovery in mining. These are the two main uses of cyanide, and apart from these there is a small consumption in the arts, as, for instance, in plating work.

In considering the two main uses as above indicated, it must be admitted that these industries have genuine need for free raw materials. This is already conceded in the fruit-raising industry, as fertilizing materials of all sorts are admitted free, and there is no more reason for charging a duty on cyanide of potash than there is for charging it on muriate of potash, or nitrate of soda, both of which are on the free list at present.

As the citrus fruit-raising industry is facing a reduction in duty on its finished products, it can well understand the placing on the free list of cyanide.

In the gold-mining industry, the case is even stronger for free raw materials. Inherently the protection of the gold producer is impossible, as the United States, in common with every civilized nation, puts no barrier upon the import of gold. Gold has a world value, and therefore the taxing by our Government of any and every raw material used in the winning of gold from the earth is just that much of a handicap upon the gold production of the United States. That this handicap is a serious matter may be shown by the statement that the present tax on sodium cyanide equals 4.47c. per pound, and a mine using 2.33 lb. of this material per ton of concentrate is paying a tax of 10.41c. per ton on each ton of ore treated, in addition to all its other taxes (corporation tax, state franchise tax, and others), and this in an industry which by its very nature cannot be protected.

Under these circumstances, I feel it can be demonstrated to the satisfaction of unbiased opinion that the action of the Senate in free-listing these materials is a wise one and worthy of support.

G. H. ATKINS.

San Francisco, August 14.

The Psychology of Zinc

The Editor:

Sir—The comments of R. G. Hall in the *Mining and Scientific Press* of August 16 are, without doubt, upholding to the present-day practice and improvements of zinc metallurgy, and subsequent working out of the more intricate zinc sulphide problems. After reading Mr. Clerc's letter in the *Mining and Scientific Press* of July 12, the casual reader feels somewhat depressed at the backwardness in zinc metallurgy in not utilizing the immense bodies of low and medium grade zinc-sulphide ores and in solving their metallurgical problem. Again, one is impressed with the fact that the real zinc metallurgist of today is a 'muscular' metallurgist, inasmuch as the different operations require personal skill in manipulation rather than technical skill.

As stated in various articles, the only available way open to the recovery of zinc is the fire-retort method, electric furnace and retort method, hydroelectric precipitation method, etc., each method being applied where the conditions of the ore and locality warrant it. Furthermore, for each of these different methods (with the exception, perhaps, of the electric furnace), the ore must be specially prepared before proper reduction to metallic zinc can be hoped for. Thus it is that the pre-treatment is most essential to ultimate success in the reduction. Each and every ore, due to its degree of complexity, requires special treatment, whether it be concentration by milling, flotation, magnetic separation, roasting, or leaching.

Most of the ores containing zinc are being mined and smelted, but the main sticker is the complex sulphide, 'black jack,' which is intimately associated with sulphides of iron, copper, lead, etc., and which will not lend itself to successful concentration and separation. Many processes have been tried on these

ores and failed. Fire, electric, and acid processes have been tried, and are being tried, with a certain degree of commercial success. Alkali processes also have been tried, but never to any great extent. Here is a field that is practically unknown upon a commercial basis. S. E. Bretherton, in an article on 'Smelting Zinc-Copper Ores' in the *Mining and Scientific Press* of April 12, describes a very promising alkali process, in which ammonia and carbon dioxide play the part of zinc solvents. The Afterthought (Shasta county) ore on which Mr. Bretherton comments, has, on a small scale, been successfully treated by this process for the removal of the greater percentage of the zinc in the ore. The cyanide process overshadows any acid process for the recovery of the precious metals, and why not an alkali process for the recovery of the zinc? It is a well known fact that zinc oxide, basic sulphate, and sulphate are soluble in ammonia and carbon dioxide. This is especially so when pressure is applied. With proper roasting, these conditions are brought about in the ore. In this process the final zinc product is a granular basic carbonate and hydrate, which when calcined gives an almost pure oxide suitable for pigment.

The field is indeed a large one, and with so many engineers working for improvements, one cannot help but agree with Mr. Hall that a successful solution of the problem of treating the troublesome zinc-sulphide ores will be attained at no far distant date.

FRANK L. WILSON.

Ingot, California, August 18.

Baffles

The Editor:

Sir—The letter of John E. Rothwell in your issue of August 2 appears to me an apt illustration of destructive rather than constructive criticism. His statement that I condemned baffles because I am connected with a "certain patented device in which the application would be expensive" comes perhaps inappropriately from an engineer who patented and placed on the market, several years ago, a thickener, the catalogue dealing with which promises "greatly enhanced settling effect produced by inclined baffles." The latter were expected, if my memory fails not, to multiply the capacity by three or better. Without raising the question of 'glass houses,' which will not interest your readers, I am sure you will agree with me that my statement, "In my opinion the principle involved of assisting settlement * * * by the use of baffles has given no practical results," is not a condemnation of a principle but an opinion as to certain facts.

I do not agree with Mr. Rothwell that it would be expensive to add baffles to the Dorr thickener, to which he refers, as I know that Mr. Dorr, being familiar with their trial at different places, had for some considerable time been seeking for positive information as to their value with a view to using them. Perhaps the best answer to his criticism is the fact that they were thoroughly tested on a Dorr thickener in South Africa, under the direction of Mr. Bosqui, and abandoned as of no value.

I think even Mr. Rothwell will not insist on calling this test or the work done by the testing department of the Anaconda Copper Mining Co. in rectangular settling-tanks 'ignorant application.'

The work of the latter Company described in the valuable article by Mr. Hayden on 'Concentration of Slimes at Anaconda', in the August *Bulletin* of the American Institute of Mechanical Engineers, is most interesting, and Mr. Hayden, in his conclusion, summarized from the tests shown in table VI, states that "If perfect settling is required a baffle tank has no advantage; but if it is desired to slough off a portion of the solids, the baffle tank has a greater capacity," which may explain some of the discrepancies in the reports on the use of baffles.

My inspection of the tables given would suggest that they might bear a more optimistic interpretation, but I assume Mr. Hayden's judgment to be based on other observations as well.

I note Mr. Rothwell states that he has found baffles of marked benefit in settling-tanks, and feel that detailed data from him will certainly be appreciated, not only by myself, but by all other metallurgists; for I am sure that everyone realizes that, in the long run, whatever is of real value will be adopted.

I realize, too, that many an engineer satisfied with the theoretical correctness of a method has kept working on it, in spite of discouragements, until all difficulties have been overcome, and improvements of great benefit have thus been given to the world.

Without professing special knowledge in the settling line, I might say that there are likely to be many principles involved in continuous settling on a large scale that do not apply to the inclined baffle tests, convincing as they may appear at first sight.

H. N. SPICER.

Denver, Colorado, September 3.

Professional Ethics

The Editor:

Sir—Professional ethics have been discussed repeatedly in your columns; it would be interesting to hear the opinion of your readers on a contingency which may occur any day in the career of a mining engineer.

An engineer makes a thorough and extensive examination of a mining property for client 'A.' On receipt of the report, client 'A' decides not to take up the property. After a certain time, client 'B' asks the same engineer to examine the same mine, probably unaware of the examination already made. What shall the engineer do?

He cannot give to 'B' the report made for 'A', because the report belongs to 'A'.

Client 'A' may refuse to give 'B' the report, or may even refuse to sell it.

The conditions at the mine have not substantially changed since the examination was made.

To go over the mine again and write an identical report would be a bluff. To do the whole work over again (sampling excepted) would be like comparing a letter with its carbon copy.

What shall the engineer do?

G. CAETANI.

San Francisco, August 13.

Special Correspondence

LONDON

DECREASE IN TIN CONTENT OF ORE FROM THE DOLCOATH AND CARN BREA & TINCROFT MINES; DETAILS OF THE HALF-YEAR'S WORK.

The big tin mines in Cornwall are passing through a period of unusual low-grade ore, and I have previously referred to the steady decrease in the content at East Pool and South Crofty mines. At the present time it is Dolcoath and Carn Brea & Tincroft that are giving lower outputs; the latter is, in fact, in an alarming position, and not for the first time during its life. It is thirteen years ago since this old group of mines was taken in hand by a company organized under limited-liability law. In those days the yield of tin concentrate was 31 lb. per ton of ore. The grade has gradually dropped until during the past half-year it was only 19 lb. Most of the time, losses have been made on the operations, but during the two periods of high price for the metal, 1906-7, and the past two years, the balance has been on the right side. A dividend of 10% on the 'priority' shares was paid in 1907, and a similar amount for 1912. It will be remembered that two years ago the directors decided to import a high-priced engineer of proved experience in other parts of the world, in order to make an attempt to reorganize the plant and the methods of working, and Edward S. King was accordingly appointed to the position of gen-

GRENVILLE MINE, SURFACE BUILDINGS.

eral manager. He was able to effect many improvements and economies, and much of the money thereby saved was put back into the mine. Lord Clifden, one of the ground landlords, and a large shareholder, came forward through his agent, John Gilbert, a member of the board, and undertook to provide capital at a low rate of interest in order to equip the mines with an up-to-date dressing plant. Under these circumstances, it is distinctly unfortunate that the grade of ore mined should continue to decrease. The financial result for the first half of 1913 has been a loss; 45,537 tons of ore raised yielded 391 tons of concentrate, selling for £48,009, or at the average price of £123 per ton. During the previous half-year, 48,055 tons yielded 455 tons, selling for £57,078, or at the average price of £125 per ton. The loss was £2785, as compared with a profit of £6736. Already the directors, with the exception of Mr. Gilbert, are beginning to become restive, and are doubting their sagacity in making the great change of two years ago. They now allege that, when they engaged Mr. King, they expected to obtain his entire services and his continuous attendance at the mine, and they grumble that the resident manager has been changed more than once by Mr. King during the short period he has been in control. Mr. King has, of course, done much work in Cornwall these two years in addition to that at Carn Brea & Tincroft. It is also obvious that changes in management during periods of special development underground and on the surface are highly inadvisable in general principles. But from my own point of view, these grumblings are not justified, and they would not have arisen had Fortune been more gracious.

The yield per ton at Dolcoath during the first half of 1913 has also been a 'lowest on record', having arrived at the point at which Carn Brea & Tincroft started. The exact figure was 30.23 lb. tin concentrate per ton, as compared with 32.09, 36.73, 41.23, and 47.38 lb. during the preceding half-years. The descent has therefore been steady and regular. The tonnage raised and treated was 58,304 as compared with 60,631 during the latter half of 1912, and the yield of concentrate was 786 tons as compared with 868 tons. The total receipts were £106,982, as compared with £118,481, and the net profit £32,061, as compared with £46,569. The so-called 'net profit' is not the same as 'distributable profit', as £4919 had to be written off for depreciation of plant. The shareholders received £17,500, being at the rate of 5% for the half-year. As I mentioned in my last letter, the directors and manager of Dolcoath have become alarmed at the poor results obtained from the main lode at depth, namely, from the 3000 to the 3300-ft. level, and attention has therefore been paid to other lodes in the property that have of recent years been neglected. A cross-cut was driven from the 1260-ft. level to explore the South lode, which is supposed to be a continuation of the lodes worked at East Pool and South Crofty. The lode has been cut, and is reported to be of good grade, but no information is given as to the nature of the ore found. If it is the continuation of the lodes mentioned, it will probably contain a much larger amount of wolfram and pyrite. But, as I said in my last letter, the public does not get much information from the Dolcoath company, and will have to wait until the meeting of shareholders, on which occasion another driblet of news will be vouchsafed in an indefinite sort of way.

NEW YORK

COPPER PRICES AND FUTURE INCREASE.—MESSINA, BOLEO, AND PITTSMONT PROPERTIES.—HALF-YEARLY REPORT OF THE AMERICAN SMELTING & REFINING COMPANY.

Copper advanced to 16½c. per pound by the end of last week. That figure was named on September 4 by the Amalgamated, and the other agencies followed suit, the equivalent price being quoted in London. Sellers report a good demand, and predictions are freely made that prices will advance to considerably higher figures before the end of the year. In London copper was bought freely in order to make the shares of copper mining companies advance, but the fact that speculative sales were too great in proportion to spot transactions was too evident, and the price of shares went down instead of up. In New York Amalgamated only advanced about half a point during the week. The foreign visible supply on September 1 was given as 26,536 tons in England, France, and afloat, and 7538 tons at Hamburg and Bremen. This shows a decrease of 610 tons since August 15. Exports of copper from this country for the week ended September 4 are given as 5344 tons, or double the rate for the same period last year.

The Messina, the Transvaal copper mine, in which the Camp Bird is interested, reports that it produced 543.78 tons of copper during the quarter ended June 30. There was milled 5960 tons, and the concentrate produced contained 32.5% copper. The first reverberatory furnace is now ready to start and the second should be ready in a few weeks. The railway is expected to reach the mine early in October, and by that time all the plant will be ready. An important copper mine of which little is ever heard is the Boleo, in Lower California, which is closely held in France, and after the French custom, its operations are shrouded in mystery. The report for last year has appeared in France and discloses the fact that 360,000 tons of ore averaging 3.51% copper was smelted last year, yielding 28,336,000 lb. copper, with a net operating profit of $1,414,024. The Company is controlled by the Rothschilds of Paris and the Banque Miraband. The matte and black copper produced is shipped directly to Europe.

The retiring of $263,000 worth of the 6% bonds of the Pittsmont Copper Co. draws attention to the highly creditable manner in which the East Butte, under the management of Oscar Rohn, is pulling itself out of the trouble caused by the former management. The Pittsmont took over the Pittsburg & Montana, which was originally capitalized at $30,000,000, assuming responsibility for the $2,500,000 bonds issued by that Company. It then arranged with the East Butte C. M. Co. in 1909 to exchange the physical property, provided the East Butte would issue $3,000,000 worth of stock to acquire 83% of the Pittsmont stock, the Pittsmont owning 90% of the Pittsburg & Montana. In this way the East Butte became responsible for the bonds and has now paid off $1,000,000 of them. Under the present management the plant has been rebuilt without ceasing operations, development work has been pushed underground, and the Company is making a net profit of $100,000 per month. The East Butte has about $700,000 in cash assets, so that in little more than a half-year it will be free of debt.

The American Smelting & Refining Co. and the American Smelters Securities Co. have issued their half-yearly reports, covering the period to June 30, which shows that the gross income for that period was $6,671,611, as compared with $7,587,942 for the same period in 1912. This decrease in gross earnings is explained by Daniel Guggenheim, president of the two companies, as coming from the unsettled conditions in Mexico and the strike at the Company's El Paso plant.

The net income, however, on account of decreased charges, shows a decrease of only $250,406 over the corresponding six months last year, being $5,027,894, as against $5,278,300 on June 30, 1912. This sum added to the previous profit and loss surplus leaves a profit and loss gross surplus of $21,787,296, as compared with $18,978,026, a gain of $2,809,269. After deducting total dividends of $4,010,000 on the common and preferred stocks, the profit and loss surplus on June 30, 1913, was $17,777,296, as compared with $14,968,026 on June 30, 1912, an increase of $2,809,269. The Company has expended in the last six months in connection with new properties or increased facilities $1,683,594 and has charged to depreciation the sum of $558,200. The property account therefore shows an increase of $1,095,753. The assets of the Company on June 30, 1913, are given as $189,880,705, as compared with $189,211,705 on June 30, 1912. The balance of $2,063,894 left after paying dividends on the preferred stock of the Company was equal to 4.50% earned on the $50,000,000 common stock, against 4.76% on the same stock for the corresponding six months of the previous year.

Morton Lexow, son of the late Clarence Lexow, is suing his father's law partners, George MacKellar and T. Tileston Wells, for considerable sums. Mrs. Lexow is a shareholder in the United Copper Co., and MacKellar & Wells are attorneys for Maurice Deiches, who has brought suit to have that Company declared insolvent. In a way too complicated to explain here, this is regarded as an attempt to prevent Mrs. Lexow from realizing anything from the wreck, and the incident is only of importance as illustrating the amount of collateral litigation to which such a fiasco gives rise.

PORCUPINE, ONTARIO

HOLLINGER AND DOME MILL EXTENSIONS.—DOME LAKE CO.'S AFFAIRS.—KIRKLAND LAKE DISTRICT.—CROWN RESERVE AND MCKINLEY-DARRAGH DIVIDENDS REDUCED.—WEST SHINING TREE DISTRICT.

It is understood that the Hollinger company is contemplating the installation of an additional 40 stamps, but it is believed that a great deal more development work is necessary before such an increase will be justified. The Dominion Bridge Co. has been awarded the contract for the steel work for the Dome Mines Co.'s mill, and this is being pushed to completion as rapidly as possible.

At the annual meeting of the Dome Lake Co., which was held at Toronto recently, three by-laws were submitted to the shareholders for their approval: (1) to increase the capital stock by 250,000 shares; (2) to issue 100,000 shares at a discount; (3) to increase the number of directors from five to seven. After considerable discussion, only the first by-law was passed. At the meeting, the shareholders found that the Company had pressing debts of $15,000 and total liabilities of $160,000. The management was severely criticized for not placing before the shareholders a full statement of the financial affairs and of the physical condition of the mine. Another meeting is to be held shortly, when it is expected that the shareholders will receive full details of the Company's position.

Several minor deals have recently been made in the Kirkland Lake district, but as a whole things are quiet and not much work is being done. At the Tough-Oakes, formerly known as the Foster, driving is being carried on from the 100 and 200-ft. levels, and satisfactory results are being obtained. It is understood, however, that the recent issue of stock was rather a failure. On the Burnside property, adjoining the Tough-Oakes, the main shaft has reached a depth of 80 ft. and a cross-cut has been started to cut the vein which dipped out of the shaft at a depth of 50 ft. The Burr-Cartwright Syndicate is stated to be obtaining excellent results on the Wright-Hargraves property, on which it recently took an option, but has thrown up the option on the Hunton property, which is only a short distance from the Wright-Hargraves. The Hudson Bay Co. has also given up its option on the claims which were being worked in the vicinity of Kirkland Lake, a recent discovery of high-grade ore is reported from the Grazelle property, which lies a short distance south of the Teck-Hughes.

During the past few weeks, two of the large Cobalt mining companies have cut their dividend payments. Early in the month the Crown Reserve, which has been paying 2% regular and a 3% bonus per month, or at the rate of 60% per year, dropped the bonuses and is now paying at the rate of 24% per year. The reason for this action was on account of the earnings for the present year having fallen so far below the expectations of the Company, due principally to the unfavorable developments met with in the Carson vein, where the high-grade ore changed to barren calcite. Exploration work in other parts of the property has also been disappointing and has not resulted in the discovery of any new orebodies. The action of the directors in cutting the dividend was foreshadowed by the heavy liquidation of the stock previous to the announcement, and a good deal of dissatisfaction has been expressed by the shareholders on account of the advance knowledge gained by those who sold stock.

The second company to cut its dividend is the McKinley-Darragh, which has been paying at the rate of 3% regular and 7% bonus quarterly. In the future, the Company will pay at the rate of 3% regular and 3% bonus, or 24% per year. The reason assigned is that on account of the extensive development program being carried on at the McKinley and Savage mines and on account of the large sums being spent on the concentrator, the cash reserve had been reduced to a lower figure than the directors thought advisable. While the yearly disbursement may be increased by the payment of extra bonuses at the discretion of the directors, there is no intimation that the Company may return to the old rate of dividend. In contrast with the Crown Reserve, it is pleasing to note that there was no advance information of the action of the directors and there was no liquidation of the stock previous to the announcement.

Shareholders in the Temiskaming Mining Co. have been expressing dissatisfaction with the directors for failing to declare the dividend at the recent quarterly period. It is stated that the Company has a credit balance of over $166,000, and the quarterly payment calls for only $75,000. The last dividend was paid on April 30. Following the sale of the Northern Customs Concentrator to the English syndicate controlling the Cobalt Townsite Mines, the Northern Customs company has started work on a new mill which will be situated on the T. & N. O. railway on the other side of the La Rose Extension property. An order for

80 stamps has been placed, which is said to be the largest single order for stamps ever given in Canada.

Men associated with the Buffalo Mines Co., of Cobalt, have taken over the Ribble Jephson properties in the West Shining Tree district. At the present time they are working 40 men and expect to increase this force in the near future. They claim to have opened on the surface an ore-shoot 200 ft. long and running between 10 and 20 ft. in width, which will average over $12 per ton. The work being done by this syndicate has caused some excitement, and a number of prospectors are going into the country which was staked during the summer of 1911. In the majority of cases the veins are too small and the average content too low to hold out much hope for successful operations.

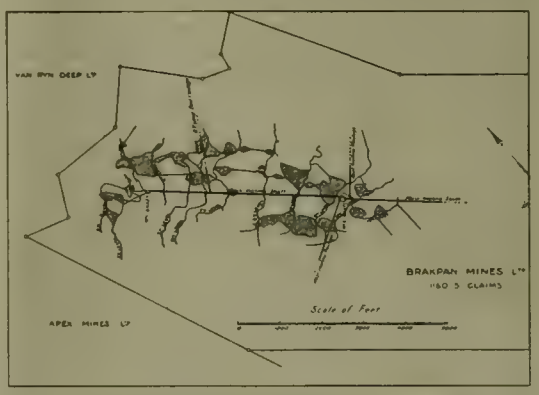
JOHANNESBURG, TRANSVAAL

THE AFTERMATH OF THE STRIKE, AND NEW DEMANDS MADE. —THE BRAKPAN MINE AND MILL RESULTS.

The principal topic of interest here is still the threatened general strike, but the centre of attraction has been transferred from the mines to the railways. It will be recollected that the general strike of the miners with the object of showing sympathy with the New Kleinfontein men was provisionally terminated by the intervention of the Government undertaking to deal with the grievances and to deal with the strike-breakers at the New Kleinfontein mine in a satisfactory manner. The strike-breakers have been awarded twelve months' wages by the Government, while a formidable list of reforms by the Miners' Association has been handed in to the Government for their early consideration. These demands include a minimum wage of 60c. per hour for surface mechanics, and $6 per day minimum wage for drill-sharpeners, and a minimum wage of one-half the above rates for unskilled workers. The Association also suggests payment at increased rates for overtime and Sunday labor where unavoidable, but asks that Sunday labor at the mines, and particularly at the ore reduction works be abolished. Weekly payment of wages in place of monthly paydays are also asked for. All the above demands are absolutely new, and were never as much as mentioned during the recent strike, so that there is little probability of such demands being granted. The fact is that at the time of the strike no grievances were advanced, and at the present time there is no general or genuine demand for the above reforms. With regard to the eight-hour day from bank to bank, in place of the existing eight hours' work per day at the face, that was somewhat prominent during the New Kleinfontein strike; in all probability it will be brought up for consideration at the next session of Parliament at Cape Town. Notwithstanding the fact that the majority of the grievances now put forward for consideration by the Miners' Association are now heard of for the first time, and in most cases have not the support of the miners, there is considerable uneasiness on the Rand, due to the possibility of the miners coming out on strike with the object of supporting the railway men. The railway employees appear to have some grievances against the Government, but the latter is showing a disposition favorably to consider the removal of these, and in all probability a general strike will be averted.

The threat of a general strike throughout South Africa has during the week been withdrawn by the Federation of Trades Unions owing to the opposition met in so many quarters and the fact that the scheme was an impossible one at best. With regard to the extravagant demands put forth by the federation on behalf of the miners, they have been successful in obtaining the following concessions: A recognized allowance of half an hour for getting the white employees to and from the working places; ten days' holiday per year on half pay; a month's notice to be given to vacate the miners' dwellings; weekly payments of wages to men engaged by the day; and consolidation of the sick and benefit societies. The only real concession obtained by the men is that of ten days' holiday per year on half pay after twelve months' continuous service underground and two years' continuous service on the surface, to take effect from July 8, 1913. Generally speaking, the long list of grievances was referred to the Transvaal Government, the minimum wage and other questions likely to add to the cost of working the mines being refused acceptance by the employers. Now that the question of a general strike has been abandoned, and the demands of the miners cut down to the above concessions, it is anticipated that work on the mines will be continued without any further interruption, as the employers have intimated that the above concessions are the utmost they are prepared to grant.

Among the different gold mines on the Rand, few have attracted so much attention lately as the Brakpan property, situated on what is known as the far eastern section of the Witwatersrand. The nominal capital of the Brakpan Mines Co. is £750,000, and the excellent results obtained in the early stages of milling, followed by encouraging reports, caused the £1 shares to rise to £4 10s. each. Results obtained from this property did much to rehabilitate this section of the Witwatersrand in the good opinion of stockholders, and even today the Far Eastern Rand continues to be more favorably regarded than the Western Rand or even the Germiston and Boksburg areas. Later reports from the property have not, however, maintained the excellent reputation previously earned, for not only has development been unsatisfactory, but deep-mining difficulties in the early stages of operations have caused a serious setback in the profits. It has long been recognized



PLAN OF BRAKPAN UNDERGROUND WORKINGS.

that in this part of the Rand unprofitable areas alternate with profitable areas, and it seems doubtful whether, if taken on the whole, more than 50% of the total area under existing conditions can be regarded as profitable. Studying the June quarter at the Brakpan, it is seen that out of 4365 ft. of development on the 'reef', less than 2000 ft. is shown by sampling to be in profitable areas, while the assay value only averaged 5.7 dwt. per ton over a width of 32 in., as compared with 7.8 dwt. over a width of 37 in. during the previous quarter.

At the end of the last financial year the entire developed profitable ore reserves were reported as averaging 6.74 dwt. over a width of 61 in., while in 1912 the averages published were 9.36 dwt. over a width of 37.7 in. In the face of these assays those obtained in the June quarter were distinctly disappointing, especially when it is remembered that selective development, as well as selective mining, is carried on as far as possible at the Brakpan mines. In regard to actual working results, the position at the Brakpan property is even worse, for during the last six months the working costs have been increased from $4.16 to $4.44 per ton, while the monthly tonnage milled has fallen from 59,130 to 53,000 tons, and the profits in June to $129,000 as compared with $187,000 in January. These results can scarcely be considered creditable to a mine starting off so well as did the Brakpan, and the present administration is paying dearly for the mistakes made in the pioneer management of the concern. The Company is, however, gaining experience in the difficul-

ties attending mining on the Rand at a depth of 4000 ft. from the surface. That serious subsidences would occur on this property was long ago recognized by many engineers outside the management.

SALT LAKE CITY, UTAH

NEW MILL AT TINTIC AND MINE DEVELOPMENTS.—SILVER KING CONSOLIDATED AND AMERICAN FLAG AT PARK CITY.—THE STARLESS AT BINGHAM.—MONTANA-BINGHAM TUNNEL.

The Knight mines at Tintic are being operated at a slow rate pending the completion of the Knight-Christensen chlorination mill. The machinery for the mill is all under cover, and the plant will be ready for regular service about October 1. The first unit will have a capacity of 100 tons, and provision has been made for the addition of four more units as needed. N. C. Christensen, the designer, estimates the treatment cost at $3 per ton. A drift driven into the porphyry on the 800-ft. level of the Dragon Consolidated to procure water for the Knight mill has obtained a flow of 20 gal. per minute. Iron sulphide showing in the face of the drift indicates higher mineralization than has yet been found.

The Chief Consolidated has gone to a heavy expense

MAP OF UTAH.

in adopting the Bisbee system of stope filling. The system was decided upon after the occurrence of a fatal accident. While the filling was in progress the output was reduced materially, but development continued and resulted in the opening of a large lens of ore on the 1200-ft. level. The Victoria Consolidated company has opened a large body of low-grade but profitable ore on its 1000-ft. level. The ore is rich in gold on the 1200-ft. level, recent shipments netting over $2000 per car.

At Park City, J. A. McIlwee, who is sinking the Silver King Consolidated shaft from the 1300 to the 1800-ft. level under contract, recently sunk the three-compartment shaft 75 ft. in 18 days, timbering all the way. At the 1700-ft. level a station 14 ft. wide, 14 ft. high, and 20 ft. long has been cut. The contract will be completed by the middle of October, and the Company will proceed with the development of the ore that was cut in sinking the shaft. Mr. McIlwee is employing 65 men on contract development at the Daly-Judge mine. A car of smelting ore shipped last week by the Thompson-Quincy brought the Company $635 net. The ore was saved during development work.

The American Flag is making separate shipments of high and low-grade ore from its new east vein, which runs almost parallel to the Ontario fissure. The low-grade ore, averaging about $22 per ton, lies between streaks of chloride and galena that average from $90 to $110 in gold, silver, and lead. Rough separation is accomplished by dumping the cars on a grizzly sloping down to a bench. The low-grade ore, which goes through the grizzly, falls into a chute and goes in with the high grade. The coarser material is hand sorted from the bench. Before this improvement was adopted the high-grade ore was picked from the vein before blasting. Occurrence of galena boulders imbedded in Ontario chlorides seems to establish the priority of the Silver King, or galena, ore deposition at Park City, as compared with the Ontario ore. The American Flag apparently has the overlapping of the two zones.

The Starless property, at Bingham, is being thoroughly sampled for its owner, E. A. Wall. Fifty samples, Mr. Wall says, average between 1 and 2% copper, with small amounts of gold and silver. The Starless is on the zone of disseminated copper developed by the Utah Copper Co. It has been opened by a 2000-ft. tunnel and development covers 6000 ft. As the owner has never approved of Utah Copper milling methods, it is likely that an entirely different system will be adopted at the Starless. The property will be within easy reach of the new Montana-Bingham tunnel. The low-grade copper ore of the Starless is estimated at several million tons. The Montana-Bingham tunnel has proceeded 2000 ft., gaining 1200 ft. vertical depth. In 1000 ft. it will gain a maximum depth of 1500 ft. It has passed through 300 ft. of porphyry containing low copper percentages and is now in quartzite. Some low cost records have been made in driving this tunnel. The American Smelting & Refining Co. is spending $250,000 at its Garfield plant on improvements. These include a 350-ft. stack.

The new two-compartment shaft of the Moscow, in the Star district, Beaver county, is down 60 ft. Machinery from the old shaft has been placed on the new one to hasten the work. The new shaft was started to save the expense of horizontal development. The Nellie, a group of eight claims, is a new Beaver county shipper, having marketed a car of $33 ore. Jens Neilson and Charles Olsen, the owners, expect to ship two cars per month.

KALGOORLIE, WESTERN AUSTRALIA

The total gold returns for June were $2,410,200, the chief producers being as follows:

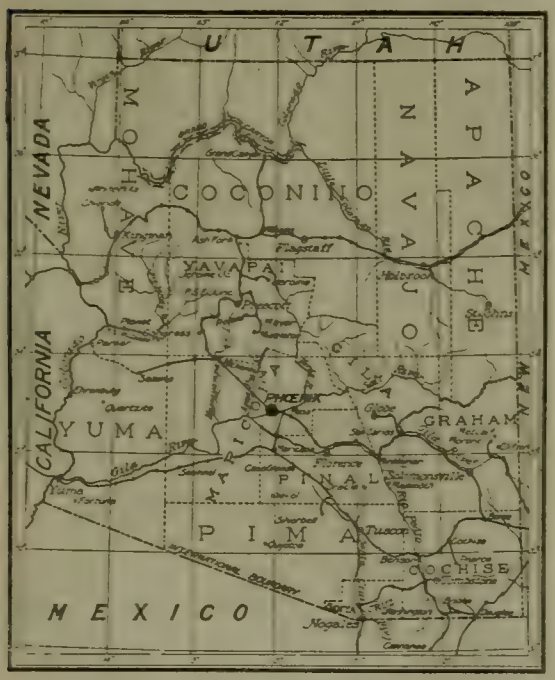
Name.	Tonnage.	Value.	Profit.	Dividend.
Great Boulder	16,457	$220,700	$115,100	$328,100
Ivanhoe	19,154	184,000	70,000	.....
Kalgurli	10,610	105,100	46,300	.....
Bullfinch	4,542	68,100	41,800	.....
Golden Horse-Shoe	25,697	184,000	28,000	.....
Yuanmi	10,400	89,200	25,900	131,200
Fenian	2,817	41,300	21,000	.....
Sons of Gwalia	13,401	103,600	22,900	81,200
Lake View & Star	17,058	99,800	18,300	.....
Queen of the Hills	3,826	37,300	15,100	.....
Sand Queen	1,500	27,800	12,500	11,200
Mararoa	2,650	24,700	9,700	.....
Oroya Links	10,830	57,100	7,900	.....
Ida H.	1,415	21,300	7,300	.....
Mountain Queen	1,995	24,500	7,000	.....
Associated	10,475	63,800	6,600	.....
Victorious	8,487	40,700	6,300	.....
Great Fingall	5,197	53,600	5,700	62,500
Golden Ridge	2,515	20,700	5,000	.....
Associated Northern	1,562	26,400	3,700	.....
South Kalgurli	9,188	49,900	2,400	.....
Lake View Consols	8,145	7,500	2,000	.....
Paringa	197	4,250	2,000	.....
			Loss.	
Perseverance	20,294	85,100	11,300	.....
Menzies Consols	2,221	16,500	1,400	.....
Burbank's Main Lode	2,005	19,400	1,100	.....
Lady Miller	1,815	8,300	2,300	.....

General Mining News

ARIZONA

Cochise County

At the Commonwealth mine, at Pearce, a great deal of mine development has been done and new equipment erected, including the new mill. A new three-compartment incline shaft, 5 by 17 ft., has been sunk. The ore from this mine is fairly low grade and oxidized down to and below water-level. It contains little sulphide minerals and no concentrating machinery will be required in the mill for the ore at present developed, according to the *Bisbee Daily Review*. It occurs in large bodies in more or less regular shoots in both the andesite and breccia formations, but as a rule these are in close proximity to the contact of these rocks. It is planned to mine the ore with the shrinkage-stope method. The new shaft equipment consists of an Allis-Chalmers electric slow-speed mine hoist, steel head-frame, three-ton ore skips, and double-deck man-cages for handling the men. The new mill and power-plant consist of the following equipment; crusher building, one No. 6 and two No. 4 Gates gyratory crush-



MAP OF ARIZONA.

ers, revolving-trommel, and inclined-belt conveyor up to the mill ore-bins. In the main building are thirty 1550-lb. stamps, arranged for coarse stamping; three 8-ft. Hardinge conical tube-mills; three standard tube-mills; 6 Dorr thickening tanks, four of them being 42 ft. diam. and the other two 38 ft. diam., and all 12 ft. high; four 18-ft. face by 11-ft. diam. Oliver filters; two Merrill clarifying filter-presses, with a combined capacity of 1500 tons of solution per day. In the precipitation building are two Merrill precipitating presses, combined capacity 1500 tons of solution per day; steam-drying pans; two Donaldson melting furnaces. The power-plant contains one cross-compound Allis-Chalmers heavy-duty Corliss engine, operated, condensing, direct connected to one 750-kw., 3-phase, 450-volt generator with exciter; surface condenser; vortex vacuum pump; centrifugal circulating pump and enclosed engine; steam-driven duplex pump; open type water heater; two duplex plunger feed pumps; vertical steam separator; automatic exhaust valve, and a four-panel switchboard complete.

About 100 men are employed. Edgar A. Collins is superintendent and B. H. Bosqui metallurgist. The Montana-Tonopah Mining Co. controls this property.

Gila County

(Special Correspondence.)—At the Miami mill, the Deister Machine Co.'s experiments with its new sand and slime tables are showing favorable returns in assays of concentrate. As the machines concentrate four times the amount of ore handled by the old type of tables and occupy little more than half as much space as the table now being used, their use should extend greatly.

Miami, September 5.

The Inspiration Consolidated Copper Co., at Miami, will add to its electrical equipment two 75-hp., one 100-hp., and two 150-hp. motors and panels recently ordered from the General Electric Company.

At the Iron Cap the face of the main east drift continues in copper ore averaging 9%. At No. 3 stope, above the drift where the high-grade streak was strongest, the ore assays 22% copper, 10% iron, and 10 or 12 oz. silver. No. 2 and 3 stopes are being extended to connect. The raise recently started on the 800-ft. level is improving, now averaging 6% copper, 20% iron, and very little silica. It is four sets, or about 20 ft., high. The ore shipments to El Paso average a carload every second day.

Pima County

The Columbia mine, in the Comobabi mountains, in the southwestern part of the county, is shipping 6000 tons of gold-silver-copper ore from Tucson to the El Paso smelter. The property is owned by Vassar, Pellet, Mrs. McKay, H. H. Huffman, and others.

Yavapai County

It is probable that the Climax Mining Co. will construct two large dams across the Hassayampa river to insure a reliable supply of water for the mill, which is situated on the river. Shortage of water has resulted in the plant being shut down for several weeks this summer.

The Rainy Day group, in the Copper Basin district, is now showing 4½ ft. of mineralized schist in an adit driven 300 ft. at a depth of 225 ft. from the surface. A vein of talc also contains $12 per ton in gold. In another claim Louis La Barr has opened 3½ ft. of ore assaying $42 per ton in copper and gold.

CALIFORNIA

Amador County

(Special Correspondence.)—At the Plymouth Consolidated mine, sinking is now in progress from the 1850-ft. level. At 2000 ft. a cross-cut will be driven to the vein to pick up the ore-shoots developed above. On the 1850-ft. level the main shoot was found to be 380 ft. long.

Plymouth, September 6.

The management of the Hardenburg mine is considering sinking the shaft 200 to 300 ft. deeper, and it is likely that the stockholders will be asked to authorize this work at their next meeting. The Company has opened a large tonnage of milling quartz in the upper portion of the mine, and is keeping the 20-stamp mill working at full capacity.

About 400 men are employed at the South Eureka, and the property is one of the greatest supports of the district. The Company is disbursing regular monthly dividends and increasing its treasury surplus. The work in the lower levels is proving encouraging, and the bulk of ore for the 80-stamp mill is coming from below the 2000-ft. level. The Company is also developing the Oneida mine, where 20 stamps are running steadily on good ore. The work of connecting the Oneida and South Eureka by means of drifts is proceeding rapidly, and will be completed within a short time. William H. Schmal is superintendent of both properties.

Inyo County

The Wancoba Mining & Milling Co. was incorporated on July 30 under the laws of Arizona. The claims are 23 miles east from Big Pine, and 3 miles from the Saline valley road. That region is well mineralized, and the owners of the group believe they have prospects justifying extensive development. A large body of wolfram has been opened in the foothills west of Bishop, and analyses are

being made at San Francisco, Los Angeles, and Boulder, Colorado.

Nevada County

Good progress is being made in building a power-plant and 10-stamp mill at the Arctic mine, while sufficient ore is developed to insure operation of the plant for some years. The Company has been greatly handicapped in the past by lack of power, and the plant now under construction will clear this difficulty. It will be operated by water power and the facilities are sufficient to keep the machinery in action at all seasons of the year.

Placer County

On September 8, fire destroyed $60,000 worth of buildings and plant at the Southern Cross mine, in Humbug cañon, on the American river.

Shasta County

(Special Correspondence.)—The Balaklala Copper Co. made a trial test of the Hall desulphurizing plant last week, and expects to commence treatment of ore on a commercial scale about September 3. One of the four roasting furnaces has been equipped with hearths and fittings for the treatment. Gas generated from crude oil is introduced into the oven, and a temperature of 700 to 900°C. maintained. The sulphur is then passed through a Field washer and precipitated in tanks. H. F. Wierum, assisted by R. E. Scott, has charge of the tests. One hundred men are on the payroll, and regular shipments of ore are being made from mine to smelter. Heavy shipments of silicious ore are being made to the Mammoth smelter daily from the Reid mine at Whitehouse, Old Diggings district. The Shasta Dredging Co. is preparing to further prospect the gravel deposits on the Saeltzer and adjoining ranches near Redding. The drill records of a former examining company have been secured. It is stated by one of the owners that the gravel averages 25c. per cubic yard, with streaks ranging from 50c. to $5.

Redding, September 1.

The Farmers' Protective Association has decided to raise $10,000 for the purpose of defraying the expenses of a campaign to protect the rights of the farmers against the smelters at Kennett and Coram. In spite of the importance of such an undertaking, there were only 30 present of the 200 members of the Association, and it will require other meetings to formulate the lines along which the organization will proceed. One member stated that, although the Balaklala Copper Co. had invited the Association to visit the Coram plant, it was more likely that an expert would be employed. Evidently from the steps taken at the above meeting, the Association does not seem satisfied by the Hall process being installed at Coram, seemingly condemning the device before even an inspection as to its installation is made, let alone a test run for the treatment of ore.

The first 400 ft. of the shaft at the Gladstone mine, French Gulch, is to be retimbered and a new hoist is to be installed. The hoisting engine will cost between $15,000 and $20,000. With the new and more powerful engine the Gladstone will be worked to a still greater depth. The shaft is sunk at the inner end of an adit 4000 ft. long.

Sierra County

A total of 118 stamps are now crushing ore in this county, as follows: Alaska mine, Pike City, 40 stamps; Alleghany district mines: Tightner, 10 stamps; Croesus (Plumbago), 20 stamps; El Dorado (Fessler), 10 stamps; Two Counties (Gold Canyon), 5 stamps; and Bear Creek, 3 stamps; total stamps in Alleghany district proper, 48; Sierra Buttes, Sierra City, 20 stamps; and Swastika, 10 stamps. All are making regular shipments of bullion, with periodical consignments of high-grade concentrate to smelters. The number of stamps will be increased before winter arrives by the starting of several mills, now idle, at Sierra City, when the fall rains have replenished the water-supply.

Siskiyou County

The Patterson Creek Gold Mining Co., owners of the Queen of Sheba mine, has paid off the men and closed permanently. The Sheba has produced many thousands of dollars in gold in the past, but during the last two years has been an unprofitable investment.

COLORADO

Clear Creek County

(Special Correspondence.)—A body of ore 25 in. wide and worth $40 per ton has been opened in the Lucky Boy workings up Spring gulch. The discovery was made by H. J. Theide & Co., who are operating under lease. It is announced that work will be resumed in a few days on the Bertha property, situated on Seaton mountain. It is proposed to remodel the mill that is on Virginia street in this city. W. L. Shaffer is manager.

The French Flag property, on Seaton mountain, has been secured under lease by Charles S. Ridley, of Denver. Work was started yesterday and shipments of mill ore will be started next week. The product will be sent to the Combination mill. Assays return from $6 to $19 per ton in gold. Telluride men have taken over the Sun and Moon mine, one of the former heavy producers of this district. Operations will be carried on through the Newhouse adit.

A streak of ore 8 in. wide has been found in the drift being driven on the Centennial vein, which is worked by the Two Kings M. Co. Assay tests show 1.5 oz. gold and 14 oz. silver per ton. A. A. Warren is manager.

Williams and Traylor, leasing on the Freeland Extension mine at Freeland, made a carload shipment of ore a few days ago that returned 1.35 oz. gold, 17 oz. silver, and 20% lead. On an average of 20 tons of mill ore is being shipped per day from the Seaton mine. Consignments are made to the Combination, Jackson, and Newton mills. E. D. Payne is manager. A 6-in. streak of ore has been opened at the Oneida mine at Freeland that is worth $200 per ton in gold and silver. Shipments of mill ore have been going out for some time, the product being consigned to the Combination mill. Owen & Rogers are operating under lease.

Idaho Springs, August 29.

San Miguel County

The Junta Consolidated Gold Mining Co., at Telluride, will install three 100-kva. transformers and 50-hp., 75-hp., and seven 20-hp. motors recently ordered from the General Electric Co. The Smuggler-Union Mining Co. has also ordered a 4-ton electric mining locomotive from the same company.

Teller County (Cripple Creek)

The suit commenced by the Portland Gold Mining Co. against the British corporation, Stratton's Independence, Ltd., to recover $300,000 damages for ores alleged to have been wrongfully mined by the defendant Company from the territory of the Portland company on Battle mountain, has been settled by 'stipulation.'

A brief supporting the United States Government's contention that it has the right to collect the sum of $4883 from the Stratton estate as a war tax has been filed in the United States District Court in Denver, by Henry E. Lutz, assistant United States district attorney. The claim to this amount arises from the sale of the Independence mine on Battle mountain by the late W. S. Stratton to an English syndicate through Verner Z. Reed, then a resident of Colorado Springs, who held an option on the property. During August the El Paso company shipped 89 cars or 3250 tons, and lessees 33 cars of ore. Eight mines of the United Gold Mines Co. operated by lessees were on the producing list of that corporation in August, and a total production of 33 cars estimated of a tonnage content of 1000 tons resulted. In addition, 1165 tons of low-grade ore was treated at the Wild Horse mill.

Measurements taken early in September by T. R. Countryman, representing the Cripple Creek Deep Drainage & Tunnel Co., of the flow from the Roosevelt deep drainage tunnel, gave results of 6275 gal. per minute. A comparison with the flow measurement of the corresponding period last year shows a falling off and decrease of 3725 gal. per minute, the gauge last September at this time recording 10,000 gal. per minute. The Vindicator mine produced 65 cars of ore on company account and 35 cars by lessees in August. The 1600-ft. level is opening well.

IDAHO

Lemhi County

The geology and ore deposits of this county are described in U. S. Geological Survey Bulletin 528, by Joseph B. Umpleby. This county, situated in the east-central part of Idaho, has until recently been difficult of access. With the extension of the railroad to Salmon in 1910, mining activity in parts of the area took on new life. Placer gold was discovered at Leesburg in 1866, and soon thereafter lode deposits were recognized. Lead-silver deposits were worked actively in the eighties, but not until the advent of the railroad did this industry reach its maximum importance. The total production of the county is about $20,000,000, two-thirds of which has come from gold, three-fourths of the remainder from lead, about $40,000 from copper, and the rest from silver. The basement rock is a gneissoid granite of Archean age which outcrops in the northwestern part of the area. Unconformably above it is a thick and widespread series of Algonkian schists, slates, and quartzites. The ore deposits of the county may be grouped as gold placers and lodes, lead-silver veins, and tabular replacements, copper-bearing gold veins, cobalt-nickel deposits, and tungsten-bearing veins. Sixty-three mineral species are recognized in the ores of Lemhi county. The outlook for a steady growth in the mining industry of the county is bright. A large tonnage of base gold ore remains. Placers are now being worked by dredges, which are converting into an asset ground heretofore valueless for mineral. The annual production of lead-silver has increased greatly since the advent of the railroad and seems destined to become the most important in the county. Tungsten will probably become an asset, but the future of cobalt and nickel is more uncertain.

Shoshone County

It is reported that about 20 ft. of high-grade copper ore has been opened in an adit at the North Fork mine, 22 miles above Prichard. The Marsh Mining Co., operating the Marsh mine near Burke, has made another acquisition by purchasing the control of the Poorman Extension Mining Co., one of the pioneer corporations of the Coeur d'Alene, its charter having been issued in 1886. The holdings consist of the Green Mountain, Fuller, Burke, Clark Fraction, and Fir Fraction, all of which adjoin the original Marsh group on the north and the Poorman property on the east. The five claims include approximately 45 acres. Acquisition of the Poorman Extension properties, together with the Got-Em-Now claim, recently purchased from Patrick Clark, gives the Marsh company control of 130 acres, patented, including a part of the town of Burke, lying on both sides of Canyon creek. The portal of the Marsh main working adit is on the Green Mountain claim, an easement for the adit having been secured several years ago, and the purchase of the Poorman Extension ground gives the Marsh surface rights much needed in operation.

It is stated that the long adit being driven from the Humming Bird ground into the Hercules to cut the latter's orebodies at approximately 800 ft. below the present No. 4 adit level will be completed about March 1, 1914, as the work is progressing now at the rate of 250 ft. per month. The adit will be about 8000 ft. long and will provide underground facilities permitting Hercules ores to be delivered direct to the railway by gravity.

MICHIGAN

Houghton County

The Calumet & Hecla company is now sending over 2000 tons of ore that is coming from the stopes to the mills daily, and operations are being increased. Other mines in the district, the Champion, Quincy, Isle Royle, and Superior, have resumed production, and it is hoped a few short weeks at the most may see conditions again normal in the district.

MONTANA

Granite County

(Special Correspondence.)—Rich ore has recently been opened in the property of the Gold Hill Mining Co. at Maxville. R. B. Hoffman is superintendent. J. P. Raines of Butte is interested in the property.

Maxville, September 5.

(Special Correspondence.)—The Swastika Mining Co., at Phillipsburg, is preparing to equip its mine with electrically generated compressed air. Commercial ore has been developed containing silver and copper.

Phillipsburg, September 1.

Jefferson County

(Special Correspondence.)—A promising body of silver-copper-lead ore has been opened in the 1200-ft. adit of the Ironside property. This mine is on the head of Little Boulder river, 15 miles north of Butte.

Butte, September 1.

Lewis and Clark County

(Special Correspondence.)—A rich development is reported from Marysville. William Smigaj, an old prospector, claims to have uncovered from two to four feet of ore assaying 200 oz. silver and $20 gold per ton. His claim lies near the Whip-Poor-Will ridge between Gloster and Empire.

The Butte & Minnesota Mining Co. has exercised its options on some claims on Wolf creek, 9 miles from the Great Northern railway. The ore contains gold, copper, and silver. It is planned to build a mill this fall. There is considerable activity in the Scratch Gravel hills, north of Helena. The Copper-Silver Montana Mining Co. has been doing considerable development work. Profitable ore containing gold, silver, copper, and lead has been opened in the shaft while sinking between the 400 and 500-ft. levels. The vein is in granite, the copper occurring as tetrahedrite. The shaft is only 600 ft. from the Great Northern railway and a few miles from the East Helena smelter of the American Smelting & Refining Company.

Helena, September 1.

Silverbow County

The Tuolumne Copper Mining Co. reports as follows for the year up to July 31:

Ore mined, tons	22,875
Copper, per cent	3.99
Ore smelted, tons	22,395
Metal production:	
Copper, pounds	1,310,569
Gold, ounces	92
Silver, ounces	46,858
Revenue from metals sold	$133,819
Balance from December 31, 1912, etc.	204,679
Total revenue	$338,498
Mining and development	100,950
Equipment and general expenses	40,967
Total expenditure	$141,917
Dividends	160,000
Cash on hand	34,509
Accounts receivable	2,072

The new surface equipment at the Belmont mine of the Anaconda Copper Mining Co. is about ready for use. Steel bins of 2000 tons capacity have been built and a steel trestle connects the bin with the hoisting shaft.

NEVADA

Esmeralda County

(Special Correspondence.)—The Darms Coal Mining Co., operating three miles from the Tonopah & Goldfield railroad near Coaldale, reports that the drill has gone through four veins of coal, and a contract has just been let to sink a two-compartment shaft to 400-ft. depth. Work started on August 14, and early in November the coal is estimated to be opened. An analysis made at Goldfield shows the following: Moisture, 1.80%; volatile matter, 32.60; fixed carbon, 50.60; and ash, 15 per cent.

Coaldale, September 6.

Preliminary estimates of the Goldfield Consolidated's August operations are as follows: Ore treated, tons, 32,119; gross value, $389,000; profit, $194,000. The tonnage treated would have beaten the previous high record, had not oper-

ations been interfered with by storms which shut off the power. Costs totaled $6.10 per ton.

HUMBOLDT COUNTY

The National Mines Co. has cut a larger body of high-grade ore than ever in No. 5 and 6 levels. This is encouraging to the owners of the property. The Company is driving south on the rich vein, and at the same time is sinking the shaft to a lower level to cut the rich vein.

The Charleston National Mining Co. has nearly completed the installing of the large hoisting plant. This is one of the finest pieces of machinery in the camp, and will enable the Company to sink to a great depth. It is reported that Mr. Stowe intends sinking a large working shaft or incline in the foot-wall of the vein similar to that of the National Mines Co.'s large shaft. High-grade ore is being taken from the vein to the north of the workings in the Company's mine.

NYE COUNTY

(Special Correspondence.)—Tonopah has had a trying time with electric storms, and this week the heaviest rainfall in this county which has been recorded, drowned out the water works at Rye Patch. This kept all of the mining companies busy hauling water and pumping it from different sources in order to keep the mills running, but the only mill that really suffered was the Belmont, which was compelled to stop 30 stamps for about two days. The water-supply of Tonopah was described in the *Mining and Scientific Press* of December 14, 1912.

Tonopah, September 4.

PROPERTY OF THE DARMS COAL MINING CO.

At Manhattan, a consolidation of the Manhattan Mustang and Jumping Jack Merger Mines Co. is now under way, the latter property including the Jumping Jack, Indian Camp, and Stray Dog claims. All of these have produced a good deal of ore and are in the schist belt.

STOREY COUNTY

At the Labor Day sports at Virginia City, Mike Grivic and Pat Hughes, Comstockers, won the drilling match, driving a hole 42½ in., and Berry and Trabucca were second with 39 in. to their credit in the 15 minutes allotted.

UTAH

JUAB COUNTY

With the satisfactory ranges assumed once more by the spelter market, the May Day, Uncle Sam Consolidated, and Lower Mammoth companies have resumed the extraction of zinc ores for the market. James C. Dick, the general manager, returned from these properties on September 1, and when asked in regard to the permanence of these shipments, he said it was more a question of the spelter market than anything else, for in all these mines, and the May Day in particular, there is a large tonnage awaiting attention from the management. The zinc ores find a ready market in the Middle West.

PIUTE COUNTY

It is stated that H. F. Campbell, of New York City, and C. H. McDowell, of Chicago, secured from the State Land Board surrender of the state's right to a section of land 12 miles from Marysvale in the southern part of the state, said to contain valuable deposits of alunite.

SALT LAKE COUNTY

The Alta Tunnel & Transportation Co. has decided to continue driving its tunnel throughout the winter, and special precautions are being taken to prevent snowslides damaging the property. On one day during the first week in September the Utah Copper Co. sent 29,000 tons of ore from Bingham to the mills at Garfield.

SUMMIT COUNTY

From May 28 to August 21, the American Flag mine at Park City has produced the following metals: gold, 245 oz.; silver, 14,625 oz.; lead, 107,067 lb.; copper, 1982 pounds.

WASHINGTON

FERRY COUNTY

The smelters at Greenwood, Grand Forks, and Trail, British Columbia, require more silicious ores, and there is a market for over 5000 tons per month from Republic mines, if they can supply this quantity.

STEVENS COUNTY

The transmission line from Colville to the United Copper mine at Chewelah, 28 miles, has been completed, and the transformers are being installed and connections made with the four motors, of a combined capacity of 265 hp. The new 125-ton mill will be ready to operate in a few days. The working force will be increased from 85 to 110 men. A shipment of 282 tons of ore from the Silver Standard mine, near Hazelton, to the Trail smelter returned $106.32 per ton. Both the Erie and Harris mines, in this district, have sent rich ore to the smelter. The adit being driven by the Portland Canal Tunnels, Ltd., is in near 1850 feet.

CANADA

BRITISH COLUMBIA

The report of the Granby Consolidated Mining, Smelting & Power Co. for August shows that 101,722 tons of ore was treated, of which 99,641 tons came from the Company's properties and 2081 tons was custom ore. During the month the Grand Forks smelter made and shipped 1,827,300 lb. of blister copper. During the eight months of the current year there has been smelted 829,070 tons of ore, of which 820,240 tons was from the Company's properties, while 8830 tons was custom ore. During the same period there was made and shipped 14,492,997 lb. of blister copper.

(Special Correspondence.)—Shipments of ore from Kootenai and Boundary mines to the Trail smelter last week totaled 6454 tons, making a total for the year to date of 241,527 tons. In the Slocan district the principal shippers were the Standard, 74 tons, and the Utica, 30 tons. The No. 1, at Ainsworth, shipped 141 tons, and the Silver Hoard, in the same camp, sent out 48 tons. In the Nelson district the heaviest producer was the Yankee Girl, at Ymir, which shipped 131 tons. Production of the Kootenai districts shiped to Trail was: Nelson, week 1165 tons, year 52,831; Lardeau, year 332 tons; Rossland, week 5661 tons, year 165,432; East Kootenai, week 378 tons, year 24,604; and Slocan and Ainsworth, week 3022 tons, year 131,142.

Spokane, Washington, September 6.

ONTARIO

During the week ended August 30, five mines shipped 252 tons of ore and four mines shipped 143,916 oz. silver bullion. Since this date the Nipissing and Buffalo companies shipped 135,128 and 66,694 oz., respectively.

The drift between No. 6 and 16 shafts, on the 360-ft. level at the O'Brien mine, connected the two shafts last week, and preparations are being made to sink on No. 6

vein. A winze will be sunk 50 or 75 ft. and another level opened. A 6 by 16-ft. tube-mill and three Deister tables are being added to the O'Brien mill. A new system adopted some months ago which has given perfect satisfaction at the mill is that of a submerged screen for the stamps. The screen is an invention of M. R. Shannesy, of the mine, and can be used under as much as 18 in. of water. Its efficiency is noted in the discharge giving an increased tonnage and improves the wearing conditions of the dies. It also prevents choking. The pumps are working on the drainage of Kerr lake, and will continue until the beginning of December, the date estimated for the completion of the job.

Schools and Societies

The MONTANA STATE SCHOOL OF MINES, at Butte, began the school year on September 2, under favorable circumstances. The faculty has been strengthened by the addition of Bancroft Gore to the chair of metallurgy. Mr. Gore is a Harvard graduate with many years practical metallurgical experience in Montana and South America. The school is in better condition than ever in its history, and the mill is in first-class working order under the direct supervision of a practical millman. The mineralogical and geological museum has been expanded and systematized so that it now compares favorably with others. The local practising engineers are taking an increasingly active interest in the school and its students.

Beginning this fall, HARVARD UNIVERSITY and the MASSACHUSETTS INSTITUTE OF TECHNOLOGY are to maintain in coöperation a School for Public Health Officers. The facilities of both institutions are to be available to students in the school, and the certificate of public health is to be signed by both A. L. Lowell and R. C. Maclaurin, presidents of the respective universities. The object of the school is to prepare young men for public health work, especially to fit them to occupy administrative and executive positions such as health officers or members of boards of health, as well as secretaries, agents, and inspectors of health organizations. The requirements for admission are such that graduates of colleges, or technical and scientific schools, who have received adequate instruction in physics, chemistry, biology, and French or German, may be admitted to the school. The medical degree is not in any way a prerequisite for admission.

The AMERICAN MINE SAFETY ASSOCIATION will meet on September 22, 23, and 24, at Pittsburgh, and a large attendance is expected from distant mining states. An interesting program of papers and discussions has been prepared, and arrangements have been made to visit points of interest in and about Pittsburgh. J. W. Paul, of the U. S. Bureau of Mines, reports that the arrangements for the mine-rescue contest, which will be held at Arsenal Park on September 22, assures the success of this unusual event. Handsome prizes have been offered by the Draeger Oxygen Apparatus and Hirsch Electric Mine Lamp companies, and the American Mine Safety Association, for the men who compete in showing their skill in doing rescue and recovery work at mines. At the same time there will be held a first-aid contest somewhat similar to those held elsewhere in the mining regions. For this a number of handsome prizes have also been received, notably from Johnson & Johnson, a first-aid cabinet and also a first-aid instruction outfit; from Bauer & Black, a first-aid cabinet; American Red Cross, a set of medals; and the American Mine Safety Association, a set of medals for the individual contestants. Many entries have been made. The Bureau of Mines has arranged a big experimental explosion at its mine at Bruceton. This will be the first explosion exhibit given at the mine since its completion. It is expected to attract unusual attention. Altogether, those in charge of the affair feel confident that this will be one of the biggest and most important meetings of persons interested in coal-mining held at Pittsburgh, excepting, possibly, only the National Demonstration held two years ago.

Personal

Professional men are invited to send news of their engagements and travels. Such news is interesting to friends.

C. S. HERZIG has gone to Tulsa, Oklahoma.

L. J. PEPPERBERG has returned from Wyoming.

S. W. PARR has been in San Francisco this week.

F. J. LORING will be in California early in October.

P. R. BRADLEY was in Plumas county over Sunday.

SIDNEY J. JENNINGS was in Salt Lake City recently.

B. B. THAYER has returned to New York from Butte.

G. W. CRANE will spend about a year in the Tintic district, Utah.

RUSH M. HESS has returned to Guayaquil, Ecuador, from Telluride, Colorado.

Ross B. HOFFMANN has returned from Alaska and is now at Carmel-by-the-Sea.

F. L. RANSOME was in San Francisco Monday, and has gone to the Yosemite.

EDWIN J. COLLINS, of Duluth, was in Denver last week on professional business.

EDWARD CLARK, who has been spending the summer in California, was in San Francisco last week.

J. S. DILLER, who has been making geological surveys in Trinity county, will be in San Francisco shortly.

FRANCIS P. BRAY, who has been spending two months in Australia, is returning to London by way of Manila, China, Japan, and across Siberia.

F. C. LINCOLN has left the University of Illinois to accept a position with the Bolivian Development & Exploration Co., of which H. G. Knowles is the head.

ARTHUR W. BUEGREN, engineer of the Matehuala unit of the American Smelting & Refining Co., of Matehuala, San Luis Potosi, Mexico, is at Oakland, California.

EDWARD H. BENJAMIN has severed his active connection with the Joshua Hendy Iron Works, and will resume his former practice as consulting mining engineer.

BRADLEY STOUGHTON was guest of the local members of the American Institute of Mining Engineers at San Francisco on Friday of last week, and was entertained by the Los Angeles members Thursday of this week.

The present address is wanted of WAYNE CHOATE, a mining engineer who several years ago represented English investors in this country, mainly in New Mexico. He was last heard from at Detroit, Michigan. He is cousin to RUFUS CHOATE, formerly ambassador from the United States to England. Kindly communicate with this office.

Obituary

HENRY BARRIOHLET KAEDING, who died in Los Angeles, California, June 12, from heart trouble, was born in San Francisco in 1877. He was the son of one of San Francisco's pioneer business men, and his early education was obtained in the public schools. His technical education was, with the exception of a year at the California School of Mechanical Arts, and a few months with Frank Green, then city chemist, obtained through personal study. After four years in the lode mines of Amador county, and a year in the placer mines of Plumas county, he made an extended trip, in 1896, to the South Pacific islands in a small schooner, exploring the Galapagos, Guadaloupe, and other islands, and making extensive collections of the flora and fauna for the Smithsonian Institution. He was an authority on Western ornithology. In 1898 he went to Korea for the newly organized Oriental Consolidated Mining Co. and was one of the first to successfully treat concentrate by cyanidation at a time when little was known about this branch of cyanidation. He had charge of properties in Mexico and for two years was in charge of the Siempre Viva Mining Co. of Nicaragua. He was a frequent contributor to the *Mining and Scientific Press* and other scientific papers, and was a member of the American Institute of Mining Engineers, the California Academy of Sciences, the Cooper Ornithological Club, and other scientific societies.

The Metal Markets

LOCAL METAL PRICES

San Francisco, September 11.

Antimony	12—12½c	Quicksilver (flask)	$40
Electrolytic Copper	17½—17¾c	Tin	46—47½c
Pig Lead	5.00—5.05c	Spelter	7¼—7½c

Zinc dust, 1400 lb. casks, per 100 lb., small lots $9.50—9.75; large $7.50—8.00

EASTERN METAL MARKETS

(By wire from New York.)

NEW YORK, September 11.—Copper market is strong and a large business is being done both at home and abroad. European trade prospects are much brighter and supplies are being imported at a heavy rate from America. It is to be expected that as the price of copper goes up, the consumers will be more reserved, but the fear of a temporary scarcity in supply is expected to maintain the demand. The lead and spelter markets remain quiet. Spot to November copper is quoted at 16⅝. Lead is quoted at $4.70 and spelter at from $5.85 to $5.95. Spot tin is quoted at from $42.25 to $42.50. General advance is to be noted in copper stocks.

SILVER

Below are given the average New York quotations, in cents per ounce, of fine silver.

Date.		Average week ending	
Sept.	4	July 30	59.28
"	5	Aug. 7	59.29
"	6	" 14	59.12
"	7 Sunday	" 20	59.16
"	8	" 27	59.46
"	9	Sept. 3	59.60
"	10	" 10	59.58

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	56.25	63.01	July	60.67	58.70
Feb.	59.06	61.25	Aug.	61.32	59.32
Mch.	58.37	57.87	Sept.	62.95	....
Apr.	59.20	59.26	Oct.	63.16	....
May	60.88	60.21	Nov.	62.73	....
June	61.29	59.03	Dec.	63.38	....

The features of the silver market remain unaltered, according to Pixley & Abell, on August 23. Throughout the week China has sent moderate buying orders, and, as offerings have been under normal, the present rates have been easily held. The Indian bazaars also have given a little support by buying for the September settlement steamer leaving London next week. Bombay stocks were reported on August 19 to be 3000 bars, and it is possible that a little more may be required for this settlement.

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.		Average week ending	
Sept.	4	July 30	4.40
"	5	Aug. 6	4.50
"	6	" 13	4.48
"	7 Sunday	" 20	4.68
"	8	" 27	4.75
"	9	Sept. 3	4.75
"	10	" 10	4.73

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	4.43	4.28	July	4.71	4.35
Feb.	4.03	4.33	Aug.	4.54	4.60
Mch.	4.07	4.32	Sept.	5.00	....
Apr.	4.20	4.36	Oct.	5.08	....
May	4.20	4.34	Nov.	4.91	....
June	4.40	4.33	Dec.	4.20	....

ZINC

Zinc is quoted as spelter, standard Western brands, St. Louis delivery, in cents per pound.

Date.		Average week ending	
Sept.	4	July 30	5.20
"	5	Aug. 6	5.40
"	6	" 13	5.45
"	7 Sunday	" 20	5.51
"	8	" 27	5.60
"	9	Sept. 3	5.63
"	10	" 10	5.65

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	6.42	6.88	July	7.12	5.11
Feb.	6.50	6.13	Aug.	6.96	5.51
Mch.	6.57	5.94	Sept.	7.45	....
Apr.	6.63	5.52	Oct.	7.36	....
May	6.68	5.23	Nov.	7.23	....
June	6.88	5.00	Dec.	7.09	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California, being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask of two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending			Week ending	
Aug.	14	41	Aug. 28	40
"	21	40	Sept. 6	40
			" 13	40

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	43.75	39.37	July	43.00	41.00
Feb.	46.00	41.00	Aug.	42.50	40.50
Mch.	46.00	40.20	Sept.	42.12	....
Apr.	42.25	41.00	Oct.	41.50	....
May	41.75	40.25	Nov.	41.50	....
June	41.30	41.00	Dec.	39.75	....

TIN

New York prices control in the American market for tin, since the metal is almost entirely imported. San Francisco quotations average about 5c. per lb. higher. Below are given average monthly New York quotations, in cents per pound:

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	42.53	50.45	July	44.25	40.70
Feb.	42.96	49.07	Aug.	45.80	41.75
Mch.	42.58	46.95	Sept.	48.64	....
Apr.	43.92	49.00	Oct.	50.01	....
May	46.05	49.10	Nov.	49.92	....
June	45.76	45.10	Dec.	49.80	....

COPPER

Quotations on copper as published in this column represent average wholesale transactions on the New York market and refer to electrolytic copper. Lake copper commands normally from 1-5 to 1-4c. per lb. more. Prices are in cents per pound.

Date.		Average week ending	
Sept.	4	July 30	14.58
"	5	Aug. 6	14.92
"	6	" 13	15.53
"	7 Sunday	" 20	15.59
"	8	" 27	15.51
"	9	Sept. 3	15.69
"	10	" 10	16.32

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	14.09	16.54	July	17.19	14.21
Feb.	14.08	14.93	Aug.	17.49	15.42
Mch.	14.68	14.72	Sept.	17.56	....
Apr.	15.74	15.22	Oct.	17.32	....
May	16.03	15.42	Nov.	17.31	....
June	17.23	14.71	Dec.	17.37	....

COPPER PRODUCERS' ASSOCIATION REPORT

The Copper Producers' Association statement, September 8, shows a decreased surplus. The details are as follows:

	Pounds.
Stock of marketable copper of all kinds on hand at all points in the United States, August 1, 1913	53,594,945
Production of marketable copper in the United States from all domestic and foreign sources during August	131,632,362
Deliveries for consumption, August	73,649,801
Deliveries for export, August	73,263,469
Stock of marketable copper of all kinds on hand and at all points in the U. S., September 1	38,314,137

Recent changes in surplus have been as follows, in pounds:

	Increase.	Decrease.
August 1912	.....	3,579,046
September	16,364,213	.....
October	13,679,380	.....
November	9,419,095	.....
December	19,148,523	.....
January 1913	17,885,770	.....
February	.....	896,134
March	.....	18,032,928
April	.....	28,720,162
May	.....	8,074,883
June	.....	14,569,619
July	690,339	.....
August	.....	15,280,908

The Stock Markets

SAN FRANCISCO STOCKS AND BONDS

(San Francisco Stock and Bond Exchange.)

BONDS

September 10.

Listed.	Bid	Ask	Unlisted.	Bid	Ask
Associated Oil 5s	$ 98½	—	Natomas Dev. 6s	$ —	100
E. I. du Pont 4½s	83½	—	Pac. Port. Cement 6s	99	—
Natomas Con. 6s	77	79	Riverside Cement 6s	77	79
Unlisted.			Standard Cement 6s	91½	—
Ass. Oil 1st ref.	74½	—	Santa Cruz Cement 6s	80	90
General Petroleum 6s	57	57½			

STOCKS

Listed.	Bid	Ask	Unlisted.	Bid	Ask
Associated Oil	43	43½	Mascot Copper	1½	2½
Amalgamated Oil	85	—	Noble Electric Steel	—	[illegible]
E. I. du Pont pfd	86	92½	Natomas Consol.	9	12
Pac. Cst Borax, com	—	[illegible]	Pacific Port. Cement	61	—
Pacific Crude Oil	22½c	—	Riverside Cement	45	—
Sterling O. & D.	70c	[illegible]	Santa Cruz Cement	84	[illegible]

NEVADA STOCKS

(By courtesy of San Francisco Stock Exchange.)

San Francisco, September 11.

Atlanta	$ .15	Mizpah Extension	$ .40
Belcher	.36	Montana-Tonopah	1.17
Belmont	7.27	Nevada Hills	.54
Big Four	.30	North Star	.72
Cash Boy	.08	Ophir	.25
Florence	.25	Pittsburg Silver Peak	.45
Goldfield Con.	1.95	Round Mountain	.36
Goldfield Oro	.08	Sierra Nevada	.07
Halifax	1.55	Tonopah Extension	1.90
Jim Butler	.63	Tonopah Merger	.71
Jumbo Extension	.12	Tonopah of Nevada	4.75
MacNamara	.12	Union	.14
Mexican	1.25	West End	1.52
Midway	.46	Yellow Jacket	.40

COPPER SHARES—BOSTON

(By courtesy of J. C. Wilson, Mills Building.)

September 11.

	Bid	Ask		Bid	Ask
Adventure	$ 1½	2	Mohawk	$ 44½	45
Allouez	38	38½	North Butte	28½	28¾
Calumet & Arizona	67½	67¾	Old Dominion	42½	43
Calumet & Hecla	440	445	Osceola	87	89
Centennial	13½	14	Quincy	61	63
Copper Range	40¾	41	Shannon	6½	6¾
East Butte	12¾	13	Superior & Boston	2¼	3½
Franklin	3¾	4	Tamarack	31	31½
Granby	76	76½	U. S. Smelting	40	40⅜
Greene Cananea	6¾	7	Utah Con.	9½	10
Hancock	18¾	19	Victoria	1¼	1½
Isle-Royale	21	21½	Winona	99c	—
Mass Copper	3½	3¾	Wolverine	46½	47

NEW YORK QUOTATIONS

(By courtesy of E. F. Hutton & Co., Kohl Building.)

September 11.

	Bid.	Ask.		Bid.	Ask.
Alaska G. M.	20	20¼	Mason Valley	6	7
Braden Copper	7⅛	7⅜	McKinley-Dar.	1½	1¾
B. C. Copper	2¼	2½	Mines Co. Am.	2⅛	2⅜
Davis-Daly	1⅞	2¼	Nipissing	9	9⅛
Dolores	2	4	Ohio Copper	⅜	½
El Rayo	1	2	San Toy	18	22
Ely Con.	6	8	Sioux Con.	1	2
First Nat.	3⅛	3¼	So. Utah	⅛	¼
Giroux	14½	15⅛	S. O. Calif.	182	185
Greene Can.	6⅜	7	Tri Bullion	⅛	¼
Hollinger	15½	16½	Tuolumne	¾	⅞
Iron Blossom	115	125	United Copper	¼	¾
Kerr Lake	2⅜	2½	Wettlaufer	14	16
La Rose	2¼	2⅜	Yukon Gold	2	2⅛

AUGUST COPPER PRODUCTION

	Pounds.
Copper Queen	7,590,994
Copper Queen custom ores	661,410
Montezuma	3,547,047
Detroit	2,187,223
Phelps-Dodge total	13,981,564
Chino	6,050,867
Miami	3,097,500
Shannon	1,248,000
Anaconda group	23,775,600
Ray	4,500,000

AUGUST ON STOCK EXCHANGE

Business on the New York Stock Exchange for the month of August was a little more active than in July, but below August of last year. Total sales this year amounts to 6,102,350 shares, against 8,946,165 last year. The largest day's trading was 537,815 shares on the 12th, and the smallest 160,219 shares on the 25th of the month.

Bond transactions were far below the previous month and a year ago, sales amounting to only $29,539,000. The largest day's business was $1,912,000 on the 12th, and the smallest $917,000 on the 20th, according to the *Evening Post*. The month's total sales compare as follows with previous months and with August in other years:

STOCKS, SHARES

Aug. '13	6,102,350	Aug. '12	8,946,165
July '13	5,204,760	Aug. '11	15,031,200
June '13	9,643,096	Aug. '10	10,386,720
May '13	5,409,014	Aug. '09	24,537,840
Apr. '13	8,496,162	Aug. '08	18,541,518
Mar. '13	5,202,116	Aug. '07	14,905,697
Feb. '13	6,379,250	Aug. '06	31,729,274
Jan. '13	8,713,729	Aug. '05	20,289,047
Dec. '12	12,907,020	Aug. '04	12,193,123
Nov. '12	8,789,678	Aug. '03	15,468,286
Oct. '12	14,079,840	Aug. '02	14,090,431
Sept. '12	10,026,318	Aug. '01	10,791,312

BONDS, PAR VALUE

Aug. '13	$29,539,000	Aug. '12	$45,507,000
July '13	34,604,000	Aug. '11	47,849,000
June '13	42,039,000	Aug. '10	31,367,000
May '13	42,045,000	Aug. '09	113,522,000
Apr. '13	54,461,000	Aug. '08	82,517,300
Mar. '13	39,029,000	Aug. '07	30,289,000
Feb. '13	45,777,000	Aug. '06	55,206,000
Jan. '13	54,548,000	Aug. '05	87,887,500
Dec. '12	42,464,000	Aug. '04	67,026,000
Nov. '12	38,543,000	Aug. '03	45,808,500
Oct. '12	46,879,000	Aug. '02	52,806,300
Sept. '12	45,590,000	Aug. '01	36,665,100

STANDARD OIL DIVIDENDS

The *Financial World* comments as follows: "In figuring the total amount of dividends that will be paid this year by the various former subsidiaries, 30 odd in number, of the Standard Oil Co., it is calculated that shareholders will receive in round figures the sum of $100,000,000. The sum might be a million or two above or a million or two under the $100,000,000 mark, but it will not be far from it either way. The old capital stock of the Standard Oil Co., before the trust was broken up, was $100,000,000, so that this year's dividends will represent about 100% return on the old capital. For the third quarter of the year the total disbursements will be about $15,000,000, making for the eight months this year thus far paid about $86,500,000. The fourth quarter will increase this to the $100,000,000 mark. In 1912 cash dividends paid totaled only $92,000,000, but since then there have been various increases and additional stock distributed, while in March last the Standard Oil of New Jersey paid a 40% dividend amounting to nearly $40,000,000. There is a probability also that next spring the New Jersey company will pay another dividend that will be classed as extra and large. The Standard Oil subsidiaries are doing the cream of the oil business, and their dividends are creamy also. No skimmed milk there."

Money coined at the mints of the United States in August was as follows.

Denomination.	Pieces.	Value.
Dimes	2,300,000	$230,000
One-cent pieces	19,145,000	191,450
For Philippine Islands:		
20-centavo pieces	205,000	₱41,000

The unfilled orders of the United States Steel Corporation on August 31 totaled 5,223,468 tons, a decrease of 175,888 tons over July. On July 31 there were 5,399,356 tons, and on June 30, 5,807,377 tons.

Book Reviews

BRITISH COLUMBIA. Report of the Minister of Mines for 1912. Compiled by W. F. Robertson. P. 350. Ill., index.

The period under review in this work has been the most productive in the history of British Columbia mining. The statistical data and general survey of the industry are presented in a most interesting manner. The various districts are discussed in an authoritative way, which together with the illustrations and figures presented form a composite treatise on the mining industry of that country which is not to be had in any other work on the subject. The scope and progress made in mining during the past year may be judged by the output figures, which show an increase from $23,499,999 in 1911 to $32,440,000 in 1912.

ELECTRICITY IN MINING. By Siemens Brothers Dynamo Works, Ltd. P. 201. Ill., index. Charles Griffin & Co., Ltd., London. For sale by the *Mining and Scientific Press*. Price $3.50.

The application of electricity to mining is becoming more general every year, and today electrical equipment is to be had for the driving of every machine used in or about a mining property. Electricity has been found as a most useful form of power in the driving of every class of machine from the most insignificant pump to the largest of mine hoists, and in most cases it has been found to be superior to either steam or compressed air. In the work under review it has been the purpose of the authors to present a work indicating the various purposes to which electricity can be applied in mining work and to give a general idea as to the design and lay-out of such installations. Among the subjects discussed are included distribution systems, power stations, switch gear in generating stations, power transmission, electric winding engines, pumping plants, mine fans, compressors, haulage systems, locomotives, auxiliary machines, rock-drills, signaling systems, and shot firing. While the work cannot be regarded as a textbook on the subject of electricity applied to mining and is largely descriptive of the application of the products of the Siemens company to mining operations, the splendid illustrations and diagrams are of interest, and, with the discussion, present a general idea as to what well equipped plants are like and the broad application of electricity to mining operations.

ELECTRICAL ENGINEERING FOR MECHANICAL ENGINEERS. By H. J. S. Heather. P. 324. Ill., index. D. Van Nostrand Co., London. For sale by the *Mining and Scientific Press*. Price $3.50.

This work comprises a series of lectures which were written by the author for a special class of men on the Rand, who found themselves confronted by peculiar circumstances. The men were the resident mechanical engineers of that district and had to deal with the problem of a change in the power-supply for the mines from steam to electricity. Previous to 1908, electricity had been used only to a small extent in the gold mines of the Witwatersrand and the mine electrician occupied a comparatively unimportant position, being responsible to the resident mechanical engineer at each property. As a consequence, the capabilities of some of the electricians were not of a high order, and the limitations in their responsibilities had resulted in their being, as a class, somewhat deficient in the power of handling men, the very quality to which many of the mechanical engineers owed their positions. Seeing that the change from steam to electricity was to come suddenly, it appeared likely that the gold mining industry would find itself short of men capable of taking engineering charge of the mine under the new conditions, unless some of the resident mechanical engineers were able to obtain sufficient electrical knowledge to enable them to retain their posts satisfactorily. It was to meet these conditions and to benefit these men that this series of lectures was compiled. The classes of electrical engineering work dealt with are, accordingly, to a great extent those which these men were most likely to need. As an elementary course in practical electricity this work is most valuable, embracing as it does a large field and covering those points of the most practical importance in the ordinary handling of electric power plants.

GENERAL METALLURGY. By H. O. Hofman. P. 909. Ill., index. McGraw-Hill Book Company, New York. For sale by the *Mining and Scientific Press*. Price $6.

Metallurgical literature consists largely of treatises and monographs dealing with the metals proper and parts of metallurgical activity, with but few works that make any attempt to cover the entire subject in even a general way. It has been the aim of the present work to cover the field of general metallurgy in a manner which will be useful both as a text and reference work on the subject. While it is impossible to take up in detail, in a work of this size, all of the various branches of the science, Mr. Hofman has succeeded in presenting a volume which covers the subject in a most commendable manner. Special attention has been given to mechanical processes, as the tendency of modern practice is largely in this direction. The general literature of metallurgy has been drawn upon freely, and references will be found in the footnotes to most of the books and papers of importance which have been published on the subject. The thermo-chemical data have been taken from J. W. Richards' book on 'Metallurgical Calculations,' and many illustrations have been borrowed from R. H. Richards' standard treatise on 'Ore Dressing.' The work discusses in a general way the history of the metals, the physical and chemical properties of metals, alloys, and metallic compounds, the metallurgical processes, ores, fluxes, apparatus, and metallurgical products, and in detail fuels and refractory materials. The subject of fuel, being one of primary importance in most metallurgical operations, is covered in a most thorough manner. The many industrial fuels are discussed as to calorific power and applications. Briquetted fuel, which has come to be such an important factor in the European fuel market, and gives promise of a much more general use in the future, is discussed as to manufacture and use. As there is no material on the market that meets all of the requirements of a perfect refractory, the subject of the adaptability of certain refractory materials to certain uses is one which is an important metallurgical consideration and is discussed in an interesting and instructive manner. Electro-metallurgical processes are treated in a general manner, both as to processes involving the conversion of electrical energy into heat for the purpose of producing a temperature necessary for a process, and its use in the decomposition of a compound by wet electrolysis, where the amount of heat generated is relatively small or by dry electrolysis, where the amount of heat generated is necessarily large. The mechanical processes which are necessitated by metallurgical processes are also reviewed. Those operations involved in the crushing of ore, concentration, briquetting, rolling, forging, pressing, and drawing of metals and alloys for use in the arts; solutions have to be handled in wet processes and solids separated from liquids by filter-pressing or other mechanical means; smelting operations require forced draft or blast, and the air may have to be heated or cooled before it is made to act upon fuel or charge; the vapors and gaseous products of a process have to be withdrawn from the apparatus in which they are produced, and perhaps some of the metal recovered as flue-dust before the gases are allowed to pass off into the open. The mechanical appliances used in these processes are illustrated and their uses described.

In the present work the aim has been to cover the field of general metallurgy as a whole. The good of the older endeavor has been combined with that of modern research, and the whole has been treated from the point of view of the metallurgist who has a leaning toward physical chemistry.

A CIRCULAR SHAFT, 29 ft. in diameter and 221 ft. deep, with reinforced-concrete walls 5 ft. thick, has been sunk near Edmonton, province of Alberta, Canada, to serve a coal mine owned by French capitalists. It has taken 10 months to complete the shaft, and an output of 2000 tons of coal daily will be made when the equipment is finished.

Company Reports

HUTTI (NIZAM'S) GOLD MINES, LTD.

The Company was registered in 1901 to acquire, subject to the consent of the Nizam's Government, by assignment from the Hyderabad (Deccan) Co., Ltd., the mining rights over a leasehold area containing 92 square miles in the state of Hyderabad, southern India, held by the Hyderabad company from the Government of the Nizam, under their Raichore Doab Gold Fields lease, upon terms including a royalty of 5% in gold produced. The authorized capital is £70,000, in 70,000 shares of £1 each; 69,610 shares are issued and fully paid. The report presented in May 1913 covers the previous 15 months. During that time 27,733 tons of ore was crushed. The value of the gold recovered was £78,720, of which £63,055 was obtained from the mill and £15,666 from the cyanide plant. During 1912 the total working cost amounted to 34s. per ton of ore treated. The milling cost, inclusive of crushing and tramming, was 5.7s. per ton of ore crushed, and the cost of cyaniding was 2s. per ton. The ore reserves are approximately 20,000 tons, containing 15,000 oz. of gold. The full dividend for the 15 months was 10%. The credit balance on December 31, 1912, was £11,908. During the year £8000 was spent for a new Diesel engine, air-compressor, and other equipment. A slime plant is in course of construction, and a railway to the mine is to be started soon. The fuel and water supply is rather limited.

ABANGAREZ GOLD FIELDS OF COSTA RICA

The Company has issued $3,880,000 of common stock and $1,000,000 of preferred stock. Improvement work was started three years ago, it is hoped to be completed during this year, and it is anticipated the plant will then be able to handle at least 10,000 tons of ore per month. The results for 1912 were disappointing in that the ore-shoots which have hitherto yielded supplies of high-grade ore furnished a much poorer grade. For instance, one on the fifth level gave an average recovery of only $9.65, as compared with an average of $29.97 for the past seven years. The gross receipts from the sale of bullion were $606,782.22. The rebuilt mill has forty 1250-lb. stamps on concrete mortar blocks, and ten more are being erected, while five tube-mills have been erected. Air-compressors, rock drills and stoping drills, and an electric hoist have been installed at the mine and a power-plant built on the Guacimal river; the total expenditure on improvements during the year amounted to $222,781. To provide funds for this work, $403,400 in three-year 6% notes has been issued, and $106,500 in demand notes, the deficit of operating receipts as compared with expenditures for the year having been $175,463. Charges for depreciation, amortization, etc., bring the total deficit to $213,005.

SOUTH UTAH MINES & SMELTERS

The Company was organized under the laws of Maine, in 1909, and is a reconstruction of the Newhouse Mines & Smelters. The property comprises 13 copper-mining claims, two placer claims, and the townsite of Newhouse, in Beaver county, Utah. The authorized capital is $4,300,000, in 860,000 shares of $5 each; 654,800 shares are issued and fully paid. The report for 1912 gives the total shipments of concentrate and crude ore as 34,763 tons, with 5,921,864 lb. copper, 48,546.35 oz. silver, and 2,449,961 oz. gold. The net smelter returns were 5,527,810 lb. copper, 2,449,961 oz. gold, and 43,691.71 oz. silver. The average ratio of concentration was 12.51 into 1, and the average mill recovery was 59.09%. The total cost of mine operation was 83c. per ton, or 6.44c. per pound of copper; that of mill operation was 67c. per ton, or 5.19c. per pound of copper; that of smelting was $2.22 per ton, or 17.17c. per pound of copper. The total net cost of operation was 15.50c. per pound of copper. The mine has little ore reserve developed. The No. 2 French orebody is the most promising find of the year; at present each foot of height proved in this orebody means a reserve of 1350 tons. The orebody averages, including a shoot of low grade in the centre, a little better than 1% copper. The twelve months ended June 30, 1913, closed with a net loss of $31,114.

IRON MOUNTAIN TUNNEL COMPANY

The holdings of this Company are at Superior, Montana. The authorized capital is 200,000 shares at $10 each, of which $1,700,000 is issued and outstanding. During the year, improvements have been made and new machinery purchased and installed. It was evident that the plant must be electrified throughout before it could be successfully operated. A contract was made with the Northwestern Development Co. providing for the delivery of electric power at 60,000 volts at the plant of the Iron Mountain Co. An ore-sorting plant was constructed, also an Ingersoll-Rand electrically driven air-compressor installed. A transformer house has been constructed, and a new boarding-house built. Plans are being made for the providing of $35,000 additional capital so that a McQuisten tube concentrating plant, estimated to cost $10,000, can be built. E. C. Smith, a minority stockholder, instituted suit to prevent sale of his stock for an unpaid assessment.

BROKEN HILL PROPRIETARY BLOCK 14 COMPANY

This Company was registered in Australia, in 1887, to acquire silver-lead mining property at Broken Hill, New South Wales, and a smelting works at Port Adelaide, South Australia. Additional leases near Broken Hill have since been acquired, and tungsten and bismuth properties in New South Wales. The authorized capital is £155,000 in 100,000 10% cumulative preference shares of 6s. each, and 100,000 ordinary shares of £1 5s. each, all shares being issued and fully paid. Concentrating works have been erected, but operations have been suspended since November 1907, and ore is now being sold. The present output is chiefly from the carbonate zone. The report for the half-year ended March 31, 1913, gives the tonnage of carbonate ore shipped as totaling 6992 tons, assaying 25.4% lead and 14.9 oz. silver, compared with 12,484 tons, assaying 28.63% lead and 15.99 oz. silver, during the previous period, the total metal contents being 1776 tons lead, 104,181 oz. silver, and 3574 tons lead, 199,619 oz. silver, respectively. The cost of mining was £1 15s. 6d. per ton, compared with £1 6s. 10.6d. in the previous term, the difference mainly caused by the scarcity of men suitable for this work and the consequent small output. The further continuance of carbonate ore work depends on the exploration of the old workings, and as extraction proceeds it becomes more difficult to maintain a steady output of ore of a suitable grade. For the half-year 9503 tons of sulphide ore was delivered at the Junction North, at a cost of 16s. 9.4d. per ton, the average value being 15.4% lead, 1205 oz. silver, and 12.01% zinc, these figures comparing favorably with previous shipments of 2173 tons assaying 15.1% lead, 11.9 oz. silver, and 11% zinc. The purchasers were unable to handle larger consignments, but as they have increased their capacity, it is hoped the next half-year will show an increased output. The working profit for the half-year was £6578 and the net profit £5805. One dividend was paid, of 1s. 6d. per share, amounting to £15,000, and the balance now standing at credit of profit and loss account is £72,569.

GREAT BOULDER PERSEVERANCE GOLD MINING CO.

The quarterly report of this Kalgoorlie company contains the following: Development covered 2157½ ft. The policy of developing the Furness and D lodes has been continued with good results, and the latter has been traced on the 900-ft. level. The finding of an eastern branch of the Lake View lode on the 2050-ft. level gives encouragement to resume work at the bottom of the mine. The average ore mined has risen from 6.39 dwt. for the previous quarter to 6.57 dwt. for the period under review. The grade of the ore treated during the quarter was below the average of the broken ore reserves; this has increased the average value of the ore remaining in the stopes. Broken ore in the stopes amounts to 172,107 tons averaging $6.34 per ton.

Ore treated, tons	61,691
Gold and silver production	$288,000
Working costs per ton	$4.37

Concentrates

Most of these are in reply to questions received by mail. Our readers are invited to ask questions and give information dealing with the practice of mining, milling, and smelting.

A 100,000-CU. FT. FAN has been erected at the 'B' shaft of the Old Dominion, Arizona, for ventilating the west end of the mine, and the ventilation underground is already greatly improved.

AFTER a year's work with a continuous decantation and counter-current solution system of slime treatment, followed by dewatering on a Portland filter, Mr. Bowman, manager of the New Reliance mine, South Dakota, states that he is satisfied with the operation of the process. Recovery of gold is from 85 to 87%, and total milling costs are less than $1.25 per ton. The plant is handling 100 tons per day. During July the total cost of mining and milling was $2.48 per ton, which is good work.

MIXTURES of gas and air have three critical points, namely, when the mixture begins to be explosive, when it is most explosive, and when the mixture burns without explosion. Oil gas of the following composition begins to explode in proportions of 7 parts of gas and 93 parts of air: CO_2, 1.6%; CnH_2n, 6.8%; O_2, 0.2%; CO, 3.4%; H_2, 52.1%, CH_4, 30.8%; and N_2, 5.1%. It is most explosive when the proportions are 15.4 of gas to 84.6 of air, and the mixture begins to burn without explosion when the proportion is 24.5 of gas to 75.5 of air.

COST of removing silt from harbors in British Columbia, by five different types of dredges, is as follows:

Type.	Hours dredging.	Material, moved, cu. yd.	Cost, cents per cu. yd.
Elevator	2,003	951,200	16.6
Suction scraper	2,386	2,597,500	5.8
Dipper	3,513	349,275	20.7
Dipper	3,444	576,125	26.2
Agitator-suction	2,786	1,006,570	12.5

ALUNITE is a mineral with a theoretical content of 11.4% potash (K_2O) and 37% alumina. While the mineral is seldom found pure in nature, its deposits are of importance as a possible source of both potash and alumina, and interest therefore attaches to several of the recent discoveries of this mineral by geologists of the United States Geological Survey. A recent investigation of the Nogales region, in southern Arizona, by F. C. Schrader, of the Survey, revealed a deposit of alunite. Analyses of rock samples collected from the Evening Star copper prospect by Mr. Schrader showed large percentages of alumina and potash, and while the discovery of the alunite was only incidental to the investigation of the copper deposits, it has served to suggest that other alunite deposits may be found in this formation, which occupies an area of many square miles. Another deposit of alunite discovered by Mr. Schrader is at Bovard, Nevada, where, he says, the rocks show as high as 10 and 11% of potash. The actual extent of the deposits of the Bovard district is not known, as the character of the rock was not recognized by Mr. Schrader on the ground, so that no prediction of the possible value is justified.

TWO SYSTEMS of rope transmission are in general use, the American or continuous rope, and the English or multiple-rope system. The former uses rope wound over the grooves of driving and driven sheaves with suitable idlers and tension carriages that automatically regulate the tension of wraps of rope over the various grooves. This is the system in general use today. The English, or multiple system, requires an independent rope with splice for each groove on the driving sheave, and is nearly always used for heavy powers, large ropes being utilized on deep-grooved sheaves. No tension is used in this system, the rope running at moderate slackness, allowing the natural gravity or weight of the ropes to provide sufficient traction or tension. Rope transmission is adapted for use under many conditions impossible or impracticable with other methods of power transmission, especially for crowded conditions, long distances, and large powers. Its economy in cost and maintenance, its noiselessness, its smooth running and positive features, and its simplicity, compactness, and ease of distribution are recognized by engineers everywhere.

FERBERITE is the name given to an iron-manganese tungstate from the Sierra Almagrera, Spain, which contained 3% manganese oxide. The view that the name should be given to a practically pure iron tungstate seems to be somewhat prevalent, but the above example, and the common usage in regard to other minerals, do not justify this restriction. Analyses of ferberite from the Nederland-Beaver Creek area, Boulder county, Colorado, vary as follows: tungstic acid, 60.98 to 74.13%; iron oxide, 19.13 to 24.14%; manganese oxide, 0.08 to 0.69%; lime, 0.35 to 1.28%; silica, 0.71 to 16.10%; aluminum oxide, 0.46 to 3.10%; and magnesium oxide, nil to 0.59%. Ferberite is generally almost black, with a slight tendency to brownish black, and on fresh granular surfaces a weak steel-gray color. The lustre varies with the surface examined. The cleavage is perfect, and the mineral shows a tendency to break into thin crumbling plates. Small crystals are common in cavities. The specific gravity ranges from 7.1 to 7.5, nearly three times that of quartz. The streak made on a light colored, hard surface, or on rough porcelain, is dark-grayish black, suggestive of brown. The powder made by scratching the surface with a knife is black to very dark brownish black. The fusibility varies with the percentage of manganese present.

AMONG the more noteworthy alterations in Rand metallurgical practice that have taken place during the past two or three years, particular reference may be made to the tendency to equip ore-reduction plants with tube-mills of less capacity and length than hitherto. In the past most of the tube-mills, in fact all the mills installed on Witwatersrand mines, were 5½ by 22 ft. For some years these dimensions were regarded as the sizes of standard tube-mills. All mines under control of the Central Mining & Investment Corporation, for which fine-grinding practice was decided on, were of this size, according to the *South African Mining Journal*. The most recent equipment installed on the 'main reef' properties have, however, been 6 by 16½ ft. The new Van Ryn Deep 80-stamp mill includes eight 6 by 16½ ft. tube-mills, and the Consolidated Langlaagte 100-stamp mill contains ten mills of a similar dimension. Apparently the Johannesburg Consolidated Investment Co. has been the pioneer Rand firm in deciding upon a smaller size of tube-mill, but for some time past there has been a feeling among Transvaal metallurgists generally that shorter tube-mills than the standard 5½ by 22 ft. would do more economical work. It is understood that exhaustive experiments have recently been carried out at a leading Witwatersrand mine with a view to determining the most efficient and economical size of tube-mill. It is also stated that these researches have gone a good way toward proving that mills of even smaller dimensions than the 6 by 16½-ft. tube-mills erected at the Consolidated Langlaagte and the Van Ryn Deep will more nearly approach the ideal as regard the combined consideration of capacity, efficiency, and cost. It is expected that these tests will have an important and far-reaching effect on Rand ore-reduction methods. It seems probable, at any rate, that in the future such new mills as may be installed on the Witwatersrand will be shorter than the standard 5½ by 22-ft. mill. This view appears to be fairly widely held now, that in the larger size tube-mills five or six feet of the cylinder may be regarded as so much mechanical waste, having regard to the comparative horsepower cost of the large and small mills. Some time ago, the metallurgical department of the Central Mining & Investment Corporation installed an 8-ft. Hardinge mill for testing purposes at the Village Deep. These tests, it was understood, proved the mill to give efficient results on a fine product, but indicated that it did not give entire satisfaction with coarse particles of ore. It was stated that with screening of 100 mesh the mill did good work, and this mill was afterward purchased by that Company and now forms part of the permanent equipment.

Production Statistics

SALT AND BROMINE

The production of salt in the United States, including Hawaii and Porto Rico, in 1912 was 31,524,908 bbl. of 280 lb. each, or 4,408,473 short tons, valued at $3,402,772. The corresponding figures for 1911 were 31,183,668 bbl., or 4,360,786 tons, valued at $3,545,692. Thus for the year 1912 there was a gain of nearly 70/ in quantity of salt produced and of nearly 10% in value as compared with the production of 1911. The average price of salt per barrel in 1912 was 25.210c., or $2.02 per short ton, as compared with 28.760c. per barrel, or $1.81 per short ton, in 1911. The following table gives the production and value of the salt produced in the United States in 1912, by states:

State.	Barrels.	Value.
New York	10,547,221	$2,918,344
Michigan	10,946,795	2,974,429
Ohio	5,269,178	1,364,196
Kansas	2,171,656	544,292
California	1,040,000	620,144
West Virginia	196,181	66,015
Texas	871,064	240,526
Utah	268,283	154,774
Hawaii	9,266	9,266
Nevada	12,549	25,772
Other states	*2,230,771	445,666
Totals	31,524,908	$9,402,772

*Includes Idaho, Louisiana, New Mexico, Oklahoma, Pennsylvania, Porto Rico, and Virginia.

Imports of salt totaled 986,664, and exports 445,785 bbl.

The production of bromine was 947,200 lb., valued at $106,201. The industry is centred in Michigan, Ohio, Pennsylvania and West Virginia. Calcium chloride is also produced from the industry amounting to 15,880 tons, worth $107,172, in 1912.

SAND AND GRAVEL

The total production of sand and gravel in the United States in 1912 reported to the U. S. Geological Survey by producers was 64,214,677 short tons, valued at $47,761,186, as compared with 59,442,476 short tons, valued at $41,194,340, in 1911, a net increase in quantity of 4,472,201 tons and in value of $1,862,872 over the production of 1911. Sand for building purposes constitutes about one-third of the total production. In 1912 the production of building sand was 23,672,187 short tons, valued at $7,894,281, as compared with 24,814,142 short tons, valued at $7,714,596, in 1911, a decrease in production of 1,062,185 short tons, but an increase in value of $179,685 over the production of 1911. The average value of building sand per ton increased from 30c. in 1911 to 33⅓c. in 1912. As there can be no appreciable diminution of the supply of building sand in this country in many years, the most plausible explanation of this increase in value must be higher wages paid to laborers. As 1912 was a year of prosperity and building was brisk, it seems hard to account for the falling off in production of building sand of more than 1,000,000 tons.

The tonnage of gravel produced exceeds that of sand. The total production of gravel used for concrete, paving, filter beds, roofing, road-making, railroad ballast, and other purposes in 1912 was 39,798,530 short tons, valued at $7,737,941, in comparison with 34,627,892 short tons, valued at $6,716,954, produced in 1911, an increase in quantity of 5,170,638 short tons and in value of $1,020,987. These figures show an increase in average cost per ton of gravel from approximately 19c. to 19c. Although in all probability wages paid to laborers have increased and tended to raise the cost of gravel, it is believed that the introduction of machinery during the year 1912 tended to reduce the average cost per ton and hence the average value has changed but little.

The gravel figures for 1912 do not include, as they did in 1910, a considerable quantity of chats or tailing from the Missouri zinc mines and of slag used for road building in Alabama and Tennessee. The production of chats in Missouri in 1912, as reported by the Missouri Bureau of Geology and Mines, was 2,750,440 tons.

Recent Publications

Bureau of Mines, Washington, 1913:

Coal-Mine Fatalities in the United States. June statement. Compiled by Albert H. Fay. P. 17.

Abstract of Current Decisions on Mines and Mining. October 1912 to March 1913. By J. W. Thompson. Bulletin 62. P. 529.

Cuyahoga Formation in Ohio. By D. Dale Condit. Fourth series, Bulletin 17. P. 363. Ill., charts, maps, index. Geological Survey of Ohio, Columbus, 1912. Heretofore practically no detailed work has been done on the rocks of this formation, hence literature on the subject is meagre. The existing knowledge was its area of outcrop and thickness, and that it was composed of shales and sandstones, with an occasional bed of limestone. The work detailed in the book was done during the summer and autumn of 1912. The fauna of the formation was studied by Clara Gould Mark. The volume is well illustrated, with maps, and 16 plates of fossils.

United States Geological Survey, Washington, 1913:

Advance chapters from Bulletin 540, Contributions to Economic Geology, 1912, part I.

New Areas of Diamond-Bearing Peridotite in Arkansas. By Hugh D. Miser. Bulletin 540-U. P. 15. Maps.

Iron Ore in Montana and Wisconsin. Papers by Eugene Stebinger and Frederick T. Thwaites. Bulletin 540-H. P. 16. Maps.

Structural Materials in Colorado and California, and Clay in Montana. Papers by J. F. Hunter, R. W. Pack, and C. M. Bauer. Bulletin 540-K. P. 16. Maps.

A Geologic Reconnaissance of the Fairbanks Quadrangle, Alaska. By L. M. Prindle. With a detailed description of the Fairbanks district by L. M. Prindle and F. J. Katz, and an account of lode mining near Fairbanks, by Philip S. Smith. Bulletin 525. P. 220. Ill., maps, index.

Professional Papers:

Clay Products of the United States, 1912. Compiled by Jefferson Middleton. One chart.

Geology and Ore Deposits of Lemhi County, Idaho. By Joseph B. Umpleby. Bulletin 528. P. 182. Ill., maps, plans, index.

Geology and Ore Deposits of the San Francisco and Adjacent Districts, Utah. By B. S. Butler. No. 80. P. 210. Ill., maps, plans, index.

Report on the Mining Operations in the Province of Quebec, During the Year 1912. By C. T. Davis, superintendent of Mines. Quebec, 1913.

Catalogues Received

Braun-Knecht-Heimann Co., San Francisco, California. Catalogue No. 6. Price list of scientific apparatus. 592 pages. Illustrated. Index. 9¼ by 6½ inches. This is an excellent publication and should have a place in the technical library of every mining company. It contains well illustrated and short descriptions of apparatus for analyses of ores, oils, asphalt, and cement; bacteriological apparatus; laboratory specialties and a long price list of necessary chemicals and 100 pages dealing with laboratory machinery for which the name 'Braun' has become so well known. For prospectors there are given details of outfits at a low cost, while for assayers are given outfits for every occasion, besides the plan and description of a modern metallurgical laboratory. There is a complete list of prices of both common and rare minerals, useful reference tables, covering many subjects, and an excellent index indispensable for this class of book. Analytical work at present is progressing at such that consequently new and often complicated apparatus is necessary. Samplers, assayers, and chemists must be fully alive to this fact, and will find the latest in the volume under review. Perhaps some of the more interesting apparatus shown is the crushing machinery, pulverizing furnaces, balances, glassware, interesting methods, and the silica ware. The latter is superior to glass for many uses and is not as well known as it should be.

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EDITORIAL

CIRCULARS and newspaper puffs are being liberally used locally to attract attention to a supposed new process exploited by the Foss International Ore Reduction Company. The statements made are so absurd as not to deceive any engineer for a moment; to all others we merely say, *don't.*

A GENERAL strike of the coal miners of Colorado was declared for September 23 by the unanimous vote of the Trinidad convention in which a resolution of the executive committee of the United Mine Workers of America indorsing the strike was adopted. The mining industry is passing through a period of severe industrial unrest, and it is to be hoped that with the settlement of these differences between the miners and operators a period of peace of more than a few months duration may follow.

GOLDFIELD suffered severely from a cloudburst September 23. While there was some loss of life and much of property, we are glad to report that both losses were less than at first thought. Electric service was interrupted, but aside from that the Goldfield Consolidated Mines Company escaped with little injury. The *Goldfield Daily Tribune*, with true journalistic spirit, overcame the difficulties of the situation, and by means of type and hand press, presented a readable if abbreviated Sunday issue the following morning. Having once suffered ourselves, we appreciate the effort this cost, and extend congratulations to our contemporary with our sympathy to the citizens of the desert city of gold.

REPORTS from the Lake Superior mines would indicate that there is being enacted a revival of Amazon warfare in that locality. The legendary women of the Black Sea and Caucasus are being impersonated by the wives of the striking miners, and the results obtained are equally as glorious as the victories over the ancient Greeks. In recent encounters at Planedale and Centennial between these modern Amazons, who have substituted the broom for the sword, and the strike-breakers, the attacking force would have triumphed had it not been for the arrival of reinforcements of women from the rival camp who turned the tide of battle. There may be some truth in the current phrase regarding 'The Female of the Species.'

SELECTIVE flotation offers large possibilities of usefulness, as is being found at a number of points. There is also much to be done through supplementary processes of preparing the ore for flotation as by Horwood's method of roasting. We printed Au-

gust 30 a general résumé of work now under way at Broken Hill in Australia. Our attention has been called to the fact that this was possibly misleading as to phrasing, since selective flotation is, admittedly, but a special application of the main process owned by Minerals Separation, Limited. In fact, the various methods being tested at Broken Hill are being operated under license from that Company, which owns the patents covering them.

MEXICO, on the sixteenth of September, celebrated the one hundred and third anniversary of her independence. The military display in Mexico City rivaled that of the centennial celebration of three years ago, and a great increase of patriotic sentiment is reported, as evidenced by the thousands of students who, having been organized into military companies, participated in the parade and are enthusiastic in their support of the federal government. Would it not be a still greater mark of patriotism for these students of the medical, law, engineering, and agricultural schools to exchange their gold braided regalia and cockades for the khaki and sombrero of the *rurale* and join hands with the government in the suppression of the revolutionary element which has all but deprived Mexico of her existence as a nation? The fighting qualities of an army which has been forced into service and largely recruited from the prisons and penitentiaries cannot be expected to be as great as that of an army inspired by patriotism and which is fighting for a cause. It is a consolation to the Americans on this side who have friends and relatives in Mexico to know that the *grito* of '*Viva la Independencia*' has not been changed to '*Mueren los gringos,*' as is annually rumored and predicted in Mexico at this season of the year.

Genesis of Butte Ores

Among notable features of the Butte meeting of the American Institute of Mining Engineers, common opinion ranks high the presentation of the paper by Mr. Reno Sales on the origin of the Butte ores. It is too voluminous, and too full of significant observation and keen inferences, to permit of adequate review here. Based as it is on fifteen years work of a well trained corps of geologists following a plan proposed by Mr. D. W. Brunton, developed by Mr. H. V. Winchell, and for the last dozen years executed by Mr. Sales and his excellent staff, it forms probably the most thorough and most accurate geologic study ever made of a similar area; one, moreover, which has been explored to a depth not greatly disproportionate to its horizontal extent. An excellent feature of the work has been the unfailing discrimination of fact and inference and the painstaking recording day by day of the exact position of the various rocks, veins, and ores in miles of underground workings. No geologist or engineer can study Mr. Sales' maps and sections, unfortunately too large for reproduction here, without recognizing the immense amount of work that has gone into their making, and without realizing that they constitute a mine of information and a standard for the future. If other great companies will follow the lead of the Anaconda Copper Mining Company in establishing, and especially in patiently maintaining, similar geological departments, we shall have in time a solid basis for deductions regarding ore deposits. That the work will justify itself as an economic measure, may be judged by the results at Butte, where single blocks of ore found as a result of this close study have more than paid for the whole work.

While to mining engineers the greatest value of Mr. Sales' work lies in the structural studies, the geologist will have keenest interest in the light thrown on genesis of ores. Mr. Sales believes that the Butte ores are the result of "one period of mineralization, varying in intensity, possibly, from time to time, with important changes in chemical character of solutions." He explains most ingeniously the differences between the copper veins of the central area and the silver-zinc veins of the peripheral region, as the result of the change of solution from acid to alkaline character as the originally acid waters penetrated the dominantly alkaline rocks. This appeals to us as sound, though a question arises as to what caused deposition from acid waters of the copper, if acidity was a condition of their being carried in solution. Other questions may be raised, and more light is needed, but at least the facts of occurrence are on record.

One of the controversial questions at Butte is as to the origin of the chalcocite. Following the first work on secondary enrichment, it became popular to look on all of it as secondary. Deeper exploration seemed to necessitate a change in this view, and Mr. Sales holds that much of the chalcocite ore is of primary origin. We present his argument on another page. It will be noted that in the main, he rests his case on structural evidence, and this we believe to be sound. Recognizing fully the debt that geology owes to the chemists, and the need, as urged by Mr. J. W. Richards at Butte, for further synthetic studies, we own a preference for the results of structural sections and maps. If an orebody is in a certain place, the argument that it is chemically impossible for it to be there carries little weight. We make haste to say that any such contretemps is probably to be charged to the geologist who has been unable to give to his confrere an accurate account of the conditions to be met. Much credit is due to the long list of chemists who are patiently trying to help the geologist with his problems, but in the main their work must be to explain already discovered facts, rather than to furnish any wealth of criteria for future use. An excellent case in point has just arisen in the matter of the origin of pyrite. Studies made at the Geophysical Laboratory at Washington, which we discussed in our issue of September 30, 1911, pointed clearly, almost conclusively, to the rule that with cold waters and under surface conditions marcasite and not pyrite would be formed, that the latter was generated through the action of hot alkaline waters. This rule, if correct, would afford a convenient and widely useful basis for discrimination. Unfortunately, studies in the laboratory of the University of California, since completed, have resulted in formation of excellent

crystals of pyrite under surface conditions with acid waters, and so the criterion loses its value. The conclusion of the whole matter seems to be that each should faithfully record the facts as he sees them day by day; the interpretation will change as knowledge increases, but the facts are inviolate.

Trailing the Nitrogen Atom

The chemist, in surveying the universe, has much reason to feel that, if he had the power, he could remold it nearer to our present needs. It has often been pointed out that the relative abundance of the chemical elements and the ease with which they can be obtained and utilized bears no proportionate relation to the needs of man. Manganese is as easily produced as iron and is much more abundant than copper or lead, but is of exceedingly limited usefulness. Titanium is more abundant than carbon, but is of almost no use. Potassium is one of the most abundant and useful elements, but is widely distributed in small amounts only, and its recovery either in the form of salts or in the metallic state offers so much technical difficulty as to constitute one of the leading chemical problems of the day. But the most conspicuous case of maladjustment is nitrogen, which is everywhere present, forming nearly 80 per cent of our atmosphere, and yet is one of the most difficult elements to obtain in any form which is useful to animal and vegetable life. Animals, which must have nitrogen to form their proteid matter, are indeed totally dependent upon vegetable life for their supply, having no other means of obtaining it than by eating vegetables or other animals. Plants, though growing in an atmosphere largely composed of nitrogen, draw with difficulty their supply from the soil, where the obscure processes of nitrogen-fixing bacteria, the natural process of the decay of organic material or of rocks, and the slight effect of electric discharges in the air, together supply enough to maintain a limited stock of the necessary element. This suffices for the metabolic processes of living matter, but in the field of chemical industry more concentrated sources of supply are necessary, since great quantities of nitrate are consumed in the manufacture of explosives, fertilizer for stimulating the growth of plants, and a host of recent products, such as collodion, celluloid, and artificial silk, to name but a few.

Unfortunately, the nitrates of all the common elements are soluble salts, and hence the ordinary processes of nature whereby deposits of substances are formed have not run their usual course. Nowhere in the world, except in Chile, have deposits of nitrates of notable size been formed. Every rule has its exception, however, and in northern Chile, in what is probably the driest climate in the world, opportunity has been afforded for the formation of deposits of sodium nitrate of large size and occurring over a large area. Upon this district the world is dependent for nearly its whole supply of nitrate salts, and the output has grown in the past century from nothing to over 6,000,000,000 pounds per year. At the present rate of production the known supply will only suffice for less than a half century more.

Foreseeing the pressure of urgent necessity, chemical engineers have already begun to develop methods of tracking down and seizing the elusive nitrogen atom. It has long been known that electric discharges of high potential cause the nitrogen of the air to combine with oxygen, thus putting the nitrogen in usable form. A dozen years ago two Americans, Messrs. C. S. Bradley and R. Lovejoy, patented a method of thus producing nitric acid from the nitrogen of the air. This was a technical success but a commercial failure; the cost of the electric energy required being prohibitively high. At about the same time Messrs. Christian Birkeland and Samuel Eyde built a similar plant at Ankerlokken, near Christiana, Norway. The lower cost of power there made operation feasible and a later plant built at Notodden is now using 60,000 electrical horse-power in the manufacture of nitric acid. According to Mr. Thomas H. Norton, United States consul at Chemnitz, Germany, who has recently made a comprehensive report on the nitrate industry, the cost of electric power at Notodden is $2.94 per horse-power year, and at Odde, on the west coast of Norway, it is being produced for $1.96 per horse-power year. This places electrochemical industries on quite a different basis from that prevailing in the United States, where a lower production cost for electrical energy than $10 per horse-power year is uncommon.

A more promising method of fixation of atmospheric nitrogen is the manufacture of $CaCN_2$, nitrolime, or cyanamide, as the commercial product, an intimate mixture of this substance with lime, carbon, and calcium carbide, is generally called. This is produced by passing nitrogen over hot calcium carbide, and contains on the average 20 per cent nitrogen. By treating this with super-heated steam, ammonia can be formed for industrial uses, or the nitrolime can be directly utilized as a fertilizer. The chief American producer, the American Cyanamide Company, which has a plant of 12,000 tons yearly capacity at Niagara Falls, Ontario, is now enlarging its plant to a capacity of 50,000 tons per year, and is selling its product in such distant places as Porto Rico, Hawaii, and the Philippines. The Company is obliged to secure its electric power from the Ontario Power Company, at rates which are probably not unusually low.

A further possibility is the development of the natural processes of nitrate formation. In the decay of organic matter nitrates are naturally formed and under proper conditions can be leached out and utilized. It was thus that the necessary supplies of potassium nitrate for the manufacture of powder were obtained in this country during the progress of the Revolutionary war. The present high cost of labor, the slow reactions, and the scanty yield of this method have caused it to be neglected, but with the ever-increasing knowledge of bacterial action it is not impossible that improved methods may in time be devised for the conversion of the atmosphere from a useless deluent into a valuable chemical substance. It should be added that an important source of the present supply of ammonia is as a by-product of the distillation of coal, but the demand for ammonia is so great that additional sources of supply are still necessary.

Solution Control in Cyanidation

By A. W. Allen

The generally accepted equations of zinc-box reactions indicate the formation of a double cyanide of zinc and an alkaline earth as a by-product resulting from the deposition of the gold and silver. This reaction undoubtedly occurs in alkaline as well as neutral solutions. Silver nitrate titrations of such solutions may indicate either the content of free cyanide or of total cyanide. In the former case the result shows, roughly, the amount of potassium, sodium, or calcium cyanide present, which is generally recorded in terms of the potassium salt. On the other hand, a total cyanide estimation serves to indicate the content of free cyanide plus the equivalent, also in terms of potassium cyanide, of the double cyanide present; and also the hydrocyanic acid.

Estimation of Free Cyanide

Since the commencement of the industry it has been generally taken for granted that free cyanide content may be estimated by the direct addition of standard silver nitrate to the working solution; and total cyanide by the same method, after the addition of alkali. Since cyanide treatment invariably includes the precipitation of gold and silver by zinc, and since the great majority of cyanide operations are conducted with alkaline solutions, it is exceedingly difficult to understand how any line of demarcation can be drawn. By the adoption of such a method it will be seen that if the alkali is added in the plant the subsequent titration of the solution would reveal a high free cyanide content; if added in the laboratory, a high total cyanide content. The adoption of such a line of reasoning must necessarily mean the general acceptance of the theory that the addition of alkali to a working solution containing the double cyanide of zinc and an alkaline earth results in the entire regeneration of the cyanogen in the double salt, and its conversion into potassium, sodium, or calcium cyanide. This, again, is tantamount to saying that in a normally alkaline solution, gold and silver are precipitated in the zinc-boxes, and free cyanide regenerated. My own experiences of the behavior of plant solutions in connection with the solution and precipitation of gold and silver are entirely opposed to this idea. As far as I know, there is no evidence to show that any such regeneration occurs in actual practice, or that the double cyanide in question may be formed by the addition of acid to a normal plant solution carrying zinc salts, which is an obvious corollary.

Titration Results

In protectively neutral solutions the titration with silver nitrate gives free cyanide content. In protectively alkaline solutions the titration gives free cyanide content, plus the equivalent in terms of potassium cyanide of the double salt, in proportion to the amount of protective alkali present. In the presence of sufficient alkali the estimation becomes a total cyanide one, although often reported as free cyanide. I therefore suggest that the result of a simple titration of a working solution with silver nitrate is of no definite value or significance, since only in the absence of free protective alkali would the result represent actual free cyanide content. In the presence of free protective alkali the result might indicate anything from available free cyanide to unavailable or only partly available double cyanide.

In a neutral or acid solution the titration would exclude the hydrocyanic acid. By a comparison of actual solution tests I have evidence that this substance is equally powerful with free cyanide as a solvent for gold; and, as a result of the definite recognition of its solvent powers in the Gitsham process, it may be suggested that the occasional success attending the practice of heating cyanide solutions is, in some measure at least, due to its liberation, added to the fact that, under conditions of low alkalinity, its content is not included as an available solvent in the result of the simple titration test.

It seems, therefore, unreasonable that the efficiency of a solution should be arrived at by a method which, under certain conditions of alkalinity, would exclude a powerful solvent; and, under other conditions of alkalinity, would include in the result the cyanogen in a zinc salt which makes the solution unworkable when the content rises above a certain percentage.

Precipitation on Zinc

An inevitable result of precipitation with zinc is the inclusion of zinc salts in the working solution. With an excess of free cyanide and a moderate alkalinity in the solution entering the zinc-boxes, the ordinary titration method will give a higher free cyanide content at the tail than at the head of the box. In other words, the solution will appear to have a higher efficiency after the addition of zinc than before it. This fact may be cited as a striking instance of the absurdity of this method of testing, since it is obvious that ultimate fouling of solution may be entirely due to the addition of zinc as a concomitant of precipitation.

The following figures of actual titration results of solution entering and leaving the zinc-boxes are of interest:

	Incoming, per cent.	Outgoing, per cent.
Total cyanide	0.175	0.175
Free cyanide:		
Direct titration method	0.145	0.150
After neutralization of solution on basis of protective alkalinity arrived at by Green's method	0.120	0.095

It is my opinion that the lack of a uniform method of determining the available and partly available cyanogen contents of a working solution is, in the main, responsible for many of the opinions expressed from time to time as to the effect of alkalinity on extraction. For example, a definite 'cyanide strength,' based on the simple titration with silver

nitrate, is being maintained, for some reason the alkalinity rises and, in proportion to the amount of rise, the zinc double salt appears in the result of the titration. The 'cyanide strength' is then brought down to normal by a decrease in the amount of fresh cyanide added. The solution or precipitation of gold becomes unsatisfactory and the high alkalinity is suspected as the cause. This is then lowered. The 'cyanide strength' drops in proportion and is raised to normal by the addition of fresh cyanide. The extraction or solution troubles disappear and the previous poor results are attributed to the alkalinity. In all probability the method of titration of the solution was at fault and indicated a 'cyanide strength' when sufficient alkali was present which bore an entirely different ratio to the actual available cyanide than did a corresponding titration when the solution was neutral or of a low protective alkalinity.

Chemical Reactions

The following equations probably represent the reactions occurring during the titration of a solution containing free cyanide and zinc potassium cyanide.

(1) Free cyanide

$$AgNO_3 + 2KCy = KAgCy_2 + KNO_3$$

(2) Zinc-potassium cyanide

$$*2AgNO_3 + 4KOH + K_2ZnCy_4 = 2KAgCy_2 + Zn(OK)_2 + 2KNO_3 + 2H_2O$$

In each case the end point is indicated by the precipitate of silver cyanide formed by the excess silver nitrate on the potassium silver cyanide.

If sufficient acid be carefully added to an alkaline plant solution so that neutrality, as far as protective alkalinity is concerned, is obtained, then none of the cyanogen existing in the form of simple cyanides of the alkaline earths, or the double cyanide of zinc and an alkaline earth, will be affected; and a titration can then be made with neutral potassium iodide as indicator, which will give an estimate of free cyanide present. On the other hand, the raising of the alkalinity by the addition of excess caustic alkali will not affect the behavior of the standard solution toward the free cyanide present; but the cyanogen existing in the form of the double cyanide of zinc and an alkaline earth will, together with the hydrocyanic acid, and in presence of the excess alkali, postpone the end point until all the cyanogen existing in the form of free cyanide, hydrocyanic acid, and double cyanide, has been recorded.

The following results of the careful addition of weak acid to a plant solution carrying free cyanide and double cyanide are of interest; and serve to demonstrate that there is no loss of cyanogen.

Series 1.

	Prot. alk., %		KCy, %	
1	Neut.		0.125	(free)
2	0.005	(NaOH)	0.137	
3	0.007	"	0.138	
4	0.010	"	0.140	
5	0.012	"	0.140	(total)

Original solution tested with alk. KI and $AgNO_3$. Result, 0.14% (KCy). Protective alk. then neutralized with N/10 HNO_3, then gradually raised with NaOH. Solution tested with $AgNO_3$ and neut. KI at definite intervals of alkalinity.

Series 2.

	Prot. alk., %		KCy, %	
1	Neut.		0.160	(free)
2	0.003	(NaOH)	0.162	
3	0.006	"	0.165	
4	0.008	"	0.170	
5	0.011	"	0.175	(total)

Original solution tested with alk. KI and $AgNO_3$. Result, 0.175% (KCy). Solution then treated as in Series 1.

The necessity for adequate solution control work was exemplified in a recent experience. Routine titration for 'cyanide strength' had been made regularly and showed no material alteration in the composition of the solutions. Precipitation went from bad to worse in spite of the adoption of all the usual methods of regaining control. The solution was then analyzed and was found to contain a high zinc content and also a considerable amount of copper. Acid treatment was tried for the purpose of removing the double salts, but was abandoned because no satisfactory method of application could be evolved. The use of potassium permanganate was also tried and abandoned on account of the precipitation of the gold in considerable quantities (as with the acid method) together with the zinc and copper. The difficulty of collecting the precipitate from either reaction, or of doing anything with it when collected, prohibited the practical utilization of either method. Electrical precipitation, on an experimental scale, was also tried and the idea abandoned.

Solution Control

The question ultimately resolved itself into one of solution control. As the source of copper was temporarily at an end the free cyanide strength of the solution was dropped to a minimum and the bulk of the copper allowed to deposit on zinc shavings, the latter being removed and replaced by fresh zinc as soon as thoroughly coated. This took about two days, during which time there was practically no precipitation of gold. As soon as all the copper had been removed in this manner the free cyanide content in the solution entering the zinc-boxes was raised considerably, the idea being that a point of saturation had been reached with the normal strength and that further solution of the zinc was impracticable without an increase in the normal free cyanide content. This solution of the zinc was considered necessary for the formation of the hydrogen which, in a nascent form, was an essential element in the breaking up of the potassium gold cyanide in the solution entering the zinc-boxes.

The outgoing solution showed an immediate drop in valuable content, and as soon as satisfactory precipitation had been secured the discharging of barren solution with the residue was commenced and the usual water wash abandoned. By these means the excessive amount of zinc was removed from the solution, the coppery zinc was gradually replaced in the boxes, and the free cyanide content was allowed to drop to normal without any interference with the efficiency of precipitation. In subsequent operations

*Clennell, 'Chemistry of Cyanide Solutions,' p. 37.

a mixed solution and water wash was used, and sufficient barren solution (amounting to about 15% of the tonnage treated) was discharged with the residue to prevent the accumulation, above a workable limit, of undesirable compounds.

Zinc Losses

It is interesting to note in passing that the quantity of zinc so discharged in the residue is but a small fraction of the amount which disappears daily from the plant. The loss of zinc from plant solutions is a mystery which has yet to be definitely solved. Virgoe suggested the formation of an insoluble double carbonate as a result of a possible combination of zinc potassium cyanide with atmospheric carbon dioxide. Whatever the cause, it is evident that the automatic reduction of zinc content prevents the fouling of cyanide solutions in the great majority of cases. Under other conditions, however, as in the present instance, the reaction stops at a certain point, after which active measures must be taken for the removal of an undesirable accumulation of zinc. The strength of the cyanide solution entering the zinc-boxes must often be increased in proportion to the amount of zinc in such solution; and an unnecessary consumption of both solvent and precipitant results from an endeavor to effect satisfactory precipitation from foul solution.

As soon as facilities were secured it was deemed advisable to go more into detail in the matter of solution control, especially with regard to the estimation of zinc content. Independent tests were then made for total cyanide, free cyanide, and protective alkali. An additional test for hydrocyanic acid was also included and a modification of Bettle's[1] was decided upon. The result of this test gives free cyanide plus hydrocyanic acid, which is practically an available cyanide result in the absence of protective alkali.

A résumé of the complete series of tests is as follows:

Estimation.	Principal salts indicated in result.	Preparation of solution.	Indicator	Titrated with	End point.
Total cyanide	KCy, NaCy, $CaCy_2$, K_2ZnCy_4, HCy	Add excess caustic alkali	KI	$AgNO_3$	Yellow opalescence
Protective alkali		Add K_4FeCy_6; then slight excess $AgNO_3$ over that required in previous test	Phenolphthalein	N/10 HNO_3	Disappearance of red coloration
Free cyanide; *i.e.*, available cyanide in presence of protective alkali	KCy, NaCy, $CaCy_2$	Add N/10 acid till protective alkali is neutralized; *i.e.*, amount shown necessary in previous test	Neutral KI	$AgNO_3$	Yellow opalescence
Available cyanide, in absence of protective alkali	KCy, NaCy, $CaCy_2$, HCy	Add $NaHCO_3$	Neutral KI	$AgNO_3$	Yellow opalescence

The effect of dilution in the titration for total cyanide of a solution carrying the double cyanide has been discussed by other investigators. As a means of emphasizing the necessity for strict uniformity of operation, the following is instructive.

[1]Proc. Chem. Met. & Min. Soc. of S. A., Vol. I. p. 165.

Total Cyanide Estimation Result

Plant solution:	(KCy),%.
Undiluted	0.167
Diluted with equal bulk of water	0.172
Diluted with twice bulk of water	0.157
Diluted with three times bulk of water	0.175

Experiments made by me showed that reverse titrations for total and free cyanide gave almost identical results as direct ones, indicating that the amount of silver nitrate added by the ordinary method in quantity sufficient to give a distinct end-point, although in actual excess of the amount required to satisfy the equation, gives for all practical purposes a substantially correct estimate.

Protective Alkali

Green's method, as outlined, seems to be the most satisfactory, provided strict uniformity is observed in the amount of excess silver nitrate added.

It has been found preferable in estimating protective alkali under conditions of low alkalinity to count the number of drops of dilute acid necessary to neutralize a small amount of cyanide solution, rather than to attempt to read the burette. In the subsequent estimation for free cyanide the slow addition of acid is essential; and this is best made by adding the exact number of drops shown to have been necessary by the preceding test.

The free cyanide method is one of many given by Clennell,[2] and in my opinion, gives uniformly satisfactory results.

Hydrocyanic Acid

The bicarbonate should be added only in moderate excess, and a check test occasionally made to correct for the presence of carbonate. The inferred definition of 'available cyanide' in connection with the result of this test is consistent with my experience of actual practice.

In all of the above tests for cyanide the formation of a cloudiness inevitably preceded the appearance of distinct opalescence. The latter indication has been looked upon as the only reliable end-point. In the present instance control testing is not considered in the light of an analysis of the solution, but rather calls for a quick and sufficiently reliable method of arriving at results of comparative accuracy.

[2]'Chemistry of Cyanide Solutions,' pp. 25 and 26.

The difference between the free cyanide result in the presence of protective alkali or the available cyanide result in its absence, and the total cyanide result, gives an approximation of the amount of the double salt present, in terms of potassium cyanide. One fourth of this amount gives an estimate for zinc in the form of the double cyanide.

Use of Burettes

Standard solutions, indicators, and correctives, are all measured from burettes. These are mounted on revolvable stands with the result that the complete series of tests can be made very rapidly; and absolute uniformity of condition is assured for each estimation.

The final estimation for zinc content as double cyanide has been checked by analysis for total zinc in the same solution made by the sodium sulphide, ferric sulphate, and potassium permanganate method.

	Methyl orange.	Phenolphthalein.
K_2ZnCy_4	4KOH	.....
4KOH	4KOH	4KOH
$Zn(OK)_2$	2KOH	2KOH
4KCy	4KOH	4KOH

The addition of alkali to a protectively neutral solution carrying the double cyanide should therefore result in an increase in the sum total alkalinity to phenolphthalein, and a decrease in the sum total alkalinity to methyl orange. A number of tests that I have made would seem to indicate that the supposed reaction does not occur. The end points with the phenolphthalein are slightly uncertain, but in no instance was it possible to show an increase of alkalinity to this indicator. It was equally impossible to show a decrease in the alkalinity due to the methyl orange.

The figures in the following test will serve to indicate the method employed:

	Cyanide (as KCy)		Alkalinity (as KOH)		
			To Phenolphthalein.		To Methyl Orange.
Volume.	Total, %.	Free, %.	Prot., %.	Total, %.	Total, %.
50% working solution	0.114	0.057	....	0.015	0.115
50% added alkali	....	....	0.052	0.052	0.054
Numerical average	0.057	0.028	0.026	0.033	0.084
Titration average	0.057	0.028	0.026	0.031	0.084

The direct titration results were slightly higher than those from analysis, the greatest difference amounting to 0.005%. These differences were consistent and comparisons were made from solutions carrying variable amounts of zinc. The results indicated the comparative accuracy at least of the direct titration method on the solution in question.

Acidity and Regeneration

At one time I made some experiments to determine whether it might be possible, under ordinary conditions, for the double zinc salt in a plant solution to be locally decomposed in contact with an acid ore or an acid water, according to the equation:

$$K_2ZnCy + H_2SO_4 = 2HCy + ZnCy_2 + K_2SO_4$$

The conclusions arrived at were that such decomposition was possible in a solution of low free cyanide content; but that the hydrocyanic acid formed is so entangled with the precipitate of zinc cyanide that subsequent contact with alkali would result in a reversion to the original compound thus:

$$ZnCy_2 + 2HCy + 2KOH = K_2ZnCy_4 + 2H_2O$$

rather than conversion of the hydrocyanic acid into a cyanide of the alkali.

Alkalinity and Regeneration

The equation upon which the suggestion of regeneration of free cyanide by means of alkali is as follows:

$$K_2ZnCy_4 + 4KOH = Zn(OK)_2 + 4KCy + 2H_2O$$

This equation must be assumed in all cases where the simple titration of an alkaline working solution is expected to indicate free cyanide content.

According to Clennell[3] the alkaline equivalents should be as follows:

[3] 'Chemistry of Cyanide Solutions,' p. 60.

In the above test the amount of alkali added was calculated so that the recognized direct titration method of testing, as advocated in the most recent text-books on metallurgical practice, would indicate the whole of the cyanogen content of the solution as free cyanide.

Mechanical Mixture

In considering the figures it is interesting to note that as regards total alkalinities, the figures favor the assumption that nothing more than a mechanical mixture has taken place. It is also noticeable that the actual titration average of the protective alkali is in agreement with the numerical average. Had regeneration occurred there would have been a reduction in protective alkali content, free alkali being used up to complete the reaction and the alkaline free cyanide so formed being reduced to neutrality as a result of the addition of silver nitrate, after the ferrocyanide, in the protective alkalinity test.

Another point worthy of notice is that the neutral solution, free or available cyanide result, minus the alkaline solution, total cyanide result, gives a definite idea of zinc content. The direct titration method is of no value in this connection and, as a result, the fact is often overlooked that a solution may be as foul with zinc after the addition of alkali as before it. This quantity of zinc in solution is an important factor in the efficiency and economy of operations. Its presence invariably affects the precipitation and sometimes the solution of gold, and a regular estimation of its content is second only in importance to an estimation for free or available cyanide. The cumulative ill effects of adding cyanide in lumps at the head of the zinc-boxes in an effort to improve precipitation is indicated by the subsequent determination for zinc content. The system is an unsatisfactory palliative rather than an actual remedy, pre-

cipitation only being effected by an increased addition of zinc and a further fouling of the solution.

Satisfactory precipitation, from an economic point of view, is more a question of ultimate value than actual metal content. The 'barren' solution after gold precipitation may contain a few grains per ton as compared with a corresponding 'barren' solution after silver precipitation which may contain as many pennyweights. Each may be referred to as the residue after satisfactory precipitation, but it is obvious that the question of zinc content is more important in the case of the treatment of gold ores where a complete or nearly complete precipitation is essential, a small percentage of the metal representing a high money value. In either case the precipitation is at maximum efficiency at the commencement of operations and deteriorates with the accumulation of zinc in the solution.

In conclusion, it may be added that, in piecing together the above notes, a deal of recognized information on zinc precipitation has been included for the sake of clarity. I wish to acknowledge the fact and would make especial reference to J. E. Clennell, whose handbook on cyanide solutions is of especial interest and value.

Minerals in Persia

Writing in the *Near East*, M. Charles Brouard, a mining engineer, who has spent many years prospecting and traveling in Persia, gives interesting details regarding the mineral wealth of that country. In M. Brouard's opinion, Persia will be one of the great oil-producing countries of the future. Apart from this, it will produce large quantities of gold, silver, copper, lead, and iron. The province of Azerbaijan, with the goldfields of the Kalu river, is generally considered as the richest in mineral wealth, but geological considerations seem to point to Luristan as equally worthy of the attention of European capital. The same remarks apply to Turkish territory situate immediately beyond the western frontier of Persia. Copper ore is frequently found. The most frequent forms are chalcopyrite, malachite, azurite, and chalcosite. M. Brouard discovered an extensive manganese orebody in the vicinity of Kerman, and says that on the whole the manganese group is represented by better ore than that found in the Caucasus. The pyrolusite contains lime, practically no phosphorus, and yields an average of 40% manganese. With regard to bitumen, an interesting discovery which M. Brouard made along the Top é Khazab, in the Kuh Jahak, was a four-mile deposit of bitumen. "The rocks here were dripping bitumen from all their cracks. The bitumen itself lay as a soft bed two to five feet deep at the bottom of the river. As a rough analysis showed, its purity is nearly equal to that of Utah. Its nearly complete solubility in carbon bisulphide and the distillation products denoted the presence of a large quantity of fluid hydrocarbons, not many gaseous products, and only a negligible quantity of sulphur; its specific gravity was 1.25." The country gives promise of future development.

Progress at the Buckhorn Mine

This property is situated in Eureka county, Nevada, and is controlled largely by those interested in the Goldfield Consolidated Mines Co. At the Buckhorn mine both north and south branches of the haulage adit are being driven, and raises from this adit to the levels above have been started.

The Buckhorn mine produces an ore of a talcy nature containing about 40% silica. The scheme of treatment in the 300-ton mill under construction is as follows: Ore is dumped into a steel storage tank of 550-ton capacity, from which it passes over a shaking-screen with 1-in. apertures, the oversize being crushed by a 10 by 20-in. Blake crusher. The crushed product and screen undersize go to a revolving trommel 12 by 36 in., oversize going to

BUCKHORN MILL.

15 by 40-in. rolls, choke fed. Undersize from the trommel, with the roll product, is fed to a 6-ft. Hardinge conical ball-mill with spiral feed. Two bucket elevators, one being a stand-by, with 19-ft. centres and a 12-in. belt, lift the pulp to two 45-in. Akins classifiers. These work in closed circuit with two 5 by 18-in. tube-mills. The final overflow from the classifiers goes direct to the Dorr agitators. These are filled by a distributor, agitation being through the centre column and distributor, the arms raking pulp to the centre. Agitation is done in three vats in series. From these the slime goes to three Dorr thickeners from which the thickened pulp is run to a second battery of three, here meeting with solution from revolving filters and other barren solution. The overflow from the second three flows into the first three, and overflow from the first three is precipitated by zinc dust. Slime is treated on four Oliver filters, and the residue is agitated by four vortex mixers and discharged. The mill buildings will soon be covered, and machinery is now being installed. About 25 men are engaged on construction of the power-plant at Beowawe, and the 30-mile transmission line to Buckhorn is practically completed. S. J. Kidder is general manager of the property.

The Wettlaufer Lorrain mine at Cobalt shipped the following ore during 1912:

Class.	Pounds.	Silver, oz.
First	349,954	561,050
Second	219,939	56,785
Concentrate	385,451	191,184
Bullion	673	6,979
Total	956,017	815,998

Origin of the Butte Chalcocite

By Reno Sales

*Owing to the persistence to great depths of the mineral chalcocite in the Butte copper veins much interest has been aroused among geologists concerning the manner in which it was formed. In recent years the opinion has been quite generally held that chalcocite is largely, if not wholly, a product of descending sulphide enrichment. This view arose naturally through the discovery of the so-called 'black sulphurets' (later proved to be sooty chalcocite) of Ducktown, Bisbee, and similar pyritic orebodies. These belts of black amorphous chalcocite were found separating the oxidized zone from the lean pyritic ore below and they were early believed to have resulted from the reaction between the descending copper sulphate waters and the unchanged primary ores below. That this view was the correct one for the sooty chalcocite of this class of deposits has been abundantly proved by recent investigations.

Early Discoveries

The discovery of similar chalcocite ores in the early mining operations at Butte led many observers to the opinion that these remarkably rich ores were likewise of secondary origin and of limited vertical extent. When the zone of sooty chalcocite was penetrated, however, the predicted lean cupriferous pyrite ore was not encountered, but chalcocite-bornite-enargite ores were found, which have persisted to great depths. The chalcocite of the deeper levels does not occur in the sooty form, but instead, it is the gray massive mineral more or less intimately mixed or intergrown with bornite, enargite, or other ore minerals replacing directly altered granite. It is not necessarily a replacement of pyrite or any other sulphide mineral, being deposited directly from solution as chalcocite in veins along with bornite and other copper sulphides.

The problem of the formation of the chalcocite in the Butte veins was studied recently by C. T. Kirk,[1] who endeavored to work out a definite relation between the chalcocite deposition and certain stages of granite alteration. He concludes that such a relation exists, and that the chalcocite formation is, in the main, associated with a certain phase of granite alteration which has developed through the action of descending meteoric waters. W. H. Weed,[2] in his recent report on Butte, likewise declares that most of the chalcocite has resulted from descending waters, although primary chalcocite also occurs, but just how and where he fails to state. Many other writers familiar with these ore deposits, notably H. V. Winchell and the late S. F. Emmons, regarded the chalcocite as chiefly of secondary origin, at the same time holding the view that some of it might be primary. Recently, however, Mr. Winchell[3] has expressed the view that the deep chalcocite is largely primary.

Deposition of Chalcocite

An intimate acquaintance with these ore deposits extending over a period of years has led me to the conclusion that most of the massive chalcocite is of primary origin, in the sense that it was deposited in its present position directly from deep-seated ascending solutions. Secondary chalcocite exists in large quantities also, but it is believed to be of limited vertical extent, being confined principally to the well known sooty chalcocite zone extending from the bottom of the oxidized zone to depths ranging from 100 to 1200 ft. It should be clearly understood, as previously stated, that the sooty glance zone has no well marked lower limit, and furthermore, in the generation of sooty glance by descending waters, massive chalcocite is frequently developed, especially where the replacement of pyrite or other sulphide has reached an advanced stage. It is impossible to differentiate in hand specimens between primary and secondary chalcocite when both appear in massive form. There is of necessity in many cases an overlapping of primary and secondary chalcocite in the veins, inasmuch as primary chalcocite is believed to have originally extended to an elevation higher than the present ground surface. It follows, therefore, that to some extent primary chalcocite has been subjected to the action of atmospheric agencies along with the associated primary vein minerals. The result has been a sooty glance enrichment of the primary minerals of the ore among which there existed massive chalcocite.

Occurrence of Primary Chalcocite

The observed facts which have led me to the conclusion that primary chalcocite exists in large quantities in the Butte veins may be briefly stated as follows:

1. The occurrence of chalcocite in great abundance at levels 3000 ft. or more from the surface.

2. The intimate association of chalcocite with bornite, pyrite, and enargite in such a manner that all must be regarded as having been deposited at the same time and under similar conditions.

3. Chalcocite is found at all depths without regard to surface topography, which fact tends to show that no relation exists between the occurrence of chalcocite and present day downward seeping waters.

4. Chalcocite occurs in absolutely dry veins and ore-shoots at deep levels, and in many instances large bodies are cut by older faults, a fact further tending to show that this copper mineral is an old one and in no way genetically related to the present

*From 'Ore Deposits at Butte, Montana,' in *Trans.* Amer. Inst. Min. Eng., August 1913.

[1]Kirk, C. T., 'Conditions of Mineralization in the Copper Veins at Butte, Mont.,' *Economic Geology*, Vol. VII, No. 1, pp. 35 to 82, January 1912.

[2]Weed, W. H., 'Geology and Ore Deposits of the Butte District, Montana,' Professional Paper No. 74, U. S. Geological Survey, p. 76, 1912.

[3]Winchell, H. V., discussion of L. C. Graton's paper, 'The Sulphide Ores of Copper,' *Bulletin* No. 77, Amer. Inst. Min. Eng., May 1913, p. 800.

day or a former similar underground water circulation.

5. Chalcocite directly replaces altered granite at deep levels. The power of cold meteoric waters to effect direct replacement of granite in quantity is seriously questioned.

6. No evidence is available tending to show that chalcocite is now being deposited in the veins, except within the sooty chalcocite zone. On the other hand, where positive evidence on this point is obtainable, it indicates a tendency of the massive chalcocite to alter to bornite and chalcopyrite under present groundwater conditions.

Secondary Chalcocite

As outlined in the discussion of the formation of sooty chalcocite, the facts plainly show that secondary chalcocite has resulted from downward seeping sulphate waters, and there can be no doubt that this mineral was in the active process of formation at the time the first mine openings were made in the copper veins. Concerning massive chalcocite of the deeper levels, however, there are important reasons for believing that it is in no way related genetically to the present existing meteoric groundwater circulation, or with any water circulation system of meteoric origin, but that, whatever the source, its time of formation must be referred to a relatively old mineralization period. The Rarus fault sharply cuts the important ore veins, displacing them hundreds of feet, so that in the intersected veins the possibility of surface waters effecting an enrichment of the truncated portion of the veins lying beneath the fault is extremely remote. The upper displaced segment of the O'Neill vein, for example, is no richer in chalcocite than the sub-fault segment, excepting within the chalcocitization zone directly beneath the oxidized zone. It is evident that the descending sulphate waters moving down the upper segment could not possibly reach the lower segment, and there is no indication of an enrichment of the upper segment where it meets the Rarus fault. The moving waters did not enrich the fault, as it carries no ore, neither did these solutions spread out to other veins cut by the fault. What is said here regarding the O'Neill vein is equally true of all the veins intersected by the Rarus fault. In examples of this character where possible source of the supply of the sulphate waters has been effectually cut off from the lower parts of the veins by intervening faults, it becomes evident that the chalcocite of the lower segments either had its source in uprising solutions or else it was deposited from a descending water circulation existing long prior to the appearance of the fault, and possibly far removed from the conditions as we now know them.

Age of the Deposits

Following this line of reasoning, it is possible, as will be later shown, to prove that chalcocite, other than the sooty variety, is a comparatively old mineral, and that it was deposited in great quantities prior even to the faults of the Steward system, which in themselves carry important bodies of ore composed of enargite, bornite, sphalerite, barite, galena, and other well known primary minerals.

In the No. 16 vein, a mineralized fault of the Steward system of the Rarus and Tramway mines, extensive bodies of chalcocite-enargite ore are sharply cut by the Rarus fault. These orebodies are in the form of the characteristic fault-vein ore-shoots, and actual development proves that they do not extend upward to within 1100 ft. of the surface, the higher portions of the fissure being absolutely barren of ore or gangue minerals. Like the chalcocite ores of the O'Neill vein above noted, the No. 16 vein ore-shoots were formed long prior to the Rarus fault. The altered condition of the crushed zone of the Rarus fault, the presence of much disseminated pyrite and quartz, together with the fact that a later fault (Middle) cuts and displaces the Rarus fissures, tend to show that geologically the Rarus is not a recent fissure, therefore the water circulation responsible for the chalcocite older than the Rarus fault must be far removed from the meteoric groundwaters of today.

Relation to the Steward Fault

Going further into the history of chalcocite, certain facts seem to indicate, if not definitely prove, that chalcocite existed as a vein mineral prior to the Steward fault period. In the ore breccia of the Gagnon mine fragments of older vein matter containing chalcocite are of common occurrence. The Steward fault fissure is of later origin than the breccia and the breccia is much squeezed and faulted where they come in contact. These angular ore fragments are within and form a part of the original breccia and they are plainly not of secondary origin. They are not breccias resulting from Steward faulting or any other fault movements, but they were formed in the same manner as the Mountain View breccias and probably at the same time. These ore fragments represent a period of mineralization of an earlier date, and they are not drag ore, but pieces of older vein which have fallen into open cracks.

The Blue Vein Fissures

In tracing the formation of earlier chalcocite, attention must be given to the remarkable ore-shoots of the Blue vein fissures, of which the great orebodies of the Jessie, Edith May, High Ore, Skyrme, and Blue veins are examples. It is a significant fact that many of the largest and most important rich chalcocite-enargite ore-shoots in these veins do not extend upward to within from 500 to 800 ft. of the surface. Not only do the copper minerals fail, but the common gang minerals, quartz and pyrite, drop out, so that the ore-shoots are capped by hundreds of feet of barren crushed granite and fault clay marking the plane of movement. In two instances, notably in the Jessie and Blue veins, ore-shoots reach the surface, but in these cases the upper 500 ft. of the shoots differ materially in mineralogical composition from the richer ores at greater depths.

A study of the composition and structure of these remarkable ore-shoots indicates that the minerals forming them have had a common origin. They are not connected or related in any manner with cross-fissuring or later faulting. The Blue vein ore-shoots

do not occur at the intersections with older quartz-pyrite veins, but, on the contrary, curiously enough, they are almost universally found in the intervals between the important older veins. No apparent relation exists between the Blue vein-shoots and the later Steward faults; in fact, repeated observations of such intersections show beyond question that the ore-shoots were in existence prior to the appearance of the Steward faults. It is next to impossible, however, if not entirely so, to determine what amounts, if any, of the minerals composing the Blue vein ore-shoots were added at a period immediately following the appearance of the Steward fissures. Ore-bearing solutions traversing the Blue fissures, after the Steward faulting began, did not necessarily originate through the later fractures, nor did solutions passing along Steward fractures necessarily find their way into the Blue veins. In both cases the circulation was confined largely to irregular zones within the fissures themselves, which are now marked by the positions of the ore-shoots. The intersections of Blue vein ore-shoots rich in chalcocite by Steward fissures are numerous, and, from the evident lack of influence on the mineralogical character of the ore, I am led directly to the conclusion that chalcocite did exist in large quantities in the Blue vein prior to the Steward faults.

Origin of the Early Chalcocite

Assuming for the moment that the above inference is the correct one, the difficulties met with in an attempt to ascribe a secondary origin to this early chalcocite are numerous and of vital import. At the close of the Blue vein period (which period is assumed to be the time elapsing between the beginning of Blue vein movements and the beginning of Steward faulting), it is fair to assume that the ground surface was much higher than at present, necessitating, therefore, a former extremely deep meteoric groundwater circulation to reach chalcocite orebodies of the Blue veins now found more than 3000 ft. from the surface. When one considers the rate of the downward invasion of the oxidized zone, it is almost inconceivable that down-seeping sulphate waters could have formed the extensive chalcocite orebodies found at these depths. The time required would be enormous, and furthermore, the fact must not be lost sight of that under conditions favorable for sooty chalcocite formations, as we know them, a very large part indeed, if not all, of the copper of the descending sulphate waters is deposited as secondary chalcocite before a maximum depth of 1200 ft. below the zone of oxidation is reached.

There is another important point inviting attention, relative to the probable condition of the underground circulation existing during the time of formation of the Blue vein ores and during subsequent periods extending to the present time. It is a self evident fact that meteoric waters could not have descended to great depths along veins, faults, or fissures at a time when appreciable quantities of waters, presumably deep seated, were ascending through such channels. It is a reasonable assumption, then, that no important downward movement of meteoric waters took place in the Blue fissures until after the cessation of movement of the uprising solutions from which were deposited the primary ores. It is not unreasonable to believe that some surface waters did reach these channels of uprising waters at comparatively shallow depths, not, however, by direct descent along fissures through which deep seated waters were ascending, but by a downward lateral movement through neighboring fissures adjacent to the main trunk channels. As has been formerly pointed out, however, the movement of cold surface waters through normal granite is scarcely appreciable, and it is therefore extremely improbable that such waters could have influenced chemically, physically, or in any way whatsoever the action of the deep seated waters as they moved upward through the fissures depositing minerals undoubtedly derived from deep seated sources. The occurrence of undoubted primary ores, or quartz, pyrite, sphalerite, galena, and rhodochrosite, together with enargite, bornite, and chalcocite, in faults of the Steward system which are known to cut and displace chalcocite orebodies in the Blue and older vein systems, is conclusive proof that ascending solutions depositing primary ore continued in action long after the formation of the Blue vein chalcocite. It is probable that ascending waters continued to traverse the Steward and older fissures for a considerable length of time after the primary Steward ores had formed; in fact, it is not at all improbable that the alteration of the granite and deposition of pyrite in the Rarus fault resulted from ascending waters.

If an early circulatory system existed similar to that above assumed, it is difficult to understand how meteoric waters could have been active enough to transport large quantities of mineral from the oxidized zone to great depths at any period prior to the complete cessation of the upward movement of the primary ore solution. The time of cessation must have been as late as the end of the ore-forming period of the Steward fault veins, and possibly as late as the Rarus fault, both of which are known to be later than much of the chalcocite of the Blue and Anaconda veins.

Chalcocite of the Lower Levels

The chalcocite of the deeper levels, or in a general way the massive chalcocite of all the veins, bears no definite relation to the present surface topography. This is in marked contrast to the occurrence of sooty chalcocite known to be of secondary origin. The tops or apices of many rich massive chalcocite orebodies or shoots are found at depths ranging from 100 to 1500 ft. from the surface. The size and richness of the orebody are in no way indicated by the depth of the zone of oxidation; in fact, many of the largest ore-shoots of the fault veins are capped by 500 to 800 ft. of barren crushed granite and fault clay having an oxidized zone of less than 25 ft. in vertical extent. In the quartz-pyrite veins of the Anaconda system where the development of secondary glance is greatest, there is an apparent close relation between the depth of oxidation and the quantity of sooty chalcocite found below. A deep zone of secondary chalcocite is certain to be found below a deep zone of oxidation,

while a shallow zone of oxidation is accompanied by an unimportant development of sooty chalcocite below. If a secondary origin is assumed for the chalcocite orebodies whose tops or apices are separated from an extremely shallow oxidized zone by hundreds of feet of barren crushed granite, the question as to the source of the copper to form the chalcocite becomes of vital interest.

Source of the Chalcocite

Where the ore-shoots do not extend upward to the oxidized zone it does not appear possible that the source of the chalcocite could have been at a point higher than the top of the ore-shoot, for there is no evidence, direct or otherwise, that copper-bearing mineral of any character ever existed in the eroded and oxidized portions of the vein. The marked absence in the upper portions of many veins of an adequate source of supply for the copper found at great depths in the form of chalcocite is a common feature of these ore deposits. This is true not only of the fault veins, but in many of the veins of the Anaconda system. In the tramway and Leonard mines, for example, immense chalcocite-enargite orebodies 50 to 200 ft. thick, belonging to the Anaconda vein system, have been developed between the 1200 and 2000-ft. levels. From the 1200-ft. level to the surface these orebodies are represented only by small veins from 2 to 6 ft. in thickness, carrying but small amounts of copper. Indeed, in many instances the identity of the vein is entirely lost as the higher levels are approached. In nearly every case the oxidized zone capping the big orebodies of this district is shallow, and even if it be assumed that hundreds of feet of vein have been eroded, such eroded portions represent a source entirely inadequate to account for the chalcocite found below.

In the Shannon vein (belonging to the Anaconda system) of the West Colusa mine, the orebodies of the upper levels were of tremendous size, particularly in the region immediately underlying the oxidized zone, where there occurred a big development of sooty chalcocite. It is significant that although the vein continued big and strong in depth, with every condition favorable for secondary enrichment, the vein became poor rapidly in depth, portions of it at the 900-ft. level being too low grade to mine. Many other examples might be mentioned where old quartz-pyrite veins have been broken by later faults, and all conditions seem ideal for the formation of chalcocite ores in depth, but, other than the sooty glance enrichment, no notable addition of chalcocite has taken place.

The Mountain Chief Ore-Shoot

An interesting occurrence of chalcocite is found in the Mountain Chief ore-shoot of the Jessie vein, belonging to the Blue fault system. The oxidized zone is extremely shallow, being not more than 25 ft. deep at any point in the vein. The ore-shoots have been opened by continuous workings from the surface to the 2200-ft. level. There is a marked difference in mineralogical composition of these ore-shoots between their upper and lower portions. The change is found to take place at a depth of from 500 to 800 ft. from the surface. Some of the shoots do not extend entirely to the oxidized zones. The line may be drawn to mark approximately the elevation at which the change takes place. Above it the ore is an intimate mixture of quartz, pyrite, and chalcopyrite, the latter mineral occurring in abundance. Sphalerite and rhodochrosite are also present in considerable amounts. In the Mountain Chief mine one shoot extends entirely to the surface, where it is oxidized to a rich ore composed of cuprite and iron oxides. Immediately below these rich oxides there is but a slight development of secondary chalcocite, occurring as thin films coating the chalcopyrite and pyrite. At about the line suggested, within a vertical distance of from 50 to 75 ft., there is almost a complete transitional change from chalcopyrite ore to an ore consisting of chalcocite, bornite, enargite, pyrite, and quartz, with only small amounts of chalcopyrite. This character of mineralization has continued to the deepest levels yet opened, although there are some variations in the relative amounts of the minerals present. The development of chalcopyrite seems to take place only in the high levels or at the waning ends of the ore-shoots, indicating possibly that under certain conditions it is a lower temperature mineral than either enargite or chalcocite, assuming for the moment that all three are here of primary origin.

Surface Water Theory

In this particular example it is impossible to conceive of a surface water origin for the chacocite lying below the chalcopyrite capping. There certainly is no apparent adequate source for the copper. Where the chalcopyrite ore suffers oxidation the larger part of the copper is held in the oxidized zone as an oxide or carbonate, and, even assuming that a part of the copper was carried downward, it is quite impossible for me to believe that it could have remained in solution while passing downward over the chalcopyrite-pyrite ore, to be later deposited as chalcocite from 800 to 2200 ft. below the surface.

As already stated, many of the Butte veins have but slight oxidized zones, accompanied by sooty chalcocite zones of small vertical extent separated by hundreds of feet of barren vein from the chalcocite ores below. In such instances it is impossible to trace any genetic relation between the meteoric water circulation and the chalcocite commonly occurring at depths greater than 1000 ft. Where, however, as in the case of most of the quartz-pyrite veins of the Anaconda system, an important chalcocitization zone exists associated with massive chalcocite ores, and is underlain at greater depths by large quantities of chalcocite not associated with sooty chalcocite, it is, perhaps, reasonable upon first thought to suppose that all the chalcocite of both higher and lower levels has had a common origin. The early prominence of the copper veins of this class has been largely responsible for the former general belief in a secondary origin for the chalcocite in the Butte veins.

Changes in the Oxidized Zone

The changes which occur in the oxidized zone of the old copper-bearing quartz-pyrite veins in Butte are due to processes which act slowly. The invasion

of the oxidized zone downward into the sulphides took place at an extremely slow rate, and in view of this fact it must be admitted that the sulphate solutions originating at the sharp contact between the oxides and sulphides were extremely dilute. The chemicals added to these downward seeping surface waters through the oxidation of the sulphides are chiefly copper and iron sulphates, and possibly small amounts of free sulphuric acid. These cold surface waters, after taking up their burden at the oxide-sulphide contact, pass immediately downward along the vein, or partly through country rock, moving more or less constantly in direct contact with the pyrite and other vein sulphides. As is well known, the reaction between the sulphides and sulphate waters results in the formation of sooty chalcocite as a direct replacement of the sulphide attacked. These sulphate waters also attack the altered granite, resulting in greater porosity and in the formation of abundant kaolin. There is also a chalcocitization of the disseminated pyrite so common in the altered granite. In meeting already existing groundwaters below, a large proportion of which, although of meteoric origin, did not take copper into solution on their downward journey, the descending waters along the veins must become more and more dilute and certainly less active chemically as greater depths are reached. As a matter of fact, actual comparisons of the veins and granite of the upper and lower mine levels show conclusively that the downward-seeping waters actually become weak and inactive at not great depths below the surface, and it was due to this fact, in part at least, that C. T. Kirk was able to differentiate so clearly between the chloritic, sericitic, and kaolinitic alteration phases in the Butte granite.

It is extremely important to understand clearly this feature, because, apparently much more vigorous chemical processes have been active in the formation of the massive chalcocite of the deeper levels than were necessary for the formation of the secondary chalcocite of the higher levels. In the sooty chalcocite zone only sulphides are attacked and replaced by the chalcocite, while at greater depths massive chalcocite alone, or intimate mixtures of chalcocite, pyrite, bornite, and enargite, directly replace altered granite in quantities within and along the fault veins and veins of the oldest system. I believe that such replacements could not have been effected by dilute meteoric waters, which, in the act of reaching great depths, not only became extremely dilute and of doubtful activity, but they have been deprived wholly or in part of their copper in the regions of sooty chalcocite formation.

Reasons for Belief in Secondary Origin

The observed facts which have led primarily to the belief that the chalcocite of the Butte copper deposit is of secondary origin may be briefly stated as follows:

1. The chalcocite is often of a later age than the vein minerals with which it is associated.

2. In some instances the proportionate amounts of chalcocite in the veins have decreased rapidly with depth.

3. It has been abundantly proved at Ducktown, Morenci, Bingham, and in many other instances, that under certain conditions chalcocite is a product of descending sulphate waters.

4. The depth of the chalcocite enrichment in many of the Butte veins bears a definite relation to the depth of the zone of oxidation in the respective veins.

In an endeavor to solve the problem of the chalcocite formation, some investigations have been made. H. V. Winchell[4] succeeded in producing artificially, under normal conditions of temperature and pressure, chalcocite identical in chemical composition and physical character with the sooty chalcocite of the Butte veins. His experiments seem to prove conclusively that the formation of chalcocite, of the 'sooty' variety, at least, is easily possible under the conditions of temperature and pressure found in the upper levels of the Butte mines. Similar conclusions have been reached by H. N. Stokes and others in the laboratories of the United States Geological Survey.

Investigations of Charles T. Kirk

Perhaps the most elaborate investigation of this subject was undertaken by Charles T. Kirk,[5] who made careful chemical and petrographic analyses of the altered granite occurring in and along the Butte copper veins. He found that during the vein-forming processes the granite suffered great changes in chemical and physical character. These changes took place more or less gradually. He separated them into three general alteration phases, namely: (1) the chloritic phase, which marks the earliest stage of alteration; (2) the sericitic phase, marked by the development of great quantities of sericite through the further action of heated waters in (1); and (3) the kaolinitic phase, a change from the sericitic phase brought about through the action of descending sulphate waters or sericitized granite.

Phases (1) and (2), therefore, result from the action of deep-seated ascending waters; (3) is effected by the action of descending cold meteoric waters on phases (1) and (2). With these three alteration phases Mr. Kirk links certain generalized groups of minerals. He believes the early quartz-pyrite ores began to form with the early chloritic phases; that the copper mineralization during this and the succeeding sericitic stage was principally enargite, bornite, and chalcopyrite; and, lastly, that the chalcocite formation belongs entirely to the third or kaolinitic phase. He holds that kaolinite is wholly a product of cold meteoric water action and therefore the presence of it in deep levels indicates the presence of waters of meteoric origin. Many geologists, notably H. E. Gregory, dissent from this view and hold to the opinion that kaolinite may also be a product of ascending water alteration.

Relation Between Altered Granite and Chalcocite

It is to be regretted that Mr. Kirk did not give a

[4]Winchell, H. V., 'The Synthesis of Chalcocite and Its Genesis at Butte,' *Eng. & Min. Jour.*, Vol. LXXV, No. 21, pp. 783 and 784, May 23, 1903.

[5]Kirk, C. T., 'Conditions of Mineralization in the Copper Veins at Butte, Montana,' *Economic Geology*, Vol. VII, No. 1, pp. 35 to 82, January 1912.

series of direct comparisons between samples of altered granite taken both from the sooty chalcocite zone and the deep levels. Certainly there is much yet to be learned concerning the relation between the altered granite and chalcocite formation. Even assuming for the moment that meteoric waters have sunk to great depth in the Butte veins, accompanied by the formation of kaolinite at all levels, it does not necessarily follow that the chalcocite was deposited from such descending waters. It cannot be doubted that the sulphate waters descended to depths greater than the lower limit of the sooty chalcocite zone, but it is evident that while the chemical effect of these waters upon the granite at greater depths may have been of the same general nature as in higher levels, that is, kaolinization, the chemical action toward copper mineralization was entirely different. The chalcocite of deeper levels is not necessarily a replacement of a sulphide mineral as in the upper levels. Since the replacement of the pyrite by chalcocite in the higher zones is accompanied by the formation of ferrous sulphate and sulphuric acid, the descending waters passing below the sooty chalcocite zone still retain an abundance of dissolved iron sulphates and probably sulphuric acid to act on the sericitized granite, forming kaolin, as in the higher levels, but it is more than probable that the descending waters were entirely robbed of copper in the secondary chalcocite zone. The small amount of kaolinite present in the deeper levels as compared with the great abundance in the oxidized and sooty chalcocite zones indicates less activity, due either to dilution or to change in chemical composition of the solution.

From these considerations it is readily seen that the association of chalcocite with minor amounts of kaolin below the chalcocitization zone does not necessarily imply that both have resulted from the same solutions. The descending sulphate waters may still continue to form kaolin in regions of primary chalcocite after having deposited all of the copper burden in the region immediately below the zone of oxidation. It may not be difficult to understand meteoric waters reaching to unusual depths in the Butte veins, but I seriously doubt that such waters could retain copper in appreciable quantities after moving downward for hundreds of feet in direct contact with newly formed chalcocite and an abundance of pyrite.

Effect of Continental Fault on Water-Level

It is unfortunate that most of the granite samples used by Mr. Kirk in his investigations were collected from the Pittsmont vein, for the reason that this property is peculiarly situated with respect to the general topography of the district, and it is also in close proximity to the Continental fault, a fracture of comparatively recent occurrence. The effect of this fault upon the water-level and oxidized zone may be readily understood. The immediate effect has been to drop the former erosional surface and oxidized zone to a depth considerably below their former positions. The collar of the Pittsmont shaft at the present ground surface is about 400 ft. above the old erosional surface. In the mine workings the oxidized zone is 250 to 300 ft. thick, measured downward from the former surface, and the sooty chalcocite belt is known to extend at least 500 ft. deeper. Summing up these figures, the result is reached that the deepest general working level of this mine (the 1200-ft.) is not more than 600 ft. below the zone of oxidation, or, as a matter of fact, scarcely below the zone of sooty chalcocite. When it is remembered that in the Mountain View mine the sooty chalcocite zone is 800 to 1200 ft. thick, one is forced to the conclusion that Mr. Kirk's samples do not represent conditions far removed from the direct influence of copper-bearing surface waters. The results of his work are extremely interesting and of value, especially his investigations concerning the alteration of the granite, but in my opinion he has erred in attempting to apply his method of reasoning to the chalcocite of deep orebodies of the Butte veins with which he is evidently unfamiliar. His results are valuable inasmuch as they further corroborate and establish, from a new point of attack, the conclusions already reached by others that the sooty chalcocite, and massive chalcocite to a limited extent, of the Butte deposits, have resulted from the work of downward seeping sulphate waters whose copper was derived from the oxidized zone.

Observations of W. H. Weed

W. H. Weed[6] has set forth some facts which, in his opinion, tend to prove the secondary origin of the Butte chalcocite. He observes generally that the old quartzite-pyrite veins were originally of very low grade and they became commercially valuable through the later addition of enargite, bornite, chalcocite, and other copper minerals. He believes that this copper mineralization followed various periods of faulting, the enargite and bornite being the first to appear, probably contemporaneous in a general way with the Blue and Steward fault system. Chalcocite, which forms the bonanza ores of the district, is thought by him to have been almost entirely a product of descending sulphide enrichment processes, acting at great depths, however, only where the older quartz-pyrite veins were cracked and broken by faults, thus permitting a ready passage for the downward-seeping waters. He cites many examples of such intersections of faults and older veins in support of this view, and maintains that the old quartz-pyrite veins are workable only where thus fractured.

My own observations do not confirm Mr. Weed's conclusions as above outlined. Actual examination of a great many intersections of old quartz-pyrite veins by later faults have shown conclusively that as a general proposition the east-west veins are no richer at or near intersections with Blue vein faults than at other points along the vein, except in cases where the fault vein ore-shoots cross the older vein. It is extremely difficult to form even an approximate idea as to the extent of primary enrichment in the older veins due to the late faults of the Steward system. Mineralization processes were active in the early veins prior and subsequent to the Blue

[6]Weed, W. H., 'Geology and Ore Deposits of the Butte District, Montana,' Professional Paper No. 74, U. S. Geological Survey, p. 152, 1912.

vein period, so that it is impossible to determine, in the absence of any characteristic minerals, what influence was exerted by the later faults upon the older veins. As might be expected, the fault vein intersections are usually accompanied by a breaking and shattering of both the older vein and the country rock in the immediate vicinity, thus developing favorable factors tending to greatly influence ore deposition at such points. In any case, where a chalcocite enrichment of a vein of the Anaconda system is shown to have resulted from the influence of an intersecting fissure of the Blue or Steward system, there remains the strong probability that such enrichment is due to primary waters, if, as I believe, the primary chalcocite was deposited in great quantities, after the appearance of these faults, not only within the faults themselves, but in the fractured older veins.

Mining in Northern Ontario

By P. B. McDonald

The rapid development of Cobalt was due to the fact that a railway ran through it, bringing in the supplies and taking out the ore. But Cobalt was the making of the Government railway in northern Ontario. With some show of truth, it may be said that the Government was the making of Cobalt. A mining region without railway facilities, no matter how rich it may be, is handicapped, almost paralyzed. The miner and prospector must have machinery, coal, and food supplies; they also must have railway facilities to transport the ore. In the absence of these advantages, a mineral region, except for placer gold mining, as in the Yukon, is almost worthless.

The Government Railway

North of Cobalt, the Government railway has failed to intersect another mining region, but traverses a clay belt which promises in the future to be a fine agricultural country, but some years will elapse before it is developed. At Larder Lake there have been some discoveries, and west of it, about five miles from the railway, is the new Kirkland Lake district, in which small but rich veins of gold ore are being worked. To the west of the railway, however, two large mineral areas have been opened which promise much. These are Gowganda and Porcupine. The former of these camps is laboring under a great disadvantage from lack of direct transportation. Porcupine has now good railway facilities. The result is that while Cobalt was a poor man's camp in the sense that it was easily accessible and cheaply mined, the poor prospector is being rapidly frozen out of the Gowganda district. Gowganda is a silver camp of large area, and it may be a surprise to the people to know that, notwithstanding the disadvantage of requiring the transhipment of ore at Elk Lake, Gowganda has shipped more ore in the past year than Cobalt did in the second year of its existence. Notwithstanding its poor transportation facilities, one mine alone has shipped thirteen carloads. While a large number of claims are staked out, and there are fine surface showings over a large area, the enterprise of the miners is paralyzed by their inability to get supplies, coal, or machinery, as may be imagined, and the methods of mining obtaining there are crude. The operators are men of means who can provide the capital, but the unfortunate prospectors are forced to sell their claims because they can neither mine nor keep up the assessment work. Outsiders have shown no great disposition to purchase these claims. Nevertheless, a number of mines are being worked, and the showings are good. In one case rich ore has been mined at a depth of 150 ft., and another mine is down 200 ft. and in ore.

The New Wagon-Road

In 1909 it was expected that a branch of the Government railway would be built in, but nothing has been done. This year the miners' hopes were rewarded by the construction of a wagon-road, but of such superlative roughness that one ton of freight is more than a team of horses can haul over it. It has cost as much as $1600 to market a carload of ore from Gowganda. Naturally, the ore must be very rich to stand such a tax. Fortunately, the present high price of silver and the possible further advance cover the big expense of mining and marketing the ore from some properties. With the extension of railways and improved transport facilities a period of increased production is anticipated.

Northern Ontario, to July 1, produced almost a hundred million dollars in silver—to be exact $98,890,000. Of this production, all but one-tenth, or $9,800,000, came from Cobalt, the latter amounts coming from the other smaller silver camps, chiefly Gowganda. Cobalt, it is to be remembered, is but in its eighth year. Half of the total has gone back to the shareholders in its mines. The camp is now turning out an average of $100,000 every working day. No estimate can be made of the value of the silver in sight in the mines, but it undoubtedly runs into the millions; 10,000,000 oz. in one mine, 4,000,000 oz. in another, and 2,000,000 oz. in a mine of comparative recent operation. Cobalt has the record of American silver mining: seven and one-half years to produce nearly $90,000,000 worth of silver.

Gold, for the first time in the history of Ontario, formed a substantial part of mineral production in 1912. In 1911 the output had a value of $42,637; in 1912 the gold output increased to $2,114,086. The greater part came from the mines of the Porcupine district, principally from the Hollinger and Dome, which came into full production early in the year. Other mines at Porcupine whose stamp-mills are now working are the McIntyre, Vipond, Jupiter, and McEnaney. Besides these mines at Porcupine, the St. Anthony mine at Sturgeon lake and the Cordova in Peterborough county yielded considerable bullion. The outlook is for a much larger production at Porcupine. The other gold camps in that locality, as Larder lake, Kirkland lake, Swastika, etc., have not yet reached a stage of steady output, although there are strong hopes of ultimate profit.

New Canadian Dredges

By An Occasional Contributor

The Canadian Klondyke Mining Co. is operating four elevator dredges in the Bonanza basin near Dawson, Yukon Territory. The first one of these dredges, which is of 7½-cu. ft. capacity, was put in operation about 1907, and it has been operating continuously, excepting in the winter months. It is an electric-driven machine having a continuous bucket-chain and revolving screen. The next machine put to work was a 16-cu. ft. dredge built and put in operation in 1910. This was also an electric-driven machine, but it differed from the first one in that all motors are direct connected, doing away with the troublesome driving belts. Both of these machines were built and equipped by the Marion Steam Shovel Co., and they gave such excellent satisfaction that an order was placed in 1912 for two more 16-cu. ft. machines, which were finished in the spring of 1913. These last two machines were along the general lines of the one built in 1910, but carried many improvements, mainly along the line of convenience in operating and making repairs. These two machines are known as Canadian No. 3 and Canadian No. 4, and are exactly alike.

Difficulties in Landing the Machinery

The difficulty encountered and finally overcome in landing this machinery at the point of construction can be appreciated when it is remembered that the total weight of machinery as shipped from Marion, Ohio, was approximately 2,250,000 lb. for each machine, and due to the design, it was necessary to ship some pieces weighing as high as 25 tons. This was quite a task, as each piece had to be handled several times before finally landing at its destination, going as it did by rail to Vancouver, British Columbia, thence by boat to Skagway, from there by narrow-gage railroad to White Horse, then down the Yukon river in small boats to Dawson and from there by rail to point of construction. The long distance shipped, as well as the numerous handlings, made the freight charges very heavy.

The hulls are constructed of timber throughout, each containing about 750,000 ft. of Oregon fir, all of which had to be shipped from Vancouver. The over-all dimensions of the hull are: length, 136 ft.; width, 56 ft. 8 in., with a depth of 14½ ft. at the bow and 12 ft. at the stern. Because there is 5½ ft. overhang at both sides, the deck itself is approximately 68 ft. wide, thus giving additional area for gold-saving tables.

Bucket Equipment

These dredges are both equipped with a continuous chain of 71 buckets. These are of approximately 16-cu. ft. capacity and 40-in. pitch, and are cast solid in one piece, excepting the lip, which is of manganese steel securely riveted to the bucket proper. Each bucket weighs about 4800 lb. complete. These buckets are carried by a ladder of the plate girder type, 97 ft. centre to centre of shafts and weighing when complete about 108 tons. This weight includes the ladder structure itself, 17 ladder rollers which are bolted to the upper side of the structure, and the lower tumbler and shaft with bearings complete. The lower tumbler and shaft alone weigh about 14 tons. The total weight of the ladder with bucket-line attached is 275 tons, and adding about 50 tons for material, the total load to be carried by the suspension shaft and ladder tackle is about 320 tons. The ladder is handled by the ladder-hoisting machinery, consisting of a drum with suitable gearing, driven by a 200-hp. variable-speed induction motor. The bucket-line is driven by massive main drive machinery which is securely bolted to the inside tumbler framework. This machinery, including gearing and housing, weighs 162,000 lb. Power is furnished to drive this machinery by a 300-hp., variable-speed, induction motor, direct connected to the machinery.

Revolving Screens

The gold-bearing gravel is washed and separated in a revolving screen, which is placed at the centre of the hull aft. This screen is of the straight type, 50 ft. long and 9 ft. 9 in. diam., and is carried on two cast steel screen paths, one at each end, which are in contact with the driving and guide rollers. The driving is accomplished by friction contact at the upper end. This screen weighs about 172,000 lb., and under ordinary running conditions would contain from 30,000 to 40,000 lb. of material.

The gold-saving apparatus consists of a double bank of gold-saving tables extending the full width of the hull aft, having a combined area of about 5500 sq. ft. The upper end of these tables is fitted with cocoa matting, held in place by expanded metal, while the rest of the area is fitted with angle iron riffles. It is estimated that about 90% of the gold saved is caught in this cocoa matting. The waste material is taken from the screen and carried to a sufficient distance beyond the boat by a stacker belt, which is carried by a stacker 115 ft. long centre to centre of belt pulleys. This stacker is of box-girder type, weighing about 40 tons complete. The stacker belt is 48 in. wide, carried on troughing idlers on the return side by straight idlers, and is driven by a 50-hp. motor placed at the upper end together with the necessary driving apparatus.

High-Pressure Pumps

An immense volume of water is necessary to thoroughly wash the material as it comes from the bucket-line and at the same time carry it through the screen and over the tables. For this purpose a 14-in. high-pressure centrifugal pump, and 16-in. low-pressure centrifugal pump are used, the former being driven by a 150-hp. constant speed induction motor, and the latter by a 200-hp. motor of the same design. In addition to these pumps, there is a 4-in. high-pressure pump, direct connected to a 35-hp. induction-type motor, which is used for priming purposes and also for a general purpose pump around the deck.

The dredge is held in position while digging by two massive structural steel spuds, which are held

in suitable framework at the stern. These spuds weigh about 35 tons each, and are raised and lowered by means of the winches placed on the deck. These winches consist of eight drums arranged in pairs. From this machinery the bow and stern swinging lines are operated.

Another interesting feature of these dredges is the traveling cranes arranged to operate above the house and house framework. It is possible with these cranes to pick up material from a scow at the bow of the dredge and convey it to any desired position fore and aft. These are the only dredges in operation in this country which are equipped with this device.

Motors

All the motors on these machines are wound for 2200-volt, 3-phase, 60-cycle. The list includes the following: main drive, 300 hp.; ladder hoist, 200 hp.; screen drive, 150 hp.; winch drive, 50 hp.; stacker hoist, 35 hp. All are variable-speed induction motors. There are also the following motors, all of which are constant-speed induction type: 16-in. pump, 200 hp.; 14-in. pump, 150 hp.; screen drive, 50 hp.; 4-in. pump, 35 horse-power.

It is estimated that each dredge represents an outlay of about $475,000 as it stands ready to run. It is therefore necessary, in view of the short working season, to keep them in constant operation. This is only possible by keeping a large stock of repair parts on hand, together with the necessary facilities for making quick changes of parts, and on the efficiency of this system depends, in a large measure, the success of such placer operations.

Bismuth-Tin-Wolfram Ores from Tasmania

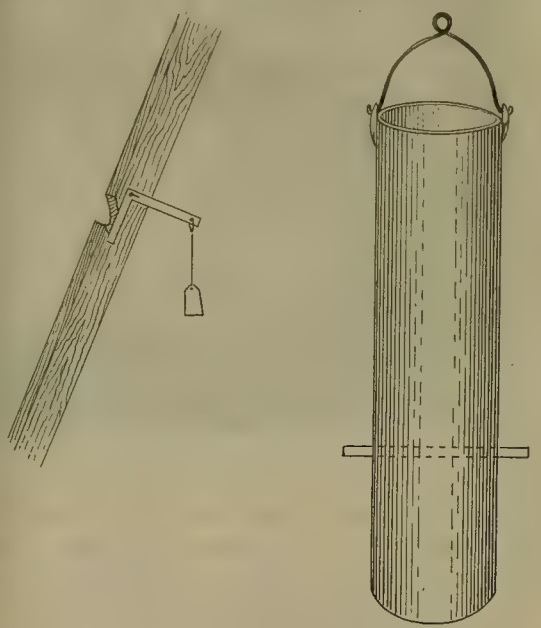
*The ore of the Shepherd and Murphy mine at Moina is very complex, containing bismuth, tin, wolfram, a large proportion of pyrites, magnetite, and traces of molybdenite. The lodes, which are of pegmatic structure, continue for great length, but are comparatively narrow, averaging only 15 to 18 in. The wall rock is principally quartzite. A number of lodes have been proved. The mill has been altered considerably from time to time. Originally, the ore was crushed by stamps, but as the metallic content is in a state of loose aggregation, and can be recovered without fine crushing, a 16 by 9-in. jaw breaker is used, and a second one is shortly to be installed for crushing the oversize. The equipment includes rolls, trommels, jigs, Wilfley tables, Frue vanners, and canvas strakes. All the machinery is driven by water power, and the output is periodically affected by shortage of rainfall. The present season, for instance, has been rather a poor one in this respect, very little rain having fallen between Christmas and the middle of March. The concentrate, averaging 32 to 40 tons per week, carries an equal content of tin, tungsten, and bismuth. It is shipped to the Company's works in Launceston, and separated into marketable products by means of two Wetherill magnetic separators. The machines give three products. The first two magnets, 4 amperes, extract the magnetite, while the second magnets, 14 amperes, separate the wolfram, leaving a final tin-bismuth product. Three products are being shipped, namely: wolfram firsts, assaying 70% tungstic acid; seconds, from the treatment of the pyritic material, averaging 63% tungstic acid; and a tin-bismuth mixture very low in tungstic acid.

*Abstract from *Mining and Engineering Review.*

A Home-Made Self-Loading and Dumping Water Skip

By H. E. Wharton

A self-loading and dumping water-skip for taking water from shafts having a slight incline is made as follows. Take a piece of old smokestack about eighteen inches in diameter and eight or ten feet long, and put a hinged valve or clack in the bottom ten inches square. Then put a piece of 1½-in. pipe through the stack at about one-fourth the distance from the bottom for a trunnion, and a bail on the top for a cable. The tracks used are made of 2 by 6-in. lumber with notches cut in them just above the top of the shaft to let the trunnion drop in when the skip lands. When the engineer slacks the cable, it dumps. The angle iron is fastened on the track as shown, with the counterbalance heavy enough to let the loaded skip drop in the notches. After dumping, the skip is hoisted a couple of feet and when it is lowered the angle iron will carry it over the notches.



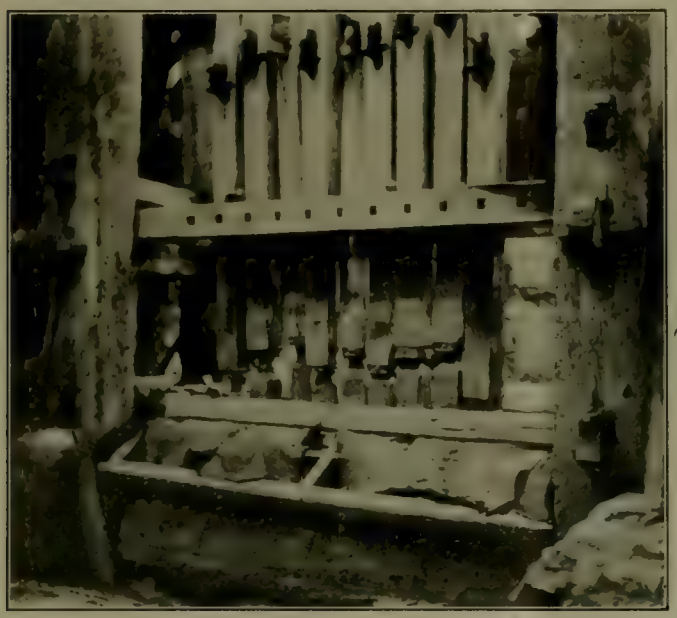
SKIP AND DUMPING DEVICE.

The Broken Hill Proprietary produced the following in July:

Mine product, silver, ounces	160,978
Mine product, lead, tons	2,519
Purchased ores, silver, ounces	191,211
Purchased ores, lead, tons	3,855
Antimonial lead, tons (estimated)	28
Zinc concentrate from flotation, tons	7,000
Metal contents:	
Silver, ounces	90,214
Lead, tons	524
Zinc, tons	3,227

Stamp-Mills of the Past

While stamp-milling was not the first form of crushing employed in the treatment of the precious metals, with its invention in the latter part of the fifteenth or early sixteenth century it may be said that the foundation of modern milling practice was laid. The first crushing appliances as described by the ancient authors, the remains of which are seen in the old Greek and Roman mills which are scattered over Europe, were hand mortars and millstones of the same pattern as those used for the grinding of wheat. In Beckman's



AN OLD OAXACA STAMP-MILL.

'History of Inventions,' the following has been written regarding the early practice and first appearance of the stamp: "In the year 1519 the process of sifting and wet stamping was established at Joachimsthal by Paul Grommestetter, a native of Schwartz. The machine was named the Schwarzer. Soon after this there was erected, in 1521, a large stamp-milling works at Joachimsthal, and the process of washing was begun. In 1525 this method was introduced at Schlackenwalde by Hans Pörtner, and in the Harz district at Wildenmann, by Peter Philip, about the year of 1524." Ruins of these old mills are still to be seen in the Harz mountains, Transylvania, Mexico, and other parts of the world.

The First Mills

In discussing the early stamp-mill, Agricola, as translated by H. C. Hoover, describes it in an interesting manner. The ore is crushed with iron-shod stamps, in order that the metal may be separated from the stone and the hanging wall rock. The machines which miners use for the purpose are of four kinds, and are made by the following method. A block of oak timber is laid on the ground and in the middle of this is fixed a mortar box. The front of the box, which might be called a mouth, is open; the bottom is covered with a plate of iron, each end of which is wedged into the timber with broad wedges, and the front and back part of it are fixed to the timber with iron nails. To the sides of the mortar above the block are fixed two upright posts, whose upper ends are somewhat cut back and are mortised to the timbers of the building. Two and a half feet above the mortar are placed two cross-beams joined together, one in front and one in the back, the ends of which are mortised into the upright posts, already mentioned. Through each mortise is bored a hole, into which is driven an iron clavis; one end of the clavis has two horns, and the other end is perforated in order that a wedge driven through, binds the beams more firmly. Three and a half feet above the cross-beams two other cross-beams of the same kind are again joined in a similar manner; these cross-beams have square openings, in which the iron-shod stamps are inserted. The stamps are not far distant from each other and fit closely to the cross-beams. Each stamp has a tappet at the back, which requires to be daubed with grease on the lower side, that it can be raised more easily. For each stamp, there are on a cam-shaft two cams, rounded on the outer end, which alternately raise the stamp, in order that by its dropping into the mortar, it may with its iron head, pound and crush the rock, which has been thrown under it. To the cam-shaft is fixed a water-wheel whose buckets are turned by water-power. Instead of doors, the mouth of the mortar has a board, which is fitted into notches cut out of the front of the block. This board can be raised in order than when the mouth is open, the workmen can remove with a shovel the fine sand and likewise the coarse sand and broken rock into which the rock has been crushed; this board can be lowered, so that the mouth thus being closed, the fresh rock thrown in may be crushed with the iron-shod stamps. If an oak block is not available, two timbers are placed on the ground and joined together with iron clamps, each of the timbers being six feet long, a foot wide, and a foot and a half thick. Such depth as should be allowed to the mortar is obtained by cutting out the first beam. In the bottom of the part thus dug out, there should be laid a very hard rock a foot thick and three-quarters of a foot wide; about it if any space remains, earth or sand should be filled in and pounded. In the front, this bedrock is covered with a plank. When the rock is broken it should be taken away and replaced by another. A smaller mortar having room only for three stamps may also be made in the same manner.

Stamp Stems

The stamp stems are made of small square timbers nine feet long and a half a foot wide each way. Where the head of the shoe is enclosed in the stem, it is bored through, and similarly the stem itself is pierced and through the opening of each

there passes a broad iron wedge, which prevents the head falling off the stem. To prevent the stamp head from becoming broken by the constant striking of fragments of ore or rocks, there is placed around it a quadrangular iron band a digit thick. Those who use three stamps, as is common, make them much larger. The iron shoe of each has a length of over two feet; at the lower end it is hexagonal. There are some who make that part of the head which is enclosed in the stem barbed and grooved, in order that when the hooks have been fixed to the stem and wedges fitted in the grooves, it may remain tightly fixed, especially when it is also held with two quadrangular iron bands. Some divide the cam shaft with the compass into six sides, others into nine; it is better for it to be divided into twelve sides in order that successively one side may contain a cam and the next be without one.

Old and New Mills

So Agricola has described the progenitor of what has come to be the standard crushing machine of today. It will be seen that an analysis of this primeval prototype shows the identical features which are embodied in modern practice, and the process of evolution has confined itself to the perfecting of mechanical and structural details. The over-shot wheel has been replaced by the motor, the square stems have been made circular and of steel, the falling weight has been increased, mechanical feeders have been installed, the shoes and dies have been altered, the shape of the mortar box has been changed, and the direct fall has been supplemented with a grinding movement, but the details as to principle remain the same. The half-tone shows one of the forefathers of the Mexican milling practice, built in one of the out-of-the-way districts of Oaxaca; it still stands as a monument to the millman of yesterday, who by axe, timber, and grit fashioned this crude mortar and added another iota of bullion to the world's store.

Use of Gasoline Motors in Coal Mines

By A. F. King

*In shape and appearance the gasoline locomotive closely resembles the electric, except that it has no trolley pole. The larger types require more height than an electric motor of the same weight. Rotation is always in one direction, so that the reversing is done by means of clutches and mitre gears. They are usually constructed so as to run on full and on half speed. Each motor is equipped with what is called a carburetor. The office of the carburetor is to properly mix the air and the gasoline in the cylinder. They are also equipped with an electric lighting device, which is so connected as to operate from a storage battery when the motor is starting, and thereafter from a magneto. Some manufacturers also equip the motor with absorption chambers, the types and capacities of which differ with the size of the motor. These absorption chambers are intended to absorb the carbon dioxide (CO_2) generated, and to cool the gases given off. It is also claimed that this absorption chamber is a protection against the ignition of explosive mine gas or coal dust in case the engine 'back-fires.'

The repairs are said to cost about the same as for electric motors of the same power, but on account of the gasoline motor having reciprocating parts, I am inclined to believe that they cost more.

Advantages of the Gasoline Motor

The advantages of the gasoline motor are:

1. That no power-plant is needed to operate them.
2. That there are no transmission wire lines or pipe-lines needed.
3. The use of the motor is not affected or interrupted by short circuits, bursted pipe-lines, or drains upon the transmission lines by other motors.
4. No trolley lines, hangers, bonds, or cables are required.
5. It aids in the humidification of the mine air.
6. It is safer than a trolley wire equipment.
7. No time is lost in handling the trolley pole or wires; and in gathering it is unnecessary to attach and detach either transmission or haulage cables.

The disadvantages of the gasoline motor are:

1. That in the use of gasoline in the mines there is an element of danger, from the fact that it readily volatilizes, and when mixed with air forms a very explosive gas.
2. The combustion of gasoline in the combustion chamber extracts oxygen from the mine air.
3. Carbon dioxide and free nitrogen are the products of the perfect combustion of gasoline.
4. The carburetor is usually adjusted to furnish, as nearly as possible, the proper mixture of gasoline vapor and air when the motor is doing its heaviest work, so that if it be assumed that, under these conditions, perfect combustion is obtained, it is evident that when the engine is running with the motor standing, or when it is doing light work, imperfect combustion results, which means that carbon monoxide (CO) is given off.
5. I am of opinion that the absorption chambers do not eliminate all of the carbon dioxide which is produced, nor do they prevent the carbon monoxide or free nitrogen from being given off.
6. When the coal must be cut by mining machines, a power-plant, though not necessarily so large, must be operated and maintained, and transmission lines, both outside and inside the mines, must be erected and maintained.
7. The gasoline motor costs from 25 to 50% more than the electric motor of the same power.
8. It is also said that, due to its having but two speeds, the gasoline motor will not start as large a trip as the electric motor.
9. One complaint I have heard is that it will not take an overload, as do electric motors; but it seems to me that the tractive effect in either case is dependent upon the weight of the motor.
10. At the present time the gasoline motor cannot safely be used in a gaseous mine.

*Read before the West Virginia Coal Mining Institute and reported in *Black Diamond*.

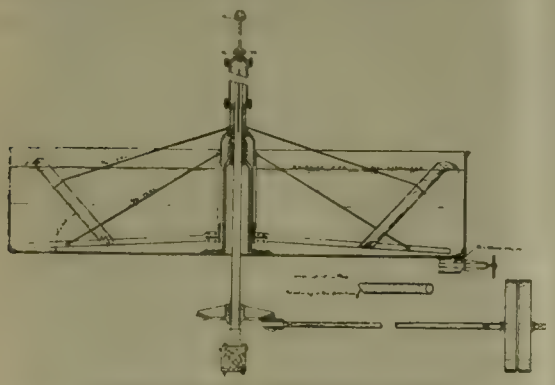
Thirteen tons 1035 lb. of silver bullion was shipped from the Belmont mill at Tonopah in August.

Slime Agitation

By H. B. Wright

*As the agitation of slime is of such importance in the present-day treatment of gold ores, the following brief particulars and the accompanying sketch of the Wright-Jaentsch centrifugal aerator, as used at the Great Boulder Perseverance mine, may be of interest.

The principle of the machine is based upon centrifugal force. It is of simple construction, works automatically, and the cost of installation and maintenance is trifling. The pipes, any number of which may be used, act essentially as simple forms of centrifugal pumps and operate at whatever speed is



WRIGHT-JAENTSCH CENTRIFUGAL AERATOR.

required. Practical tests have shown that a satisfactory rate is when the outside ends of the pipes have a circumferential speed of 350 ft. per minute. Four pipes, each with a diameter of 6 in., have given good results. The pipes should have an inclination of 45° from the horizontal; anything less than this may induce silting. When the ends of the pipes are just submerged, the greatest pumping effect is attained, for the reason that there is then no hydrostatic head to be overcome.

Treatment of Roasted Ore

In the treatment of roasted ore with cyanide solution, following pan and tube-mill grinding, it has been ascertained from a number of tests, conducted over a long period, that a vat fitted with this pipe system shows an increase of 7.5% of gold dissolved in the vats over that of the ordinary form of mechanical agitator. The following results were obtained by assaying the gold-bearing cyanide solutions from one agitator fitted with ordinary stirring gear and another equipped with the centrifugal circulating pipes. The pulp, after grinding and amalgamation, was divided as equally as possible and run into the separate vats, in order that any differences due to roasting would exercise the same relative influence. The average number of grains of gold per ton of solution in 24 charges in an agitator with stirring gear was, when filled, 117 gr., and when discharged 117.2 gr; and in an agitator with centrifugal pipes was, when filled, 115.9 gr., and when discharged 120.3 grains.

The mean average results from the ordinary agitator show that there is only 0.17% of gold dissolved in from one to two hours' agitation, whereas in the case of the pipe agitator there is 3.71% increase, or 3.54% in favor of this type. The ratio of solution to ore was 2.14 to 1, which gives 7.5% per ton of ore. It has frequently been observed that prolonged agitation shows gold being precipitated from the pulp solutions. With the ordinary stirring gear as used, it was proved that in 24 charges no less than eight showed gold precipitated, and in the case of the pipe agitator there was none. The percentage strength of the cyanide solution during these tests contained 0.085 total cyanide and 0.065 free cyanide, the standard found necessary to give the best economical results.

Twenty-three of these vats are in operation at the Great Boulder Perseverance mine; each vat is 20 ft. in diameter and 4 ft. 6 in. deep; the arms are rotated at 6.7 r.p.m., and 3 hp. is required to operate each vat.

From the formula $= P \dfrac{W \times V^2}{g \times r}$ lb.

Where P = the centrifugal force in pounds.
W = the weight of the body in pounds.
V = the velocity of the body in ft. per sec.
g = gravity's acceleration.
r = radius from centre of motion to centre of gravity in feet.

Taking $W = 60.7$ lb. (specific gravity of pulp at 1.25.)
$V = 4.9$ feet.
$g = 32$.
$r = 7$.

it is found that the centrifugal force exerted is 6½ pounds.

*Abstract from *Monthly Journal* of the Chamber of Mines of Western Australia.

Hammer-Drills

*The hammer type of drill is a natural air saver, and it is in the design and construction of this type that air economies may be effected safely and without sacrifice. It represents the evolution of the rock-drill from the piece of steel struck by a hammer through the various stages of percussive machines back again to the hammer-driven blow upon the steel, the difference being only that the blow is a rapid power blow. A hammer-drill is economical in air consumption because, in the first place, it reciprocates a light plunger which weighs only a few pounds, while with the piston-drill not only must the heavy piston be thrown backward and forward at high speed, but it carries with it the steel and bit. In hammer-drills the power is utilized, not in overcoming the inertia of a heavy body, but in compensating for that inertia through the high speed of a light body. A heavy mass moving slowly may give the same impact of blow as a light mass moving rapidly. The effective work done is represented by the weight multiplied by the velocity. The same effect may be produced by subtracting from the weight and adding to the velocity, or vice versa. In a piston or percussive drill, velocity is limited, while in a hammer-drill it is practically unlimited, and here is where the great possibilities of hammer-drills lie.—W. L. Saunders.

*From 'Rock-Drilling Economics,' *Trans.* Amer. Inst. Min. Eng., August 1913.

Discussion

Readers of the MINING AND SCIENTIFIC PRESS are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment. Insertion of any contribution is determined by its probable interest to the readers of this journal.

Government Prospecting

The Editor:

Sir—The recent communication by Albert Burch touches upon the most important subject relating to the future of mining. As prospecting is essentially work upon the ground and not at the office desk, it may be easy to overdo the subject in print, but a few remarks seem in order, especially as the first writer invites criticism. The question of Government land, especially in the West, is one which has afforded opportunity for considerable discussion by politicians and others. New suggestions come so fast that it is a remarkable person who can map out a course on the subject and adhere to it in all details. The educators who approve of study simply for mental gymnastics should certainly admire the subject with its recent turns.

After listening to the heated arguments about our Eastern brothers who have 'squandered their birthright of resources' and now wish to share in those of the 'undeveloped West,' a proposal for Government prospecting comes as a relief. Ordinarily it has been thought that the federal government should be called upon to do work falling in two classes; first, that which was so large or upon which returns would be so long delayed that private enterprise could not well embark; second, work which so intimately affected the common welfare that private enterprise could not be trusted to do it. Any new proposal for Government activity should fall in one of these classes to receive popular approval. Let us examine the subject of prospecting for the more valuable metals and see if it will fall into such classification.

Scarcity of Prospectors

That prospectors are more rare than formerly, there can be no question, and one obvious reason is that it has gradually become more difficult to find a deposit of value. The subject is frequently dropped with no further attempt at explanation. However, there may be other reasons. The prospector, to whose description no greater inaccuracy can be applied than the continued use of the word 'old', is an ordinary man with some knowledge of minerals and possessed of the spirit of adventure. Any proposal as to his work should rest upon such an assumption. During the development of the West many fields of activity besides mining have opened, and if the business of prospecting is being abandoned, it is partly due to competition or opportunities offered by other industries because the men fit for prospecting have disappeared. To meet competition in this, as in all other lines of endeavor, better or at least equal opportunities for gain must be presented. Now, certainly, the chance for gain in prospecting is arbitrarily fixed by nature; that is, a prospector can only find what already exists, and this chance has been steadily reduced as each find has taken place in the past. Therefore an effort to meet competition cannot be made along the line of increased probable reward. However, an effort can be made at the other end; that is, by decreasing the probability of loss. Nearly every Western metal mine working a crew of as many as fifty men has probably a dozen men who possess the three prime requisites of a prospector, namely, a good physique, spirit of adventure, and common sense, supplemented with some knowledge of minerals. These men are fairly sure of saving a certain amount of money every day that they work steadily, and many of them have families, which makes it absolutely necessary that they take what appears to be a sure profit. Nearly all the mining companies working such a crew of men regularly are making yearly profits. Would it not seem most reasonable to ask those who are directly profiting from mineral deposits to assist in stimulating the business of finding other deposits to replace those being exhausted? With the preceding outline of conditions in mind, there are, fortunately, all of the necessary tools at hand to proceed.

The Mineral Laws

With the present mineral laws, Uncle Sam is in the position of offering to any citizen the opportunity to search for any minerals, wherever some one else has not already appropriated them. In case of discovery, our liberal Uncle does not require anything in return, unless the discoverer wishes to gain a more secure title by obtaining a patent at a comparatively small cost. To ask the old gentleman to go to greater lengths of liberality seems absurd. On the contrary, it would not be out of order should he call for an accounting from his nephews. Probably the facts disclosed would warrant him in hereafter refusing to allow many of them to hold ground simply by doing assessment work to the amount of $100 per year. Especially when he finds that the supposed expenditure frequently dwindles to about $25 worth of actual beneficial work. Many mining concerns spend larger sums searching for new properties, frequently covering an entire continent with meagre or negative results. Such searches entail great expense for salaries and traveling. Generally, they consist in thoroughly examining deposits already known and slightly developed. Could not such an exploration policy be supplemented by a more minute search nearer home, where there must be some other deposits besides the ones now working? Many of the workmen at operating mines would welcome an opportunity of spending a part of the year in prospecting if they were assured of steady work during the remainder of the year together with living expenses while in the field. It would be easy for the company to fulfill both these conditions, when it is considered that a prospector's monthly expenses, if within 100 miles of the home camp, could not with the wildest dreams of camp luxury exceed $50, and should be nearer half that amount. Five men for six months during a year would cost, at a maximum, only $1500, and with a liberal addi-

tion for 'overhead expenses' the expenditure would be less than $3000. This sum is equivalent to mining about 600 ft. of drift, and many companies do not hesitate to do that much dead work in the hope of finding something new. Many details, of course, remain to be adjusted, such as terms upon which the men are to work, and methods of supervision. When it is considered that so many old miners are willing to take leases in old properties where the companies hesitate to prospect, and are then satisfied with little better than wages, it is reasonable to suppose that terms could be arranged satisfactorily. An agreement giving a certain percentage of gross production to the discoverer, or even a flat sum as low as $5000 for a valuable claim, would be possible. Supervision would be simple, and should be left to one competent man—engineer, superintendent, or foreman—who should work out details of terms and territory, and regularly visit all the men, direct their efforts, and take plenty of samples, giving the results of assays to the prospector. There are plenty of men who would do this part of the work and take part of their pay from discoveries.

As before stated, there is no need to ask for governmental restrictions to reserve territory. A large group of claims could be located, if desired, before the work commenced, which would be ample protection. State laws as to location work would be a factor to be considered. Instead of asking the federal government to do the prospecting and challenging the Geological Survey to show enough courage to undertake the responsibility, it may be that some people familiar with conditions will ask for evidence of past performances indicating that the Survey could accept the responsibility even should its members be so inclined.

R. P. MacLaughlin.

San Francisco, September 3.

Forest Service

The Editor:

Sir—In your magazine of June 28, in commenting on the letter of J. C. Kennedy, you say: "We confess that we have heard much of the czar-like action by officers of the Forest Service, but have had poor luck in obtaining facts as to definite actions, etc." Congress by law authorized the President to set aside forest land as forest reserves to protect the watersheds of the streams, and for no other purpose. This is beyond question. The law itself says: "No Forest Reserve shall be established except to preserve and protect the forest within the reservation or to regulate the conduction of water flows and preserve and protect the timber for the use and benefit of citizens of the United States." In defiance of the express provisions of the statute, Mr. Roosevelt, at the request of Mr. Pinchot, set aside as forest reserves, sagebrush deserts in Arizona and New Mexico, treeless table lands in Colorado and Wyoming, and mud flats in Alaska. This non-forest land made into forest reserves in violation of law is in extent double the area of all the New England states and when objection is made, the only reply is to point out the good that the Forest Service is doing, as if Congress had given the Forest Service a roving commission to go about doing good. The Forest Service has almost entire control of the livestock industry and collects by illegal charges for grazing fees a million dollars a year for which there is absolutely no warrant in law. It attempts to control mining and prospecting by its illegal claim to make expert examination of mining claims. Read the law authorizing the creation of forest reserves and see if there can be found one word that authorizes the forester to employ mining experts. The Forest Service attempts to control water-power sites, although these water-power sites are always in the valleys while the forest reserves, if located as Congress intended, would always be on the watersheds. How is it possible to speak with respect of the action of a man who made a forest reserve out of the mudflats on the shores of Controller bay in Alaska, flats that are covered by the tidewater every day? The Forest Service has not for one minute tried to carry out the wishes and intentions of Congress, but has used the forest reserve law as a blind under cover of which the forester has attempted to exercise control over the entire public domain. The Secretary of the Interior is the person authorized by law to make regulations for the entry of mining claims on the public domain. This is his duty. It is the duty of the forester to raise trees. It is wrong for a prospector to locate a mining claim that has no valuable mineral. It is a waste of money, but it is a matter that does not concern the forester. Western men should refuse to be led into discussion of the good being done by the Forest Service, but should insist that the forest reserves should be limited to the extent authorized by statute and the forester should be required to confine his activities to raising and preserving the trees.

H. W. Reed.

Salt Lake City, July 8.

Simplification of Gold Ore Treatment

The Editor:

Sir—It seems to me that A. W. Allen's article, 'The Simplification of Gold Ore Treatment,' in the *Mining and Scientific Press* of August 16, has avoided the really essential simplifications responsible for the general abandonment of amalgamation in conjunction with the cyanide process. The advantages of detailed cost data are now too generally recognized, and applied, by competent metallurgists, to warrant the assumption that the practice of cyaniding without amalgamation is only fashionable.

It should scarcely be necessary, at this date, to reiterate the various arguments regarding the evils attending all attempts to cyanide after previously crushing in water, as many millmen have always insisted must be done if results are to be had, on the one hand, and those for maintaining amalgamation while yet crushing in cyanide solution, on the other. All schemes have had satisfactory trials, and the present custom of dispensing with amalgamation has been established through good results.

Since Mr. Allen so frequently implied in his ar-

ticle that the only simplification achieved consists of dispensing with amalgamation, as though it were a trifling step in the metallurgical scheme calling for no important consideration of the mechanical processes involved, it certainly behooves readers of the journal to reconsider all problems he alluded to.

Mechanical Appliances

By far the most important merits of the modern practice accrue from purely mechanical considerations, based upon the relative efficiency, indicated by comparing the cost of operations with recovery, rather than the mere question of recovery, to which Mr. Allen's article seems confined. The really prime factor responsible for the present practice is this: it affords the maximum return for the minimum cost of installation, and operation, in the average-size plant. Another equally important consideration is that it effectually eliminates a constant source of danger, the stealing of amalgam. The one objection which appears to have outlived all others is that it has deprived its operators of their justly prized screen sample, upon which the original value of the ore, and all subsequent calculations, are based. Indeed, for this reason alone, it has been frequently debated in South Africa whether it might not be wise to resume crushing in water once more for the sake of the accuracy of the head sample obtained from the battery screens. But I doubt whether the exasperating details attending the need of eliminating the water, to preserve the economical bulk of stock solution, etc., will ever be compensated for by this, and the slightly improved recovery to which our attention has just been called.

So far as my own experience of the respective operations, mentioned by Mr. Allen, has extended, and I gladly invite correction, the millman is far more often financially embarrassed by the 'float values' than is the cyanide man by coarse gold. In fact, I think that the ultimate gain in recovery, due to the 'float values' recovered only by crushing in cyanide, has of itself often decided the question in favor of abandoning amalgamation.

Increased Strength of Solution

With regard to the increased strength of cyanide solution made necessary by the presence of the unamalgamated gold, and its effect upon the subsequent chemical loss of cyanide, I should like to learn of the assay value of such ore and the character of the gold content, capable of resisting the action of the tube-mill to any such extent as that statement would appear to imply. It would, furthermore, appear that this concern ignores the effect of the custom of daily precipitating a large portion of the solution returned to the mill, as well as the frequent changes of solution accomplished throughout the course of treatment. Thus, whereas every one may agree that, given the same system of treatment and filtration, the loss in dissolved gold is strictly proportional to the original value of the solution in the pulp, it by no means follows that said original value need ever be at all high.

It is true that even in good practice only a portion of the gold is precipitated. How ominous it sounds! But instead of regarding the fact that, say, only 97% of the value of the solution is precipitated, let us consider that the bulk of solution remains practically constant, and that it is constantly being precipitated day after day, such that only 3% of its content is allowed to return for subsequent precipitation. The cumulative effect tends to approach perfection rather than any such loss as has been too hastily implied.

Finally, I should like to ask, what would be the gold content of a solution rendered unstable thereby and consequently liable to premature precipitation, and what observations have been made upon such cases?

JOHN B. STEWART.

New York, September 3.

Symmes Agitator

The Editor:

Sir—In your issue of July 19, under the title of 'The Symmes Agitator,' Whitman Symmes describes a very interesting system of agitation installed at the Mexican mill.

In the year 1908 I worked out this same scheme and installed it at the Peregrina mill of the Guanajuato Development Co., of Guanajuato, Mexico. A 30-ft. flat-bottom tank was fitted with a central hollow steel shaft resting on a steel button in the bottom of the tank and protected with a mercury well. The drive was from the top by means of a worm gear. Wooden arms were bolted to the shaft and supported with stay rods. Four air-lifts were flexibly suspended from each radius of the cross-arm. Air-pipes were fastened with hose connections to each lift, and the air jet placed at the bottom. The arms were revolved at the rate of three-fourths of a revolution per minute. The lifts discharged at the surface of the pulp, not in the middle as shown by Mr. Symmes.

The system was for intermittent agitation and settling, so that it was often necessary to start up after an interval of 72 hours of settling. The agitator worked most successfully.

The tank was fitted to handle very fine sand, as the classification was so bad that the ordinary arm-agitators gave much trouble. The system of classification was improved to such an extent that only one of the tanks was finished. I agree with Mr. Symmes that this is one of the most satisfactory agitators I have ever seen and far superior to any system involving pumps.

P. G. SPILSBURY.

San Mateo, Costa Rica, August 11.

Mineral exports from Bolivia during the past two years were as follows:

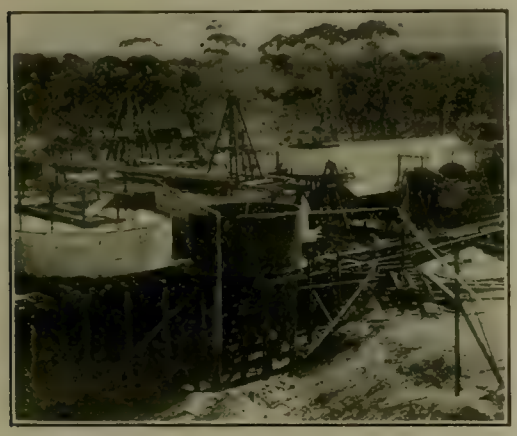
Products.	1911.	1912.
Antimony	$26,615	$1,994
Bismuth	819,297	784,183
Copper	555,080	1,311,156
Gold	22,313	23,039
Silver	1,784,633	1,676,704
Tin	20,476,806	23,289,732
Wolfram	89,932	114,847
Zinc	144,899	129,243
Total	$23,919,575	$27,330,898

Special Correspondence

KALGOORLIE, WESTERN AUSTRALIA

BULLFINCH EQUIPMENT DESCRIBED.—MINE PROSPECTS.—THE IVANHOE AND GEOLOGY OF THE WESTERN SIDE OF THE 'GOLDEN MILE.'—GREAT FINGALL, CHAFFERS, CORINTHIAN NORTH, AND VICTORIOUS MINE DEVELOPMENTS.—JUNE GOLD PRODUCTION.

A visit to the Bullfinch is an eye-opener after the way the mine and its equipment have been decried by interested or ignorant parties. Fred Morgan, the manager, is courtesy itself to all accredited visitors, and shows and explains everything. The buildings for the manager, staff, stores, and offices, etc., are quite up to date. The headgear is 80 ft. high, and the ore from the mine reaches the Symons gyratory rock-crusher from self-dumping skips, and the crushed product then falls into an ore-bin of 200-ton capacity. Self-feeders then deliver the ore to a Robins elevator which conveys it to a Robins tripper to be fed into the mill-bins of 400-ton capacity. On an elevated platform are two feed tanks with a capacity of 30,000 gal. each, as well as two mechanical thickeners, and two settlers of an equal capacity. The mill consists of 15 stamps, formerly at the Cosmopolitan mine. After leaving the mill the crushed pulp is elevated by a 40-ft. diameter tailing wheel into two Callow classifiers. The overflow goes successively into the mechanical thickeners, settlers, and feed



AGITATION AND FILTRATION PLANT AT THE BULLFINCH MILL. RIDGWAY RECIPROCATING FILTERS AT THE RIGHT. NOTE THE TYPICAL DESERT EUCALYPTUS TREES IN THE BACKGROUND.

tanks, then back to the mill. The coarser particles from the classifiers gravitate into a tube-mill and then pass into a Silverthorn & Adair grinding pan. The overflow then returns to the tailing wheel and again circulates. The thickened pulp from the settlers and mechanical thickeners is pumped to three improved Ridgway vacuum-filters, from which the gold solution is passed on to the zinc-boxes. The residue from the filters is agitated with salt water from the mine, and the waste product is sent to the dump by a double-plunger pump. The floors by the battery-house, precipitating and smelting rooms are concreted, so that all waste water and gold solution gravitate to a sump, and are returned to the mill. To complete the installation, another tube-mill and grinding pan, as well as five stamps are being added, which will raise the capacity to 6000 tons per month. In the engine-room are a 350-hp. engine and generator, the former by James Howden & Co. and the latter by Bruce, Peebles & Co.; an 18-drill Ingersoll-Rand compressor of the latest pattern. The hoisting engine is a 14 by 30-in. first-motion, by Fraser & Chalmers. Steam is supplied by three 250-hp. Babcock & Wilcox boilers with superheaters and economizers complete. The various sections of the plant are operated by 11 motors varying from 15 to 70 hp., all controlled from a switchboard in the engine-room. In fact, the system is practically automatic, and combines economy with efficiency. The mine is being developed at 100, 210, and 310 ft., and ore reserves already blocked out above 210 ft. are conservatively estimated at 158,000 tons, worth $12.42 per ton. During the erection of the plant, development was practically suspended, but is now being pushed ahead. Mr. Morgan asserts confidently that he could easily supply a mill double the size with ore. This is easily feasible with stopes ranging from 5 to 60 ft. wide. On examining the rich portion of the lode, from which the original owners recovered $435,000 from 1776 tons, equal to the large average of $245 per ton, only four men were to be seen at work there out of an aggregate of 160 miners employed. So far as one can judge from present developments, the mine has a long life ahead of it.

Malcolm Maclaren, who reported on most of the mines controlled by Bewick, Moreing & Co., three years ago, is paying a return visit at present. He has thoroughly examined the Great Fingall at Day Dawn, and the Fenian at Meekatharra, and after thoroughly inspecting the Ivanhoe at Kalgoorlie and Sons of Gwalia at Leonora, he will leave for the eastern states. In the four lower levels of the Ivanhoe the ore-shoot has been impoverished owing to an intrusion of graphite, but Mr. Maclaren assured the directors that the intrusion was probably temporary, and when it disappears the ore would again improve. The main shaft is down 2750 ft., and the next level will be 2870 ft., the deepest point reached in any mine in Western Australia. On Mr. Maclaren's advice, the Ivanhoe company has acquired the Ivanhoe Junction and two adjoining leases on the west and intends spending $48,000 to explore them at depth. Mr. Maclaren's theory is that the gold in the Ivanhoe and Horse-Shoe was precipitated in a quartz-dolerite intrusion, the western wall of which is just outside the Ivanhoe's western boundary. This intrusion dips west at an angle of 65°, and should be in the Ivanhoe Junction claim at a depth of 3000 ft. Mr. Maclaren is of opinion that a new and large profitable lode will be found there, and he has so impressed the directors that they are prepared to risk the above sum to test his theory. Many geologists have drawn big fees for reporting on the mines of this state, but Mr. Maclaren has offered his advice, and this advice has been followed.

The manager of the Great Fingall expects to have the head-frame and double-drum winch erected at the No. 13 level of the mine ready for work in August, when ore for the mill will be drawn from No. 18 to No. 14 levels. The costs will be high, as the interior shaft is 900 ft. north of the shaft at No. 13 level, and the new shoot pitches still farther north. For instance, at the No. 15, there is no ore south of the shaft, and the ore-shoot only becomes profitable 200 ft. north, and continues profitable to 360 ft. At No. 18 level the ore-shoot is profitable from 100 to 580 ft. north of the shaft. The south drift at this level has been extended 400 ft. in low-grade ore that is only worth from $1 to $2 per ton at the most. The ore reserves blocked out in the new ore-shoot total 50,000 tons, worth $9.60 per ton, but the tonnage can quickly be added to when stoping starts and winzes and raises are driven. The upper levels of the mine are practically depleted, and only a few pillars of ore remain, and the future depends entirely on the new ore-shoot. The mine's record is 1,825,280 tons, returning $23,313,900, and dividends aggregating $8,734,300 have been paid.

Shareholders of the Chaffers at Kalgoorlie have agreed to the proposed reconstruction of the Company with an assessment of 36c. per share, 12c. per share having already been called for, and the remaining 24c. will be called upon when required. The net amount available after deducting underwriting commission will be $235,000. A new sulphide treatment plant is to be installed, capable of treating 6000 tons per month. According to Boyd Aarons, the manager, the total costs, exclusive of depreciation and head office expenses, will be $5.50 per ton. The ore in sight on December 31, 1911, when this estimate of cost was made, was only 104,000 tons of an extractable value of $6.15 per ton. Deducting costs at $5.50, this would leave a profit of $67,600. As this profit did not warrant a new plant, John Morgan,

manager of the South Kalgurli, was commissioned to examine the mine and advise. He suggested further development and pointed out that, as the ore-shoots of the two leading lodes on the Golden Horse-Shoe, No. 2 and 3, and of the main lode of the Great Boulder, known also as the Horse-Shoe No. 4, were pitching into the Chaffers at depth, sinking was more than justified. Since then the ore-shoot in Chaffers No. 4 lode (Horse-Shoe) has been opened for a length of 300 ft. and carries an extractable value of $6.24 per ton, over a width of 77 in. At the same level Chaffers No. 3 lode (Horse-Shoe No. 2) has been opened for a distance of 43 ft. and has a recoverable value of $26 over a width of 64 in. The installment of such a small treatment plant at present seems premature, and it would be far better to wait and see if a much larger plant would not be justified. For instance, during the first half of this year, the Golden Horse-Shoe and Boulder together treated an average of 43,070 tons per month, and the ore-shoots from which the bulk of the ore came are rapidly dipping south into Chaffers ground which extends right across the south end of both mines. The average costs of the Boulder and Horse-Shoe were $5.96 per ton, and it is therefore unlikely that Mr. Aarons' estimate of $5.50 per ton, working on such a small scale as he proposes, will leave much to go on, and there is little margin for miscalculations.

The Corinthian North mill has been crushing for months, and the result has been disappointing. The mine was to be equipped with a 20-stamp mill, tube-mill, Ridgway vacuum-filters, and all accessories very much on the same line as the Bullfinch under the same control. The output was to be 6000 tons per month, returning $5.20 per ton. Costs were estimated by Richard Hamilton, of the Great Boulder, and Fred Morgan, of the Bullfinch, at $3.60, leaving a net profit of $1.60 per ton. Owing to scarcity of water, the mill has only run at intervals, and in two months has treated only 6566 tons yielding $21,700. The residue remains untreated, as the filter-plant is not completed, and is estimated to contain $34,000. The 5-in. pipe-line from the Government water scheme to supply the Bullfinch traverses the Corinthian leases, but does not convey sufficient water to fully supply both mines, and the Corinthian merely gets any surplus. So much for state-managed enterprises under a Labor Government. [We presume this reflects more on the engineering department than the Labor Government itself.—EDITOR.] It is expected that enough salt water will shortly be available in the main workings to make the mine independent of the Government supply except for boiler water.

A month has elapsed since the south cross-cut at No. 5 level of the Victorious at Ora Banda, owned by the Associated Northern Blocks, cut the lode, and G. M. Roberts has no cheering news to offer. Where the cross-cut penetrated the lode the ore-shoot was 72 in. wide and assayed $26.50 per ton, but on driving both ways on its strike, assays only showed $4.20 going west and $1.92 going east. As the ore is hard sulphide rock, this is quite unprofitable. Mr. Roberts is still confident that rich ore will again be picked up, as the four winzes sunk from No. 4 level were in rich ore half way down to No. 5 level. The market apparently has faith in the mine, as the price of shares keeps steady. Even if the rich ore-shoot is found, the mine will never be a high-grade property, as there are already opened nearly 300,000 tons of ore of an assay value of $5 per ton, and it would require a lot of high-grade ore to mix with it to raise the average $1 to $2 per ton.

PLATTEVILLE, WISCONSIN

PRICES AND PRODUCTION.—SHIPMENTS FOR AUGUST.—LABOR SHORTAGE.—NEWS OF DEVELOPMENT.

The month of August proved to be one of the best so far this year in this field. Heavy rains and a wide range in prices up and down on the inferior grades of ore militated against a large production the first half of the month. Good roads, good weather, and stronger prices jumped the production from 60 to 90 cars per week the latter half of the month, and this, except for lead ore shipments, was heavier than usual. One of the most prominent buyers in the field submitted his report showing average prices prevailing in the field during the month, which was as follows: 30% zinc ore, $16.50 to $17.50; 35%, $19 to $21; 40%, $23 to $26; 45%, $27 to $30; 50%, $35 to $38; 60%, $46 to $49 per ton. On open market production the New Jersey Zinc Co.'s buyers set a terrific pace all the way through the month and secured 80% of the entire open market production. The American Zinc Co., of Hillsboro, Illinois, a subsidiary of the American, Zinc & Lead Smelting Co., which fired its new smelter this spring, entered the field during the month. Spelter prices remained firm, Joplin quotations governing in the Wisconsin field. An average price would be about $5.70 per hundredweight for the month. On this score another large operator is quoted as making this statement in writing: "Don't look for anything better in prices unless spelter gets stronger. Smelters as a rule were low on stocks, but as soon as they get a supply prices will adjust themselves; $50 ore should mean about $6 to $6.25 spelter; instead of that it is now about $5.70. What we want is a steady market, $50 ore, and 6c. spelter."

Deliveries of zinc ore for the month of August were distributed among the following buying concerns as shown: Mineral Point Zinc Co., 150 cars, 5481 tons; Grasselli Chemical Co., 52 cars, 2031 tons; National Separating Co., Cuba, 45 cars, 1823 tons; Empire Roasting Co., Platteville, 30 cars, 1108 tons; American Zinc Co., Hillsboro, Illinois, 18 cars, 657 tons; Illinois Zinc Co., 19 cars, 745 tons; Matthiesen & Hegeler Zinc Co., LaSalle, Illinois, 12 cars, 433 tons; Linden Zinc Co., 6 cars, 180 tons; Joplin Separating Co., 2 cars, 71 tons; and Wisconsin Separating Co., 1 car, 30 tons; a total of 435 cars, 12,559 tons. The shipments to the last five named concerns were all high-grade zinc ore. Shipments of ores out of the field by camps are shown in the table herewith.

Camps.	Zinc, lb.	Lead, lb.	Sulphur, lb.
Benton	4,998,000	126,300	4,152,900
Platteville	4,522,000	65,800	.....
Hazel Green	2,814,000	60,000	.....
Galena	2,404,000	82,000	.....
Livingston	2,352,000	.....	.....
Shullsburg	2,210,000	.....	.....
Cuba	2,030,000	112,100	559,200
Linden	1,824,000	.....	233,770
Harker	880,000	.....	.....
Montfort	320,000	80,000	.....
Mineral Point	258,000	.....	.....
Rewey	164,000	.....	.....
Highland	66,060	.....	.....
Potosi	64,000	.....	.....
Totals	24,906,000	536,200	4,945,870

Gross production of concentrates from mines for the month, 22,570,500 lb.; net deliveries to smelters, 16,037,900 lb. The Mineral Point Zinc Co. shipped 30 cars of high-grade roasted zinc ore, 2,262,500 lb., to DePue, Illinois. Potosi entered the list of producing camps with a car of 56% zinc ore from the Wilson mine, a newly organized mining project. Shipments of carbonate zinc ores out of the northern camps were slow in materializing and the first car went out the last week of the month. Several thousand tons of material is ready to go to furnaces at Mineral Point and shipments will be regular for the remainder of the current year.

Briefly told, the following operations are in progress. At Highland the New Jersey Zinc Co. is rushing work on the remodeling of the Kennedy plant. Jigs are all being rebuilt, new crushers of heavy capacity are being installed, the collar of the main hoisting shaft is set in concrete, and a large engine is being assembled. The East End mine, the property of the Wisconsin Zinc Co., at Platteville, is producing 10 cars of zinc ore per week. The Klar-Piquette mine is storing several thousand tons of ore in bin. The Bull Moose mine at Benton is rushing a 100-ton power and concentrating plant to completion. The shaft will reach

the top of the ore deposits at 165 ft. The Martin shaft by the Vinegar Hill is down 140 ft. with 25 ft. more to sink. Two new mills and power plants will be built by the New Jersey Zinc Co. at the Coker and Sunrise mines. The Lawrence equipment newly built is ready to go into commission at Hazel Green. Zinc ore is being stripped at the Scrabble Creek mine owned by the Cleveland Mining Co. The Mineral Point & Northern Railway Co. has appropriated $65,000 for road improvement and the replacing of all bridges and culverts with steel and cement. It is rumored the road is about to pass into the ownership of the Chicago, Milwaukee & St. Paul line. Prospecting is at low ebb at all points in the field. Labor is in good demand, the Linden, Highland, and Galena districts being short of men. The famous Black-Jack mine below Galena, now being reopened by the New Jersey Zinc Co., is waiting for the Inter-State Power Co., of Galena, to bring in current. The core of the deposits here have never been touched.

BUTTE, MONTANA

ACTIVITY IN THE EAST CAMP.—COPPER DEPOSITS IN FLATHEAD COUNTY.—JOHN D. RYAN'S ADDRESS TO THE HELENA COMMERCIAL CLUB.—VALUE OF BUTTE OREBODIES AT DEPTH.—LEACHING ORES.—THE BUTTE & GREAT FALLS MINING CO.—THE ELM ORLU MILL.

Many rumors are afloat to the effect that the Thomas F. Cole interests have enlisted the support of the Guggenheims in some Butte ventures. No positive statement is forthcoming as yet, but it is generally conceded that a lot of mining territory near the East Butte property has been recently bought for interests connected with Mr. Cole. As it is generally conceded that the North Butte Mining Co. is about to issue a block of its treasury stock, it is not improbable that the funds thus derived are intended for the purchase of new ground.

Some time ago the rumor of large copper deposits in an out-of-the-way part of Flathead county was recorded, but the United States Geological Survey's report on the district gently but firmly puts a quietus to the boom. The prompt and fearless report of the Survey cannot be too highly commended, as it protects the public from costly investigation and wild-cat investments. Of course, the sponsors of the district will complain, and that loudly, for the claims they hoped to sell will not be sold, and the companies they hoped to promote will not be promoted. It seems that this Felix Basin country is given to copper booms, this being the fifth or sixth stampede started during the last twenty years.

John D. Ryan recently addressed the Helena Commercial Club. The burden of his speech was an appeal to the people of Montana not to misinterpret the motives of his companies. He admitted that philanthropy was not the prime purpose of the Amalgamated Copper Co. or of the Montana Power Co., but he urged that the activities of these corporations were resulting, and would continue to result, in great benefits to the state. He said that the proposed legislation antagonistic to the power company would merely result in retarding hydro-electric development in the state, with its attendant advantages, by scaring away the capital needed in this development. He invited others to come into the power business also, if they wished, as his company controlled but 25% of the available power. Mr. Ryan pleaded that his companies should be commended rather than enviously condemned. The power company had not only developed hydro-electric power which had not theretofore been utilized, but had created a market for this power by the development of irrigation schemes and utilization in the mines and on the railroads. The necessity for Mr. Ryan's speech reflects significantly on pure democracy as a form of government. After establishing these large and important enterprises in entire conformity with the laws of the land, it is still necessary to protect them from harmful *post facto* laws by appealing whenever possible to the sense of honesty and fair dealing of the community.

Local optimists persist in declaring that the Butte mines are getting richer the deeper they are developed. Now, Butte has not anything to be ashamed of when it comes to rich orebodies in depth, but such statements as the above are not correct. The Butte mines as a whole are not as rich at 2000 ft. depth as they were at 1000 ft., and no one conversant with them makes any claims to the contrary. Copper glance is copper glance, and contains 79.8% copper, whether it is found on the 200-ft. level or the 3200-ft. level, but to say that there is more copper glance in the deeper levels than there was in the higher sulphide levels is getting beyond the facts. Another fallacy, which is hard to down in Butte, holds that there is a distinct lean zone generally throughout the veins from the 1000-ft. to the 2000-ft. level. This conception is a pure flight of the imagination, probably trumped up to encourage deeper sinking in the several fruitless shafts which have been sunk to depths within those figures. When a company has sunk 1500 ft., without good results, on a prospect, its stockholders should be allowed to rest in peace and not be asked to make the 2000-ft. mark on the mythical assumption that they stopped just too soon in the 'lean zone.'

Metallurgists seem ready to admit that some big things are happening, or are about to happen, in the hydrometallurgy of copper. The Laist plant at Anaconda is nearly ready for operation, and its results will be keenly watched by metallurgists the world over.

The Butte & Great Falls Mining Co. is one of the newer prospecting companies. It owns ground in the northwest outskirts of the district north of the Butte &

GREAT FALLS SMELTER, MONTANA.

Bacorn property. A shaft has been sunk 200 ft. and some lateral work done. It is now proposed to install an electrically driven air-compressor for drills and a hoist. The shaft will then be deepened another 200 ft. at least.

The Elm Orlu Mining Co. is actively at work erecting its zinc-copper concentrator on the side of Timbered Butte. From this it would seem that the rumored consolidation of Elm Orlu with Butte & Superior has come to naught, and that W. A. Clark intends to mine and mill his own ore. This also means that the litigation over orebodies in the two properties will probably come to a head in the near future. Work both day and night is being pushed on the mill building. It is reported that the Anaconda company has ordered material for a plant capable of treating 10,000 tons of tailing per day. The plant will have a capacity just 30% less than the Washoe smelter.

NEW YORK

CANADIAN NICKEL CORPORATION. ALASKA GOLD MINES. FEDERAL MINING & SMELTING COMPANIES.—CALUMET & ARIZONA PROPERTIES.—GOLD HILL CONSOLIDATED.

It appears that the announcement, with much detail, of the organization of the Canadian Nickel Corporation, Ltd., was somewhat premature, and the actual floating of the Company has been postponed until money 'flows' easier than it does just at present. Many important people, including J. R. Booth, F. S. Pearson, J. F. Taylor, and B. B. Lawrence, are said to be interested in the venture. The exploratory work has blocked out a good deal of nickel-copper ore, and the venture will be an important one, once it gets fully started. The shares of the Alaska Gold Mines Co. have been listed on the New York Stock Exchange and trading is active. Reports from the property state that the ore on No. 10 level is giving assays much above expectations; in some places $3 ore being found. Construction work is being hurried in order to get it completed, if possible, before winter. In its report to the Stock Exchange on July 15, the Company showed a total of $7,505,816 in assets, of which $2,750,000 consisted of cash in the bank. When the Company begins work at full capacity, it should considerably increase the gold output of Alaska, which was $17,198,600 last year. The Yukon Gold Co. was incorporated in California in order to comply with the law of that state before beginning to work its new holdings along the American river. In the Curb market it has been stated that the California holdings would greatly improve the position of Yukon Gold, for its Alaskan properties can only be worked in the summer months, while work in California can proceed all year.

The publication of the earnings of the Federal Mining & Smelting Co. for eleven months of its fiscal year has inspired a fresh circular from Sydney Norman, representative of the minority stockholders, who alleges that if the Federal had received market prices for its metals from the American Smelting & Refining Co.'s smelters the net profit would have been increased nearly $650,000, or almost doubled. By charging the Federal $8 per ton for smelting and paying it $4 less, on its long-time contract, than is paid in the open market for ores of that grade, it is charged that the smelting company obtains two-thirds of the profit and leaves only one-third for the mining company. As the smelting company controls the mining company, it is the minority stockholders who are doing the worrying. In speaking of the A. S. & R., it is interesting to note that the investigators of the United States Departmen of Justice who have been scrutinizing its record in Colorado are having poor success in eliciting damaging testimony, the general statement being that the Company is fair in its dealings with the mines; complaints usually being based on misunderstanding.

The report that Thomas F. Cole, James Hoatson, Charles Briggs, and Peter Ruppe have been visiting Ajo, Arizona, recently, where the Calumet & Arizona has the New Cornelia and other claims under an option which expires in October, naturally inspires much interest in the possibility of that property and what will be done with it. It is stated that 29,000,000 tons of ore averaging over 1.75% copper has been developed. Surveys for an extension of the El Paso & Southwestern railroad to the property have been begun. The problem of ore treatment is still unsolved, so far as any public statement is concerned, but a staff of investigators, under the direction of L. D. Ricketts, has long been at work upon it, and confidence is expressed that it will be satisfactorily solved.

The Cananea Consolidated Copper Co. is making a good recovery from the disturbed state in which it has been for months past. Its August production is given as 3,186,000 lb. copper, 119,522 oz. silver, and 620 oz. gold. The Braden turned out 1,572,000 lb. copper in August, the rate of recovery at the old mill being 68% of the copper content, and 62.18% at the new.

With the present interest in Appalachian gold mining, the Gold Hill Consolidated has revived under the electric touch of Walter George Newman, this time as a gold mine. The property, which is in Rowan and Stanley counties, North Carolina, near the Yadkin river, was first promoted more than a dozen years ago by Newman as the Gold Hill Copper Co. It was not long before the property was in the hands of a receiver, and the Gold Hill Consolidated, which bought the property at auction, has never amounted to anything, work being much more active on the Curb than at the mine. Enough work is now in progress to give a color of activity to the property, and more doings on the Curb are doubtless planned. The property has been worked, off and on, for many years, and has produced quite a little gold in the aggregate. Newman is best known for his manipulation of Union Copper, another Rowan county mine, which also has some promise; if worked by miners rather than stock-jobbers.

BOSTON

LAKE COPPER CO.'S AFFAIRS.—CALUMET & ARIZONA.—MEXICAN METALS COMPANY.

On September 9 the Lake Copper Co.'s assessment of $2 per share was paid, and after that date the stock will be '$5 per share paid in.' Since the announcement of the assessment on August 18 the stock has held around 6½ per share as compared with its low point this year of 5⅛. Apparently, from a market standpoint, the stock is being made to look good until the payment of the assessment. The Company was organized November 28, 1905, and has an estate of 820 acres and was originally the old Belt mine, owned by the Belt Mines Co., Ltd. It is situated about a mile south of the station of Belt, on the Copper Range railroad, in Bohemia township, Ontonagon county, Mich. The Lake lode has been the Company's big asset and in the beginning was shown by drilling to be rich, and the showing caused excitement in Boston. Then came the sinking of the shaft and extensive underground development. After a number of shipments had been made and the property had been opened, it was found by the course of the most northerly drifts that the lode was altering its course, and had changed to the west. It became impossible to correlate it with any of the neighboring lodes, such as the Evergreen, Knowlton, and Butler. J. R. Finlay, three years ago, in his celebrated appraisement work, had no high opinion of Lake. He said then: "It is not by any means assured that this mine will ever pay a dividend." Also: "It is hoped that this mine will prove to be something like the Baltic, in which case about 2,000,000 tons may be conceded to be opened up, which might yield about 40,000,000 lb. of copper. Conceding that this product may be obtained at a profit of one cent per pound during the next ten years, we get a present value of about $300,000 for this property." The Lake company has 100,000 shares outstanding, which, after September 9, will represent $5 per share paid in. But over a million dollars has been spent on the property, as the Company's treasury has realized as high as $33 per share for the stock from underwriters and 6500 shares was disposed of by the former management in the open market at from par, $25, to $71 per share.

Calumet & Arizona is a company which is being managed with great foresight. Nearly five years ago the management began a policy of acquisition of various outside properties and the laying aside, out of earnings, of a fund for the purchase of properties in Arizona and New Mexico. The Irish Mag orebody of Calumet & Arizona has produced a large quantity of ore.

The directors of the Mexican Metals Co. have called an assessment of 15c. per share. The Company is operating in Sonora and makes a statement showing that from June 1911 to July 1913 it made a loss of $2400, the deficit being due, according to the management, to the continued interference with operations on account of the chronic warfare around the mines. Some of the strongest interests in New England are understood to be behind the Company and are said to be desirous of making it an operating success.

General Mining News

ARIZONA

Gila County

The London-Arizona Consolidated Copper Co. has been organized under the laws of Maine with a capitalization of 2,400,000 shares, par value $5 each, or a total of $12,000,000. This new organization was promoted for the purpose of acquiring and taking over the properties of the London-Arizona Copper Co., London Range Copper Co., London Shamrock Copper Co., and Ball Copper Co. The consolidated property comprises 2357 acres of highly mineralized and developed copper ground situated about five miles north of Winkelman, and four miles from the new smelting plant of the American Smelting & Refining Co. at Hayden. The holdings of the consolidated company comprise the heart of the lime-porphyry deposits. The directors of the Company are Volney D. Williamson, Walter A. Burrell, John A. Finch, Robert Sweeny, B. F. Cheney, J. H. Neff, Richard E. Sloan, Frank M. Murphy, and Charles E. Finney. The consulting engineer and geologist of the London-Arizona Consolidated will be Edward W. Brooks, of Los Angeles, and the engineer in charge of operations of the properties will be Henry Kehoe.

Greenlee County

The Arizona Copper Co., at Clifton, will add a number of motors to its electrical equipment, including two 10-hp., two 50-hp., four 75-hp., and two 100-hp. motors with compensators and switches, all of which have been ordered from the General Electric Company.

CALIFORNIA

Amador County

At Jackson, the suit between the Kennedy Extension Mining Co. and the Argonaut Mining Co. is now being heard. The complaint alleges that the Argonaut company, for three years prior to April 6, 1910, had wilfully mined and extracted ore from plaintiff's ground, and particularly from the 2760, 2880, 3000, 3150, and 3300-ft. levels, to the extent of 50,000 tons, valued at $500,000, and ore is now being extracted at the rate of 5000 tons per month. In its answer, the Argonaut company admits working under ground of the plaintiff, but always on its own vein, and makes a general denial of the principal allegations. It admits driving parts of the 1460 and 1690-ft. levels beyond the southern boundary of its property and underneath the surface of the Jackson quartz claim, but that such levels were unproductive. Damages were originally claimed of $500,000, but have since been increased to approximately $1,000,000.

Calaveras County

Stockholders of the Lightner Mining Co., nearly all of whom are residents of San Joaquin county, have given an option to the Tonopah Mining Co. of Nevada. The option gives the Tonopah company ninety days' time from September 5 to complete the purchase. The terms of sale are private. The deal also includes the Sultana, Maltman, and Baunager properties.

Placer County

The hull of the dredge which the Pacific Gold Dredging Co. is building at Mammoth Bar, on the middle fork of the American river, has been launched, and the machinery is now being installed. It is expected that the dredge will be ready for operation early in October. The work of building the dredge will be done in fast time, as the first load of lumber was hauled to the bar on July 17. The hull is 105 ft. long by 40 ft. wide and 10 ft. 4 in. deep. The total weight of the material used in the construction will be over 700 tons. The buckets will be of 7-cu. ft. capacity, and the Pacific Gas & Electric Co. will supply the power. Lee Davis will be dredgemaster with a crew of twelve men.

Shasta County

(Special Correspondence.)—The Accident Gold Mining Co. is arranging for the reopening of the Sybil mine, at French Gulch. The property has been idle fifteen years, resulting from litigation, but a compromise between the warring factions was recently effected. E. C. Percival is manager. The shaft of the Gladstone mine, French Gulch, will be sunk deeper as soon as present repairs are completed. The present depth is 1100 ft., and the shaft is sunk from the end of a 4000-ft. adit. J. Deistlehorst is planning the installation of a device to treat the black sand on his placer claims on Clear creek, just below Redding. The sand has been sluiced to dumps in the past, but a recent assay showed a good gold content. Oroville people have interested Mr. Deistlehorst in a new process. A. J. Field and associates are installing a refrigerating plant at their small experimental smelter in this city. The plant is designed to treat sulphurous ores without generation of noxious fumes. The Field process, based on refrigeration, will be employed. It is expected to make initial tests before the end of the fall. Tests of the Hall desulphurizing process at the Balaklala smelter have been delayed by mechanical troubles, but these have been adjusted. The California, Shasta & Eastern company has acquired the Terry railroad, from Anderson to Bella Vista, and it is stated the extension to Ingot and the Afterthought copper mine will be commenced as soon as material can be assembled. It is further reported that the change in ownership of the railroad will result in heavier ore shipments from the Donkey and other zinc-copper mines in the Ingot district.

Redding, September 8.

Trinity County

(Special Correspondence.)—The East Fork mining district in this county is improving slowly but surely. With the extension of good trails beyond the wagon-road, which is being done jointly by the county and the United States

Forestry Service, all parts of the district are easy of access. Another improvement made by the Forestry Service is a telephone line through the district. These aids to opening the country are much appreciated, as transportation and communication is absolutely essential to the development of all districts. The lease of the Enterprise mine by R. A. Skinner and J. D. Day expired on September 1. Their last clean-up, the result of six weeks' run, was valued at over $6000. The mine will soon resume operation. D. G. Reed, of Redding, will soon begin work on the Ozark, which has produced high-grade ore. Mr. Skinner will soon begin development on the Yellow Stone, which has been closed for some time, but has a fair record. Mr.

Day is developing the Fritz. The Yellow Aster and Yellow Jacket are temporarily closed. A. A. Wolfe and Chas. Meyer, who own the Oversight and Old Oaks, respectively, will continue development through the winter. L. J. Johnston, owner of the Bonanza group; Wm. McLaren, owner of the Trinity group; and T. J. Rochfordett, of the Golden Chest group, are all busy and expect to carry on development during the winter. All of these properties are opening well, considering the amount of development which is being done, and they all have some high-grade ore. There are free gold, high-grade galena, and telluride ores here. Some high-grade sylvanite ore was mined from the Yellow Aster, and some petzite was also identified.

Placer mining in this district will soon be only a matter of history. Andy Williamson, of Rich Gulch, is busy preparing for his winter run. Merkel and Morgan, who have taken over the old Watrous mine, are also getting ready for winter, while the Poso Rico's owners, W. S. G. and G. M. Todd, have just finished cleaning-up from a successful run. These properties are operated by hydraulicking, and coarse gold is recovered. Some ground has returned as high as 80c. per cubic yard. This strengthens the opinion that the quartz mines will in time make good.

Helena, September 5.

Tuolumne County

(Special Correspondence.)—At the Moccisan Consolidated Mines, about eight miles south of Jacksonville, a new duplex, enclosed-frame, Corliss type, electrically driven compressor is being installed. Considerable development work is in progress, and a new 20-stamp mill is contemplated this fall. W. G. Anderson, recently of Nevada, is superintendent.

Jacksonville, September 13.

(Special Correspondence.)—The Curtis Bros. Mining & Milling Co., consisting of W. Walter Curtis and J. Francis Curtis, formerly of Angels Camp, have taken an option on the Wickham mine, near Jamestown, and will sink a 100-ft. winze. The mine is fully equipped with a 5-stamp mill, and it will not be long before some good ore will be milled. Curtis brothers are sons of the late Joseph F. Curtis, for years one of the best known of the old-time Mother Lode miners, having operated and promoted mines for more than thirty-five years in Calaveras county. Among some of the mines promoted were the Royal Consolidated mines at Hodson, and the Waterman gold mine at Angels Camp. He was about to make a deal for the Tulloch mine at Angels Camp when he died.

Jamestown, September 6.

COLORADO

Clear Creek County

A number of stockholders of the American Rotary Tunneling Machine Co. were at Georgetown last week to see the machine work. Everything at the American adit is now in good order, and the machine cuts nearly 6 inches in hard granite per hour, boring a hole 8 ft. in diameter. Water is plentiful, as the new pumps supply it from the reservoir of the American Sisters Power Co., and the machine has been improved so that it now requires only about half the amount of water previously needed. James Garrett & Co., lessees at the Seven-Thirty mine, are stoping a 12-in. vein for a length of 80 ft. A shipment of first and second-class ores returned 170 oz. silver and 48% lead, and 54 oz. silver and 15% lead, respectively. Herber and Hanson have a fine lease at the Waldorf property, and are stoping $45 and $65 ore. The main raise between the Capital adit and the 300-ft. level has been completed. The raise extends 175 ft. above the 300-ft. level, and is being driven as rapidly as possible.

Gilpin County

The Carr Mines Co., of Central City, will install two 50-kva. transformers, a 75-hp. motor, and accessories recently purchased from the General Electric Company.

San Juan County

Following are the shipments of concentrate and crude ore from the Silverton district during August: Concentrate: Gold Hill, 1000 tons; Sunnyside, 600; Iowa Tiger, 575; Barstow, 380; Silver Ledge mill (Warner), 110; Frisco Tunnel, 100; and Intersection, 20 tons; a total of 2755 tons. Crude ore: Southern Exploration & Mining Co., 360 tons; Dives, 300; Gold Tunnel, 150; Arastra Leasing Co., 150; Allerton, 130; Ed. Fiant, 80; Vanderbilt, 40; Celtic Leasing Co., 40; Miller & Shaw, 20; Taylor & Anderson, 20; Mayflower, 20; E. Zanoni, 20; Aspen, 20; and Frank Hough, 20; a total of 1390 tons.

Teller County (Cripple Creek)

The Victor mine, on the northeastern slope of Bull cliff, owned by the Victor Mining Co. and operated under lease by A. Osberg, in August made a production of 26 cars, or between 650 and 700 tons of ore, with an average value of $20 per ton. Seven sub-lessees are working under the Osberg lease, and extensive development of the property is under way. The Vindicator Con. Gold Mining Co. employs from 110 to 125 men on company account, and there are from 75 to 100 employed by lessees. Thirty sets of lessees are actively engaged on the Battle mountain properties of the Granite Gold Mining Co., and the production made in August totaled 65 cars or approximately 2000 tons.

IDAHO

Custer County

The smelter at the Lost Packer mine was in operation for 24.6 days and 1800 tons of ore was treated, producing 380 tons of gold and silver-bearing copper matte. This matte is now being sold at Salt Lake City, five cars having been received up to the present time. The matte averages from 8 to 10 oz. gold, 26 oz. silver, and 45% copper. A small force of miners is now at work on development in preparation for next season's smelting operations. The Lost Packer property is owned by prominent Salt Lake City capitalists who, every season, operate the smelter despite the innumerable difficulties that stand in the way of successful production. The mine and smelter are situated high in the mountains, 113 miles distant from a railroad, with a trail that is difficult to follow. The short smelting season is a disadvantage also, while during the season just ended, the Company used 300 horses for bringing in supplies and fuel and for taking out the smelter product. During the season 80 men were employed at the mine and smelter. Fortunately, however, the ores of the Lost Packer company are high grade, and, despite the difficulties, the Company will pay a dividend.

Idaho County

(Special Correspondence.)—At the Mt. Marshall mine, in the Marshall Lake district, the company is driving a cross-cut adit 2000 ft. long to cut two gold and silver quartz veins at 800-ft. depth.

Resort, September 3.

Shoshone County

The Monitor Mining Co., which operates the Monitor mine, near the Montana line, in the Mullan district in Idaho, is planning to drive a long lower adit to cut the orebodies at approximately 2000 ft. vertical depth and provide facilities for developing other properties adjoining. The Monitor in the last few years has shipped a number of cars of high-grade copper ore, containing gold, and the Richmond and St. Lawrence properties, situated on a parallel vein and adjoining the Monitor, have excellent showings of high-grade copper. The Bunker Hill & Sullivan Mining & Concentrating Co. bought the $30,000 issue of the Kellogg sewer bonds on September 10. The Nabob Mining Co. will take over the Idaho and 'V' group of claims adjoining. Both properties are opening in a satisfactory way.

MICHIGAN

Houghton County

(Special Correspondence.)—The strike in the copper district is gradually wearing out, and as the miners return to work the strikers are leaving. The Calumet & Hecla daily 'rock' shipments average 3500 tons, and the Copper Range properties 1000 tons. At the former mine there is

a trammers' strike, and the miners are doing their own tramming. Western Federation officials are differing in opinion regarding the general strike. Clarence Darrow has been visiting with the president, C. H. Moyer. Strike pay is coming in freely, and the men who stick to the Federation will probably have plenty of food for some time. James McNaughton, manager of the Calumet & Hecla, has interviewed the governor of the state of Michigan. The women relatives of strikers have shown a despicable attitude to non-strikers.

Houghton, September 11.

The Calumet & Hecla Mining Co. will install new electrical apparatus consisting of seven motors ranging from 15 hp. to 1250 hp., a 7-kw. turbo-generator set, an 8-kw. generator, one 7½-kva. and three 15-kva. transformers, switchboard, and accessories. This equipment has been purchased from the General Electric Company.

MISSOURI

Jasper County

Extensive work in the local district is planned by the American Zinc, Lead & Smelting Co. Already two mills that were idle for several months have resumed operation and the Company intends to move both the Vogey mill at Porto Rico and the American Davey No. 1, at Prosperity, to new leases which are now under course of development. There have been rumors that this Company was to reduce its operations in the district, but this is not so. With three large mills now in operation at Prosperity, the Company is reported to be in shape to treat more than 500,000 lb. of zinc sulphide ores per week and more than 100,000 lb. of galena. When the No. 1 mill is removed to its new situation, the production from the Company alone will amount to nearly 800,000 lb. of zincblende concentrate and about 200,000 lb. of galena per week.

Ore shipments from the Missouri-Kansas-Oklahoma district for the first eight months of the year were: zinc, 180,243 short tons, valued at $7,887,340; lead, 30,424 tons, worth $1,642,591; and 'silicate,' 11,830 tons, worth $362,834.

MONTANA

Broadwater County

There are reports of steady progress and a promising outlook from the Ohio-Keating property, which lies in the Radersburg district, about 1½ miles from that old mining camp. The shaft of the Ohio-Keating is now down 500 ft., and driving has been done on all levels in both directions. The veins are from 2 to 5 ft. wide and average $30 per ton in gold, the ore being a heavy sulphide. The equipment for this property is among the best in the state. It has electrically equipped compressed-air hoist and pumps. There is one triplex vertical pump on the 300-ft. and another on the 500-ft. level. During August, 20 carloads of ore were sent to the Washoe smelter.

Fergus County

During August the Barnes-King Development Co. treated 4310 tons of ore, yielding $32,088. The profit was $17,003, of which 75% goes to the North Moccasin interests as part payment for the property, on which $29,091 is still payable.

Silverbow County

The Butte & Superior mill treated 30,440 tons of ore in August, producing 11,300 tons of concentrate assaying 49.41% zinc, with a recovery of 90.9 per cent.

NEVADA

Churchill County

During August the Nevada Hills, at Fairview, treated 4368 tons of ore containing $78,150, the net realization being about $40,000.

Esmeralda County

On September 13 an electric storm accompanied by heavy rain did great damage to life and property at Goldfield, but all is again in working order. On the 500-ft. level of the Booth a large body of quartz has been cut. The Florence mine is shipping 50 tons of $20 ore per day to the Bonnie Claire mill. The mine is opening satisfactorily.

Lincoln County

According to H. W. Rand, in an interview with the *Salt Lake Tribune*, the Pioche district is more active than for years past, and there is developed between 300,000 and 400,000 tons of ore averaging about 35% iron, 3 oz. silver, and 3% lead. The Prince Consolidated has produced similar ore for some time past. The Virginia-Louise adjoins this property and has been opened to the 460-ft. level. The Amalgamated Pioche is doing a good deal of mine work and installing new equipment.

Lyon County

(Special Correspondence.)—W. E. Greenawalt reports to the Nevada-Douglas Copper Co. from Denver that he is rapidly getting the experimental plant in shape for operation and that he will be ready to start testing the ore as soon as the motor-generator sets arrive from the factory. These are due to arrive at an early date. He also reports that he is making good headway with the plans for the first 100-ton unit of the plant to be erected at the mine. As soon as these plans are completed, it is hoped to start construction work without delay.

Yerington, September 6.

Nye County

Tonopah mines produced 11,484 tons of ore worth $272,190 during the week ended September 13. August returns were as follows:

	Tons.	Value.	Profit.
Belmont	15,482	$315,142	$184,994
Tonopah	14,475	220,100	119,100
West End	4,115	.....	57,044
Merger	.....	22,000	11,000

White Pine County

It is probable that the Consolidated Copper Mines Co. will erect a reduction plant at Warm Springs of 5000 tons daily capacity. This is three miles from Ely, and as the works would be of great benefit to the town, the manager, E. F. Gray, has asked residents to sign a document releasing the Company from all damages that might accrue from smoke and dust from the plant.

ELY, NEVADA.

A No. 5½ Keystone Missouri drill is being set up at the Argus property at Taylor, which contains lead-silver ores.

SOUTH DAKOTA

Lawrence County

(Special Correspondence.)—At the Trojan mill construction work on the additions to house the tube-mill, solution-storage tanks, thickeners, and agitators, is proceeding rapidly, and a Lea recorder has been installed.

A Bury two-stage compressor, with air cylinders 14 by 7½ by 10 in., driven by belt from a 50-hp. motor, has just been installed at the Bismarck. Additional drills will be used in the mine. The ore is broken in a large open-cut, dropped through chutes, and trammed to the mill. Some expensive stripping is necessary at present. The operations in July showed a good profit.

A small steam locomotive has been put in operation to draw the cars of waste which are loaded by the steam-shovel in the course of stripping at the Wasp No. 2 mine.

In making adjustments of valuation for purposes of taxation, the recently created State Tax Commission has raised the Homestake Mining Co.'s assessment from $8,000,000, as returned by the county commissioners, to $16,000,000. Many people regard this as an unjust valuation, and it is believed the Homestake company will make an effort through the courts to have it reduced.

Deadwood, September 6.

TENNESSEE

A meeting of geologists, mining engineers, and others interested in the development and conservation of the mineral resources of the country was held at Knoxville under the auspices of the National Conservation Exposition, on September 19. This meeting was held in conjunction with the miners' field day on Saturday.

UTAH

Juab County

From the 700-ft. level of the Eagle & Blue Bell mine at Tintic, a car of ore has returned 75% lead, 25 oz. silver, and a little gold, the smelter giving $4750.

Summit County

During the month of August, 160 cars of ore, aggregating 6453 tons, was shipped from Park City. The amount shipped by each company was as follows: Silver King Coalition, 3216 tons; Daly-Judge, 1393; Daly West, 1106; American Exploration Co., 141; Grasselli Zinc Co., 149; Ontario Silver Mining Co., 111; Mines Operating Co., 67; Thompson-Quincy, 37; 'creek jiggers,' 62; and E. J. Beggs, 46 tons.

Utah County

Although little news comes from the American Fork district, yet it is reported to be quite busy. Lessees at the Pacific are stoping 18 in. of galena 300 ft. from the portal of the main adit. At the Dutchman property there is 2 ft. of rich silver-lead ore being mined, while both the Silver Flat and Miller Hill mines are opening encouragingly.

CANADA

British Columbia

The Hedley Gold Mining Co. will pay on September 30 a quarterly dividend of 3% and an additional one of 2 per cent.

Construction work on the Grand Trunk Pacific railroad in the northern part of the province may be delayed on account of the rush to the new gold placer district at Sibola creek, 110 miles southwest of Telkwa, on the Grand Trunk line.

Ontario

The Hollinger Gold Mines Co. paid a dividend amounting to $90,000 on September 9, making a total of $1,080,000. During the month ended August 12 the mill treated 11,654 tons of ore valued at $18.37 per ton, with an extraction of 97%, at a cost of $1.38 per ton. The profit amounted to $141,733, and surplus after paying dividends $625,202. The most important result of the four weeks' work has been the cutting of No. 1 vein on the 425-ft. level. The vein shows a width of 10 ft. and was reached at a distance of 26 ft. from the bottom of the winze. The ore is similar to that on the upper levels and assays average $18 per ton.

COLOMBIA

The Pato dredge of the Oroville Dredging Co. returned $3300 from 17,300 cu. yd. during the week ended August 19. The dredge is still employed in digging toward the 310 acres of tested ground.

MEXICO

Jalisco

During August, El Favor mill yielded bullion worth ₱43,000, to which has to be added smelter returns from ore and concentrate shipped from El Favor and Mololoa mines. Fourteen cars of machinery for the mill of the Cinco Minas Co., in the Hostotipaquillo district, is on its way to the mine. The manager, H. E. Crawford, hopes to have the mill completed and in operation by the first of next year.

Personal

Professional men are invited to send news of their engagements and travels. Such news is interesting to friends.

Charles Butters is in London.

C. S. Haley left for Colombia Friday.

F. F. Sharpless is at Golconda, Nevada.

Richard Beck was in New York last week.

Pierre Bourey was in San Francisco this week.

H. V. Winchell was at Butte and is in California.

Ralph Arnold has been at Lake Tahoe for the week.

J. F. Thorn will be in New York the last of the month.

Howard D. Smith is expected in the Santa Maria oil-fields.

Charles E. Van Barneveld returned from the East Tuesday.

F. Loewinson-Lessing has been visiting California dredging fields.

A. Dickeman has left Idaho and gone to Barranquilla, Colombia.

J. C. Jones is in a hospital at Reno, as a result of football injuries.

S. S. Sorensen sailed for England on September 10, and will proceed to Chile from there.

Pope Yeatman has left New York for Chile, where he will be joined by Walter Broadbridge from London.

R. B. Lamb, who has been at Austin, Nevada, recently, passed through San Francisco and Los Angeles this week.

G. A. Packard gave a talk on the Cooke City district at a recent meeting of the Montana Society of Engineers, at Butte.

Desaix B. Myers will be in Nevada county, California, this week, and at Eldorado Canyon, Nevada, the first week in October.

John D. Ryan, president of the Amalgamated Copper Co., delivered an address before the Helena Commercial Club on September 12.

J. C. Branner, president of Stanford University, has been decorated by the Brazilian Historical and Geographical Institute in recognition of his many contributions to Brazilian history and geology.

The San Francisco Section of the Mining and Metallurgical Society held its first dinner of the fall at Hotel Oakland Tuesday last. Those present were S. B. Christy, R. E. Cranston, C. W. Merrill, E. B. Kimball, P. R. Bradley, E. L. Oliver, F. L. Ransome, A. C. Lawson, and H. F. Bain.

Obituary

Jennings Stockton Cox, Jr., died at his home, 140 West Seventy-first street, New York City, on August 30. He was graduated from the School of Mines of Columbia University in 1887 and began work with the Carnegie Steel Co. of Pittsburgh, as draftsman in the Homestead works. In 1890 he served as inspector of construction in Roach's shipyard, Chester, Pennsylvania, and spent the following year in professional work in Brazil. During 1892 he was assistant superintendent of the Aurora Iron Mining Co., Ironwood, Michigan, and the next year held a similar position with the Monte Cristo and other mining companies in Washington. After spending some months in professional work in New York and Cuba he became agent for the Crocker-Wheeler Electric Co. at Pittsburgh. Going to Cuba in 1897 he became general manager for the Spanish American Iron Co., at Santiago, Cuba, which position he held until the time of his death. He was very prominent in the industrial development of Cuba; among other activities, being secretary and treasurer of the Pompo Manganese Co. Ten years ago he married Miss Ysabel Ramsden, the daughter of the British Consul at Santiago. He returned from Cuba three months ago on account of his health. He was a member of the University Club, the Alpha Delta Phi fraternity, and of the American Institute of Mining Engineers.

The Metal Markets

LOCAL METAL PRICES

San Francisco, September 18.

Antimony	12—12½c	Quicksilver (flask)	$39.50
Electrolytic Copper	17¼—17½c	Tin	46—47½c
Pig Lead	5.60—5.95c	Spelter	7¼—7½c

Zinc dust, 1400 lb. casks, per 100 lb., small lots $9.50—9.75; large $7.50—8.50

EASTERN METAL MARKETS

(By wire from New York.)

NEW YORK, September 17.—The copper market is strong and advancing; early copper is scarce and the consumers are poorly supplied. Electrolytic is quoted at 16.87 to 17c., Lake 17c., and casting from 16.62 to 16.75c. The London market is reported quiet, with spot copper at £74 12s. 6d. and futures at £74 7s. 6d. Lead is quoted at £20 12s. 6d. Bar silver is quoted at 60½c., and Mexican pesos at 46c. Tin market is easy, with spot at 42.40 and 42.75c. Antimony is dull; Cookson's quotations, 8.30c. The demand for copper is strong at 17c. and a still higher price is predicted.

SILVER

Below are given the average New York quotations, in cents per ounce, of fine silver.

Date.		Average week ending	
Sept. 11	60.12	Aug. 7	59.29
" 12	60.12	" 14	59.12
" 13	60.12	" 20	59.16
" 14 Sunday		" 27	59.46
" 15	60.12	Sept. 3	59.60
" 16	60.25	" 10	59.58
" 17	60.50	" 17	60.20

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	56.25	63.01	July	60.67	58.70
Feb.	59.06	61.25	Aug.	61.32	59.32
Mch.	58.37	57.87	Sept.	62.95	....
Apr.	59.20	59.26	Oct.	63.16	....
May	60.88	60.21	Nov.	62.73	....
June	61.29	59.03	Dec.	63.38	....

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.		Average week ending	
Sept. 11	4.73	Aug. 6	4.50
" 12	4.73	" 13	4.48
" 13	4.73	" 20	4.68
" 14 Sunday		" 27	4.75
" 15	4.73	Sept. 3	4.75
" 16	4.73	" 10	4.73
" 17	4.73	" 17	4.73

Monthly averages.

	1913.	1913.		1912.	1913.
Jan.	4.43	4.28	July	4.71	4.35
Feb.	4.03	4.33	Aug.	4.54	4.60
Mch.	4.07	4.32	Sept.	5.00	....
Apr.	4.20	4.36	Oct.	5.08	....
May	4.20	4.34	Nov.	4.91	....
June	4.40	4.33	Dec.	4.20	....

ZINC

Zinc is quoted as spelter, standard Western brands, St. Louis delivery, in cents per pound.

Date.		Average week ending	
Sept. 11	5.63	Aug. 6	5.40
" 12	5.60	" 13	5.45
" 13	5.58	" 20	5.51
" 14 Sunday		" 27	5.60
" 15	5.58	Sept. 3	5.63
" 16	5.58	" 10	5.65
" 17	5.58	" 17	5.59

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	6.42	6.88	July	7.12	5.11
Feb.	6.50	6.13	Aug.	6.96	5.51
Mch.	6.57	5.94	Sept.	7.45	....
Apr.	6.63	5.52	Oct.	7.36	....
May	6.68	5.23	Nov.	7.23	....
June	3.88	5.00	Dec.	7.09	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California, being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending			
Aug. 20	40.00	Sept. 3	40.00
" 27	40.00	" 10	40.00
		" 17	39.50

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	43.75	39.37	July	43.00	41.00
Feb.	46.00	41.00	Aug.	42.50	40.50
Mch.	46.00	40.20	Sept.	42.12	....
Apr.	42.25	41.00	Oct.	41.50	....
May	41.75	40.25	Nov.	41.50	....
June	41.30	41.00	Dec.	39.75	....

TIN

New York prices control in the American market for tin, since the metal is almost entirely imported. San Francisco quotations average about 5c. per lb. higher. Below are given average monthly New York quotations, in cents per pound:

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	42.53	50.45	July	44.25	40.70
Feb.	42.96	49.07	Aug.	45.80	41.75
Mch.	42.58	46.95	Sept.	48.64	....
Apr.	43.92	49.00	Oct.	50.01	....
May	46.05	49.10	Nov.	49.92	....
June	45.76	45.10	Dec.	49.80	....

Anything more uninteresting that the tin market during the week ended August 23 could hardly be imagined, according to Henry R. Merton & Co. Speculation in the metal is absolutely dormant, and even the professional element is disinclined to show its hands. There was some enquiry for metal from American as well as from Continental consumers, which kept the market generally firm, but whenever the demand was satisfied, prices fell back from sheer inanition. Prices for spot metal ruled high at times, touching £189 15s. early in the week, but the premium fell off when holders were tempted to lend some good lines. Transactions during the week amounted to about 1525 tons.

COPPER

Quotations on copper as published in this column represent average wholesale transactions on the New York market and refer to electrolytic copper. Lake copper commands normally from 1-5 to 1-4c. per lb. more. Prices are in cents per pound.

Date.		Average week ending	
Sept. 11	16.35	Aug. 6	14.92
" 12	16.35	" 13	15.53
" 13	16.35	" 20	15.59
" 14 Sunday		" 27	15.51
" 15	16.40	Sept. 3	15.69
" 16	16.50	" 10	16.32
" 17	16.70	" 17	16.44

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	14.09	16.54	July	17.19	14.21
Feb.	14.08	14.93	Aug.	17.49	15.42
Mch.	14.68	14.72	Sept.	17.56	....
Apr.	15.74	15.22	Oct.	17.32	....
May	16.03	15.42	Nov.	17.31	....
June	17.23	14.71	Dec.	17.37	....

With the announcement by the Copper Producers' Association, on September 8, that copper stocks had declined to 38,300,000 lb., or 6,000,000 lb. below the previous low record, corresponding to only eight days' supply of the metal, the price of copper was marked up to 16¾c. per pound. Buying was fair at first, but soon fell off with the news of a drop of over £1 per ton of standard copper in London, H. R. Merton & Co. being heavy sellers on speculative accounts. Throughout the week sales remained light, though producers held their demands firm. It is obvious that all domestic buying has been on a 'hand to mouth' basis, and indicates that consumers are of the belief that with the capacity of the mines increasing at a steady rate and general business rather slack, there can exist no sound basis for any permanent advance in copper prices. Not a few persons are frankly skeptical in regard to European statistics. For months exports to Europe have been far above normal, and for the first eleven days of September were 12,335 tons, as compared with 11,020 tons in the same period of last year. Trade conditions in Europe have not averaged better than in this country, and in Germany there has been a general movement to put trade on a less extended basis than has rsulted from the efforts to push German trade in foreign countries during the past decade. That under these circumstances Europe can continue to absorb unprecedented amounts of copper in the natural course of business is at least open to doubt, and not a few well informed people intimate that visible stocks are being converted into invisible ones for the benefit of the market. The Amalgamated continues to buy warrants on the London Exchange, and is said to plan shipping 'blister' to this country for refining. It has been suggested that this is really to provide 'standard' copper for trading on the New York Metal Exchange, where an attempt has been made to build up trading in copper warrants, as in London. The real traders in copper in New York ignore the Exchange's existence, and it should not require many tons of standard copper to meet all its needs. Some of the producers talk seriously of a 'runaway' market, but for the time being it is decidedly easy-going.

The Stock Markets

SAN FRANCISCO STOCKS AND BONDS

(San Francisco Stock and Bond Exchange.)

BONDS

September 17.

Listed.	Bid	Ask	Unlisted.	Bid	Ask
Associated Oil 5s	$100	100½	General Petroleum 6s	$56½	—
E. I. du Pont 4½s	83½	—	Natomas Dev. 6s	97½	—
Natomas Con. 6s	75½	78	Pac. Port. Cement 6s	90	—
Unlisted.			Standard Cement 6s	91½	—
Ass. Oil 5s	75½	—	Santa Cruz Cement 6s	80	90

STOCKS

Listed.	Bid	Ask	Unlisted.	Bid	Ask
Associated Oil	42½	43	Mascot Copper	1½	2½
Amalgamated Oil	84	87	Noble Electric Steel	2½	—
E. I. du Pont pfd	86	92½	Natomas Consol	9	12
Pac. Cst Borax, com	—	100	Pacific Port. Cement	61	—
Pacific Crude Oil	22½c	—	Riverside Cement	45	—
Sterling O. & D.	70c	—	Santa Cruz Cement	36	50

NEVADA STOCKS

(By courtesy of San Francisco Stock Exchange.)

San Francisco, September 18.

Atlanta	$ .14	Mizpah Extension	$ .40
Belcher	.26	Montana-Tonopah	1.30
Belmont	7.50	Nevada Hills	.53
Big Four	.27	North Star	.70
Cash Boy	.09	Ophir	.23
Florence	.23	Pittsburg Silver Peak	.38
Goldfield Con	2.00	Round Mountain	.46
Goldfield Oro	.09	Sierra Nevada	.05
Halifax	1.55	Tonopah Extension	2.05
Jim Butler	.72	Tonopah Merger	.71
Jumbo Extension	.12	Tonopah of Nevada	4.75
MacNamara	.12	Union	.12
Mexican	1.15	West End	1.57
Midway	.46	Yellow Jacket	.25

COPPER SHARES—BOSTON

(By courtesy of J. C. Wilson, Mills Building.)

September 18.

	Bid	Ask		Bid	Ask
Adventure	$ 1⅛	1¼	Mohawk	$ 42½	44
Allouez	37	⊠	North Butte	28⅛	28½
Calumet & Arizona	69½	69¾	Old Dominion	63	63½
Calumet & Hecla	445	450	Osceola	88	89
Centennial	13⅜	14⅜	Quincy	63	64
Copper Range	39⅞	40	Shannon	7⅛	7⅜
East Butte	12¼	12½	Superior & Boston	3⅛	3½
Franklin	4	4⅛	Tamarack	33½	33⅞
Granby	77	77½	U. S. Smelting	40½	41
Greene Cananea	6⅞	7	Utah Con.	9⅝	10
Hancock	18½	19½	Victoria	1⅛	1¼
Isle-Royale	20⅜	21	Winona	90c	95c
Mass Copper	3	3¼	Wolverine	44½	46

NEW YORK QUOTATIONS

(By courtesy of E. F. Hutton & Co., Kohl Building.)

September 18.

	Bid.	Ask.		Bid.	Ask.
Alaska G. M.	20¼	20¾	Mason Valley	5⅞	6
Braden Copper	8⅛	8¼	McKinley-Dar.	1½	2
B. C. Copper	2½	2¾	Mines Co. Am.	2¼	2½
Davis-Daly	2⅛	2⅜	Nipissing	8¾	9
Dolores	2	4	Ohio Copper	⅜	½
El Rayo	1	2	San Toy	18	22
Ely Con.	6	8	Sioux Con.	1	2
First Nat.	3⅝	3⅞	So. Utah	⅛	¼
Giroux	1¼	1¾	S. O. Calif.	187	189
Greene Can.	6¾	7	Tri Bullion	⅛	¼
Hollinger	16	17	Tuolumne	¾	⅞
Iron Blossom	120	130	United Copper	¼	¾
Kerr Lake	3⅜	3½	Wettlaufer	12	16
La Rose	2¼	2⅜	Yukon Gold	2	2⅛

LONDON QUOTATIONS

(By cable, through the courtesy of Catlin & Powell Co., New York.)

September 18.

	£	s.	d.		£	s.	d.
Alaska Mexican	1	17	6	Kern River Oilfields	0	7	6
Alaska Treadwell	8	2	6	Mexico Mines	6	0	0
Alaska United	4	0	0	Messina	1	10	0
Arizona	2	0	0	Oroville	0	7	6
California Amalg	0	2	0	Pacific Oilfields	0	2	6
California Oilfields	6	5	0	Rio Tinto	79	12	6
Camp Bird	0	15	0	Santa Gertrudis	0	18	9
El Oro	0	15	0	Stratton's	0	2	6
Esperanza	1	0	0	Tanganyika	2	10	0
Granville	0	11	3	Tomboy	1	6	3

AUSTRALIAN

September 18.

	£	s.	d.		£	s.	d.
British Broken Hill	1	18	9	Mount Boppy	0	15	0
Broken Hill Prop.	1	16	9	Mount Elliott	5	11	3
Golden Horse-Shoe	3	0	0	Mount Lyell	1	5	0
Great Boulder Prop.	0	12	6	Mount Morgan	3	11	3
Ivanhoe	3	1	3	Waihi	2	6	3
Kalgurli	2	0	0	Waihi Grand Junc.	1	1	3

THE PAST WEEK AT COBALT

The Buffalo Mines Co. will pay a dividend and bonus amounting to $200,000 on October 1, and $70,000 on November 15, making the total to date of $2,527,000. During August the Nipissing high and low-grade mills treated 171 and 7824 tons of ore, respectively, while the refinery shipped 553,698 oz. of silver bullion. Most of the yield came from No. 73, 80, and 63 shafts. Diamond-drilling is being done near the old Nova Scotia property in diabase. Hydraulic prospecting uncovered several small veins. On the 200-ft. level of the Cochrane an irregular vein is being opened. Steamship companies carrying Cobalt bullion to England have raised their rates from $4.50 to $7 per 100 lb., so the bullion will now go to New York.

GOLD AND SILVER PRODUCTION OF THE UNITED STATES.

The production of gold in the United States during 1912 amounted to $93,451,000, a decrease of $3,438,500 as compared with the previous year, and the lowest production since 1907. The output of silver was 63,766,800 fine ounces, valued at $39,197,500, an increase of 3,367,400 oz. over 1911, the greatest gain being made in the state of Utah, according to the joint statement of the Mint and the United States Geological Survey. The decrease in gold was caused by a reduction in Nevada's output by $4,521,200 as compared with 1911. George E. Roberts, Director of the Mint, states that while the output of gold had decreased in the United States and Australia, there was sufficient increase in South Africa to make the world's production of gold for 1912 greater than in 1911. Statistics are not yet available on the world's production.

The production of gold and silver by states during 1912 was as below, and compared with figures in our review of January 4, 1913, there is a difference of about 1.5 per cent.

	Gold (value).	Silver (fine oz.).
Alabama	$ 17,000	.....
Alaska	17,198,600	538,700
Arizona	3,785,400	3,445,500
California	20,008,000	1,384,800
Colorado	18,741,200	7,933,100
Georgia	10,900	200
Idaho	1,401,000	7,862,900
Illinois	.....	1,800
Maryland	1,200	700
Michigan	.....	543,700
Missouri	.....	30,000
Montana	3,707,900	12,524,000
Nevada	13,575,700	13,851,400
New Mexico	754,600	1,460,800
North Carolina	156,000	2,300
Oregon	759,700	54,000
Philippine Islands	461,600	5,700
South Carolina	15,400	.....
South Dakota	7,823,700	205,300
Tennessee	11,500	112,000
Texas	2,200	379,800
Utah	4,412,600	13,076,700
Virginia	300	700
Washington	682,600	350,800
Wyoming	24,300	300
Total	$93,451,400	63,766,800

THE CARNEGIE STEEL CO. is rebuilding one of the open-hearth furnaces at its Sharon works for burning powdered coal. Two other furnaces will also be equipped the same way. Three furnaces are using coal tar as fuel.

Company Reports

STEWART MINING COMPANY

This Company operates in the Coeur d'Alene district, Shoshone county, Idaho, and the report covers the first half of the current year. Results may be summarized as follows:

Ore milled, tons	87,283
Ore shipped to smelters, tons	1,963
Metal contents of ore mined:	
Silver, ounces	657,416
Lead, pounds	13,545,300
Revenue from concentrate	$466,466
Revenue from ore	74,644
Total	$541,110
Working expenses	294,249
Litigation	38,791
Profit	208,070
Dividend	123,836

The operating profit and net profit for the period under review are both slightly lower than for the preceding term, but the net earnings during May and June are much higher than the average of the six months. Current assets are $483,951 and liabilities $57,084.

Costs at the Stewart mine, Shoshone county, Idaho, during the first half of 1913, were as follows: Mining and development, $2.28; transport of ore, 15c.; sorting ore, 4c.; milling, 37c.; administration and general expenses, 31c.; taxes, 10c.; depreciation, 5c.; and litigation, 43c.; a total of $3.73 per ton.

KERR LAKE MINING COMPANY

This Company was incorporated under the laws of New York state in 1905, and owns 395 out of 400 fully paid shares of the Kerr Lake Mining Company of Ontario, Canada, owning silver-mining property in the township of Coleman, Nipissing district, Ontario, Canada. The capital is 600,000 shares at $5 par value, $3,000,000. The report for 1912 gives the production of silver by the operating company for the year as 1,855,495 oz. Of this, 1,741,804 oz. was produced from high-grade and 113,691 oz. from milling ore, which was sent to customs mills for treatment. The total cost of production per ounce of silver was 18.3c., made up as follows: mining 12.1c., shipment and treatment 5.55c., and administration and general 0.65c.

This increase over last year's report is principally due to the greater amount of development work per ton of ore mined, and larger proportion of lower-grade product shipped. The greater cost of treatment is due to the increasing proportion of low-grade ore handled. The total estimate of ore reserves September 1, 1912, contained 6,660,091 oz. of silver. The average price the Company received for its silver was 60c. per ounce. The net profits for the year, above all expenses, was $703,309. The Company paid its stockholders $690,000 in dividends, a total to date of $4,020,000. This Company owns 150,000 shares of the Wettlaufer Lorrain, valued at $60,000, and 200,000 shares of Kerr Lake Majestic Mines, valued at $79,548. Cash on hand amounts to $2316 and a reserve of $1350 for outstanding liabilities is maintained.

THE VILLAGE MAIN REEF GOLD MINING COMPANY

The Company was registered in 1890 to take over the property of a South African company of the same name, comprising 20 main reef deep-level claims on the farm of Turffontein, Witwatersrand district, Transvaal. The capital is £472,000, in 472,000 shares of £1 each; all the shares are issued and fully paid. The report for 1912 shows a total of 563,511 tons mined. The total cost of mining was £286,872. The tonnage treated in the cyanide works was 470,535 tons, yielding 72,023 oz. fine gold. The value of the yield from the mill was £628,715, or £1 6s. 9d. per ton, based on tonnage milled; the value of the yield from the cyanide plant was £301,013, or 12s. 10d. per ton, a total revenue of £929,728, or £1 19s. 7d. per ton. This is an increase of about 2s. 3d. per ton compared with 1911. The total working cost was £437,513, or 18s. 7d. per ton, an increase of 6.9d. per ton compared with 1911. This gives a working profit of £492,215, or £1 0s. 11d. per ton. In addition, a profit of £8911 was obtained from the treatment of 28,633 tons of 'accumulations.' The ore reserves were estimated at 1,683,066 tons, with a gold content of 33s. 7d. per ton. The realized net profits for the year were £443,176. Two dividends were paid during the year, each of 7s. per share, amounting to £330,400. The cost of mining, including delivery of the ore to crusher station, was 10s. 4d. per ton. Results were as follows:

Ore from mine, tons	563,511
Sorted out as waste, tons	92,530
Sent to mill, tons	470,981
Stamps working	220
Average working time, days	297.2
Tube-mills working, 250.7 days	4.2
Ore crushed, tons	470,056
Value of ore per ton, dwt.	9.73
Recovery in cyanide plant, per cent.	91.37
Cost of treatment per ton	$1.12

MASS CONSOLIDATED MINING COMPANY

This Company was organized in 1899 and has a capital of $2,500,000 in shares of $25 each, of which $2,300,000 has been paid in. Its properties include three old mines, the Ridge, Mass, and Ogima, and contain six copper-bearing amygdaloid beds. They are in T. 51 N., R. 38 W., and T. 50 N., R. 39 W., nearly 2500 acres in all. At the time of organization, $8 per share was paid in, and $15 per share has been paid in ten installments since that time, the latest being June 15, 1911. During 1912 operations were as follows:

Ore hoisted, tons	180,613
Ore milled, tons	132,891
'Mineral' produced, lb.	2,985,335
Copper produced, lb.	2,045,006
'Mineral' in ore, per cent	1.123
Copper in mineral, per cent	68.50
Copper per ton of ore smelted, pounds	15.39

The directors present the following report of the operations during the year 1912:

Income:		
2,045,006 lb. copper at 17.0205c.	$348,070	
Real estate	284	
Insurance on building burned	1,000	
		$349,354
Expenses:		
Mining, development, surface, stamp-mill, freight, office and general expense, insurance, taxes, smelting, etc., and general Eastern expense		335,673
Balance		$ 13,681
Surplus assets on hand January 1, 1912		30,710
		$ 44,392

Assets are valued at $142,031, and liabilities are $132,684.

In his report the consulting engineer, F. W. Sperr, recommends doubling the rate of production, estimating that the production cost per pound of copper would then be: mining, 4.534c.; surface expense, 1.384c.; general expense, 0.074c.; taxes and insurance, 0.19c.; freight, 1.15c.; stamp-milling, 1.61c.; development, 1c.; a total of 9.934c. per pound. The development work during the year was highly satisfactory, 352,100 tons having been added to the reserves, making the net total, December 31, 1912, 727,000 tons. Development work is confined to the Butler and Evergreen lodes. At the B shaft in the drifts driven to the west on the Evergreen lodes, at No. 6 and 8 levels, the lode shows an increasing width of ore of milling grades. At the C shaft development has been on the Butler lode, on No. 5, 7, 8, and 9 levels, and has been satisfactory.

Concentrates

Most of these are in reply to questions received by mail. Our readers are invited to ask questions and give information dealing with the practice of mining, milling, and smelting.

COPPER AND GOLD ORES have been opened in several properties in Finland, Russia.

NISSEN AND ORDINARY STAMPS are to be tested against one another at the Carn Brea mine, Cornwall.

THE TERM 'DREDGE MINING,' in Victoria, Australia, includes bucket dredging, hydraulic sluicing by centrifugal pumps, and by the jet elevator.

GALVANIZED CORRUGATED IRON may be used with advantage in making leaching, agitation, storage, and other vats about a cyanide plant for temporary or permanent use. These are largely used in Australia and last for several years, even with rough treatment such as moving the vats nearer a sand dump as it is treated, to save long transport of the sand. Corrugated iron vats are made in all

TYPICAL WESTERN AUSTRALIAN GALVANIZED CORRUGATED IRON MECHANICAL AGITATORS.

sizes up to 30 by 8 ft., or even larger, the sides being of about 22 gauge corrugated, and the bottom of 18-gauge galvanized flat iron. The top sheet is turned over a ⅜-in. rod to form an annular brace, greatly strengthening the vat. The sheets are double riveted and soldered, and the inside is given two coats of P. & B. paint. Such vats are light, and may be curved and constructed at a mine with little trouble, saving the high transport costs of heavy steel vats. For small mine plants the corrugated iron vat is strongly recommended and will be found satisfactory.

DRILLING CONTESTS on Labor Day in several mining camps were as follows: At Sonora, Tuolumne county, California, three teams contested, drilling into granite. J. Page and F. Bartlett drilled 35⅛ in., Pedro Bros. 34 1/16 in., and J. Wivell and J. Kahl reached 31 in. The first named were given the prize of $150. At Hedley, British Columbia, five teams entered. Beam and Lyon drilled 30 9/16 in. McEachern Bros., of Olalla, in good style beat the former with 31 21/32 in. Hamilton and Liddicoate, who having only two practices together before the trial, drilled 30 11/16 in. The Rossland team, Oscar Anderson and Andrew Sebla, gave a fine exhibition of drilling and drilled 34¾ in, and the Nickel Plate team, Jack Trewelah and Olie Holverseth, drilled 32 1/32 in. Altogether, it was the best drilling contest that has ever been held at Hedley, and was full of surprises from start to finish. At Cobalt, Ontario, results were as follows: (1) McKinnon Bros., Hudson Bay mine, 37⅜ in., $300; (2) McMillan Bros., 36¼ in., $200; (3) Dunbrack and McKinnon, 31 in., $100; Price Bros., 30¾ in.; Shea and Ross, 29⅝ in. At Sumpter, Baker county, Oregon, the winners were Goddard and Porter, from the Ben Harrison mine, who drilled 44 7/16 in.; followed by Baker and Dale, of the Bonanza mine, with 41 15/16 in.; Andregg and Nonoe with 41⅛ in.; the Columbia mine team, Gutridge and Linville, with 39¾ in.; and Dodson and Roberts, from the Bonanza, with 38¾ inches.

CONCENTRATION is a mechanical process for the treatment of ores by means of which the valuable minerals are separated from the worthless portions by taking advantage of their physical properties, such as specific gravity, magnetism, and adhesion, the object being to concentrate the metal content into smaller bulk, by eliminating as far as possible, the portions that are of no commercial value. In the treatment of complex ores, it also serves as a means of separating two or more minerals which are not marketable while in combination, into several products, each of which can be sold or profitably treated by other processes.

ROLLS are successfully used for crushing material for concentrating plants, sampling works, cyanide mills, rock-crushing plants, cement mills, silica-sand plants, stamp-mills, phosphate works, chemical works, and converter plants. Being essentially machines for fine crushing, their work usually follows that of jaw crushers or gyratory crushers. They may be used to reduce rock and ores of various hardnesses, also clay and shale, and they can be operated either wet or dry. Rolls are being used more extensively from year to year because their operation is smooth, continuous, and economical when they are run under proper conditions.

BUCKET and ladder dredges operated by current wheels, came into use in the New Zealand goldfields in the early '70s. These machines were of crude construction and were limited to river-channel service. Ten years later, steam power was introduced, and this type of machine became so popular that during the next twenty years over 250 of them were placed in operation in New Zealand. Yet, while some attempts were made to build and operate machines of this type in the United States, especially in the California fields, the results were far from satisfactory until a New Zealand mining engineer came to this country, examined the Yuba River placers, and had constructed a small machine. This was the forerunner of the great dredges now in operation in California, Alaska, and other states.

A SYSTEM of belt-conveyors has just been completed at the Wasp No. 2 mill for removing the tailing from the leaching vats to the dump. On account of scarcity of water and danger of polluting a stream, it is out of the question to sluice these tanks. Six conveyors, each 70 ft. long, run under the discharge gates in the bottom of the vats. These conveyors dump on a belt 90 ft. long, running at right angles to the first mentioned, and this belt discharges on to a 150-ft. belt which delivers the tailing to the dump. Some difficulty has been experienced on account of moisture causing the tailing to stick to the belts, but it is hoped to overcome this by installing revolving brushes. With the belts the time of discharging a 420-ton vat has been reduced from 8 to 3½ hours.

A CAREFUL COMPARISON of results obtained from a 16-ft. 5-in. and a 24-ft. tube-mill, working side by side at the New Goch mill on the Rand, showed the principal difference to be a saving of about 35% in power in favor of the shorter mill. The product, both in quantity and grading, was practically identical, according to E. Farrar, of the General Mining & Finance Corporation. In June there were 9922 stamps and 283 tube-mills at work on the Rand, and the proportion of tube-mills to stamps varied between 1 to 10 at the Consolidated Langlaagte, and 1 to 90 at the Durban Roodepoort. The stamp-duty varied between 5.4 tons at the West Rand Central, with 1 tube-mill to 20 stamps, and 21.49 tons at the Consolidated Langlaagte, with 1 tube-mill to 10 stamps. The relative numerical proportion of tube-mills and stamps are not the sole determining factors, as obviously the weights of stamps and screening used must be considered.

Metal Production of Oregon

The value of the mine output of gold, silver, copper, and lead, in Oregon, in 1912, according to Charles G. Yale, of the U. S. Geological Survey, was $849,886, against $669,016 in 1911. The total yield of gold was $770,041, an increase of $136,634 over the 1911 production. Of the gold output, $580,945 came from placers. There was an increase in production from hydraulic mining of $38,131, but there was a small decrease in the yield from drift and surface mines. About 50% of the placer gold recovered came from mines in Josephine and Jackson counties. The gold recovered from deep mines amounted to 28,103.21 fine ounces, valued at $580,945, of which 27,278 oz. was derived from silicious ores, 616.40 oz. from copper ore, and 208.84 oz. from lead ores. The southwestern counties of Oregon (Coos, Curry, Douglas, Jackson, Josephine, and Lane), which form an extension of the California gold belt, made a combined production of $217,565 in gold, and of $10,343 in silver. Northeastern Oregon, comprising Baker, Crook, Grant, Malheur, and Wheeler counties, reported a gold production of $552,476, of which Baker county contributed $484,041, or 87.6%. The silver production of Oregon was 57,081 fine ounces, valued at $35,105, compared with 45,221 oz., valued at $23,967, in 1911. Of the 1912 production, 1941 oz. came from placers, 44,018 oz. from silicious ores, 10,555 oz. from copper ores, and 567 oz. from lead ores.

The copper production increased in Oregon from 93,136 lb., valued at $11,642, in 1911, to 260,429 lb. valued at $42,971 in 1912. All the copper except 6049 lb. was derived from ores mined in Josephine county. The production of lead in Oregon in 1912 was 39,317 lb., valued at $1769. The output came from a small quantity of lead ore mined in Jackson county and from concentrate shipped from Lane county.

The Manufacture of Coke in 1912

By Edward W. Parker

The following table, compiled by the U. S. Geological Survey, shows the production by states during the year.

Glass, Grinding, and Furnace Sand Production

The quantity and value of glass sand produced in 1912 was lower than in the two preceding years. The production amounted to 1,465,386 short tons, valued at $1,430,471, as compared with 1,538,666 short tons, valued at $1,543,733, in 1911, a net decrease in quantity of 73,280 short tons and in value of $113,262. The glass industry was progressive in 1912, for building operations throughout the country made a steady demand for window and plate glass. Many glass factories, however, were hindered in operation by a shortage of labor. The average value of glass sand per ton was a fraction of a cent over 96c. in 1912.

Grinding and polishing sand had a good market in 1912. The production was 1,397,667 short tons, valued at $667,750, as compared with 938,628 short tons, valued at $521,761, in 1911, an increase in quantity of 459,039 short tons and in value of $145,989. Engine sand likewise showed an increase for the year, as it is likely to do annually so long as rail transportation continues to expand. The figures for 1912 are 1,288,486 short tons, valued at $428,928, an increase of 158,493 short tons and in value of $17,620 over 1911, when 1,129,993 short tons, valued at $411,308, was produced.

In 1911 the production of fire sand and furnace sand amounted to 672,140 short tons, valued at $347,733, and in 1912 to 506,900 short tons, valued at $346,000. This represents a decrease in quantity of 165,240 short tons and in value of $1733 in 1912. Paving sand also was used in smaller quantity in 1912 by 156,042 short tons, but the value, nevertheless, was greater by $19,071 than in 1911. The figures are 1,788,530 short tons, valued at $670,680, in 1912, and 1,944,572 short tons, valued at $651,609, in 1911.

Molding sand, which ranks second in quantity and value of production, broke all records in 1912, having for the first time exceeded 4,000,000 tons and passed the $2,500,000 mark. The production in 1912 was 4,484,953 short tons, valued at $2,718,398, as compared with 3,376,717 short tons, valued at $2,132,469, in 1911, an increase in quantity of 1,108,236 short tons and in value of $585,929.

State.	Establishments	Ovens built	Ovens building	Coal used, short tons.	Yield of coal in coke, per cent	Coke produced, short tons	Total value of coke.	Price of coke per ton.
Alabama	46	10,208	100	4,585,498	64.9	2,975,489	$8,098,412	$2.72
Colorado	15	3,588	0	1,473,112	66.0	972,941	3,043,994	3.13
Georgia	2	251	0	87,300	50.0	43,158	161,842	3.75
Illinois	6	594	40	2,316,307	76.2	1,764,944	8,069,903	4.57
Indiana	4	642	169	3,198,874	81.8	2,616,339	12,528,685	4.79
Kentucky	9	1,049	291	307,162	62.4	191,555	513,734	2.68
Montana	4	451	0	0	0	0	0	0
New Mexico	4	1,030	0	679,209	60.9	413,906	1,356,946	3.28
New York	4	555	0	1,095,198	72.6	794,618	3,203,133	4.03
Ohio	7	471	119	561,426	69.2	388,669	1,365,905	3.51
Oklahoma	2	260	0	0	0	0	0	0
Pennsylvania	277	53,756	1887	41,268,532	66.5	27,438,693	56,267,838	2.05
Tennessee	15	2,584	0	685,861	54.0	370,076	951,853	2.57
Virginia	18	5,408	0	1,555,969	62.2	967,947	1,815,975	1.88
Washington	6	313	0	78,693	62.6	49,260	279,105	5.67
West Virginia	129	19,064	0	4,061,702	60.7	2,465,986	4,692,393	1.90
Kansas, Maryland, Massachusetts, Michigan, Minnesota, New Jersey, Utah, Wisconsin	11	2,006	174	3,623,019	69.8	2,530,018	9,386,978	3.71
Total	559	102,230	2783	65,577,862	67.1	43,983,599	$111,736,696	$2.54

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EDITORIAL

THE Hall desulphurizing process is now in operation at the Balaklala smelter at Coram, California. We shall publish the results of the experimental work as soon as they are available.

BERING RIVER coal has been tested on the cruiser *Maryland* and, according to press reports, has been found unadapted to naval use. Why not, then, let the locomotives in Alaska have it?

REVIVAL of the mining industry has begun to be noticed by the smelting companies. One acute manager explains this as due to the shortage of money; finding it impossible to promote mines, the owners have been driven to working them, and this has resulted in discovery of additional orebodies.

MINNESOTA is one of the states that owns large tracts of mineral lands and the school fund is being rapidly built up out of the proceeds of royalties. While the charge for ore from state lands is less than that exacted by private land owners, it is estimated that the revenue derived this year will be nearly if not quite $1,000,000.

ANNOUNCEMENT has been made that the Tau Beta Pi, an engineering honor society, and the Theta Tau, a professional mining engineering society, will conclave in San Francisco in the early part of September 1915. It is hoped that a large representation will report for the convention where a cordial reception is assured to those who make the pilgrimage across the deserts to this oasis on the Pacific Coast.

WHAT constitutes a fair attorney's fee must sometimes be decided by the courts. The Silver King Consolidated Mining Company recently won a judgment for $905,000 against the Silver King Coalition Mine Company, but final payment of the money is prevented by disagreement over the charges of the plaintiff's attorneys, who have received $37,000 and claim $180,000 in addition. The Company concerned offered to pay $96,800 in addition to the advances made, and when this was refused the matter was left to the courts.

GENERAL geology still forms a part of the work of the United States Geological Survey, despite occasional rumbles of discontent. To emphasize the fact, the Survey has just established a new annual volume into which is to be gathered for prompt publication the minor papers of a scientific rather than distinctively economic character, such as result from

each season's study. The first of these papers is a scholarly assay on 'The Origin of Colemanite Deposits,' by Mr. Hoyt S. Gale, in which is marshalled evidence for the belief that they are veins probably due to the reaction of boric acid vapors accompanying the extrusion of lavas, on lenses of limestone, themselves possibly hot spring deposits. The new series of papers should prove useful as well as welcome.

THE Edison process of concentration, which has been in the experimental stage for the past two years, has, according to Mr. Thomas A. Edison, been perfected to that degree where it can profitably be applied to a large majority of extremely low-grade ores where the metal content is contained in the slime. The process is characterized as being extremely simple and the investment is trivial compared with the results obtained. The first mill to use the process will be either the Waldorf or the Burleigh mill in the Georgetown district of Colorado, and judging from the tests, which have been conducted on a commercial scale, it is believed that the vast bodies of low-grade ore in the Silver Plume mines will prove of commercial importance when treated by this new process.

MINERS who have friction with the Forest Service and who are unable to get prompt service through local officials are requested to communicate with Mr. J. F. Callbreath, secretary American Mining Congress, Majestic building, Denver, Colorado. Those living in California may write direct to Mr. B. M. Newcomb, 200 Davis street, San Francisco, who has recently been appointed chairman of a California Forestry committee which is to coöperate with the miners in sifting and presenting points of difference between them and the Forest Service. As we recently intimated, we have had bad luck in eliciting information regarding specific abuses. The Forest Service expresses entire willingness to correct any errors that may have been made by its officials, and with the Mining Congress affording a friendly medium for presentation of his case, no miner having sound reasons for complaining need continue to suffer any injustice. It would seem to be time for complainants to present specific evidences of abuse of power if they have them.

ENGINEERING in connection with the operation as well as the building of a great exposition, is a most important matter. How complex it has become is suggested by a perusal of the 'Rules and Regulations' issued by the Division of Works of the Panama-Pacific International Exposition. It requires a volume of nearly a hundred pages to state the details of the service that will be supplied exhibitors and the terms under which operations must be conducted. It is proposed to furnish electricity for lighting, and on two power circuits, one with direct and the other alternating current. There will also be compressed air, steam, high-pressure water, and domestic water pipes, to say nothing of telephones and means of communication. Careful specifications have been drawn governing all details of building, and ample provision has been made for inspection. Intending exhibitors should apply for this book at once. Meanwhile rapid progress is being made in the erection of the great exhibition palaces being put up by the Exposition company itself.

THE pacific conquest of the Urals by foreign capital is coming to be looked upon with concern by the Russians and fears are expressed by the press of that country that the near future will see the world-famed platinum fields, together with the gold deposits and emerald mines, pass entirely into the hands of the foreigners. The Issovsky platinum mines in the Iss valley, which are the most important producers in the Urals, are controlled by French capital. In the goldfields the production is largely dominated by Belgian capital, and English interests are reported to be negotiating for the famous Berezoff mines and the Miask estate. The mines of the late Baron Brevern are now being operated by English capital. The mining of precious stones, and emeralds in particular, is largely in the hands of the English. That alarm should be felt at foreign control of the mining industry is a most absurd stand, as history is proving every day. In the development of every new country and the expansion of industry in the old to meet the requirements of modern times, capital must be available and in large quantities. If it is not forthcoming from local sources, we fail to see the logic of an objection to the upbuilding of an industry which cannot fail to result in benefits to the locality in which it is founded, regardless of the source of the capital supplied. The mines of the United States, Transvaal, Mexico, South America, New Zealand, Korea, the Philippines, Rhodesia, the Malay states, and others, are living examples of the benefits wrought by foreign investment. If it be true, as often stated, that it takes an ounce of gold to produce an ounce of gold, the investment ounce that goes into the country is at least of equal fineness with the production ounce, that may come out.

Chilean Nitrate

The relation between mining and state is nowhere more pronounced than in Chile, where the nitrate industry has come to be the chief source of revenue for the government. The income from nitrate exportations has reached such proportions that the fear is expressed by many, that the decline of the industry, which cannot last forever, will result in bankruptcy, unless a readjustment of the nation's revenues is effected in the meantime. During the year ended June 30 the production amounted to 59,450,454 quintals (a quintal equals 101.41 lb.), as compared with 59,572,000 quintals for the preceding year. During this period the price of nitrate declined from $2 per quintal to $1.84 on July 1, 1913. As a result an agreement has been reached by the nitrate producers whereby the output will be restricted for a period of six months. By the present agreement 10 per cent of the output controlled by the nitrate interests will be withheld from the market. This restriction will amount to about 2,000,000 quintals or 90,000 tons during the next six months, which will reduce the supply to about that of last year. In

that the Chilean budget has been based upon an unrestricted output of 60,000,000 quintals, any curtailment of output will reflect in a decreased revenue, which it has been intimated might result in a change in the export tax. At the present tax rate the government revenue amounts to about $30,000,000 per year from this source, which is almost 85 per cent of the nation's income. However, with the supply in sight sufficient to meet the present rate of production for a period variously estimated from 35 to 75 years, any immediate curtailment of the nation's revenue is precluded. In the current edition is presented a review of the Chile nitrate industry by Mr. Walter S. Tower, the illustrations for which are reproduced from our issues of January 15 and 29, 1910, in which numbers the nitrate situation was critically summarized by Mr. S. H. Loram. While the exhaustion of the nitrate fields is by no means in sight at the present time, with the impoverishment of agricultural lands in our own country and Europe and the merits of this class of fertilizer being demonstrated, the present rate of consumption will undoubtedly be greatly increased. It is reasonable to suppose that the present supply is far from being inexhaustible, and in addition to presenting a problem in national finance for future Chilean administrations, a new source of supply will have to be developed. Experiments toward this end are at present being conducted.

Desulphurizing Cobalt Ores

Preparation of complex sulphide ores for cyanidation has been one of the difficult problems before metallurgists. The standard method has been that of oxidizing the sulphur by roasting, but this, while effective, is expensive. Another method widely in vogue is by fine grinding to break the ore into such small particles as to permit satisfactory contact of the solution and the mechanically enclosed metals. Development of this 'all-sliming' process has greatly increased extraction, but it is clear that its success is contingent upon the metal being ultimately in free particles. Where it is chemically combined, as is gold and silver in the tellurides, or silver alone in argentite, and a wide range of arsenides and sulphantimonides, grinding alone is not sufficient. Cyanide solution acts upon these minerals but slowly, and there has been insistent demand for some chemical which would operate to accelerate the process.

At Kalgoorlie, and to a smaller degree elsewhere, the tellurides are decomposed by the use of bromocyanide, and at various times attempts have been made to use iodine or other solvents. It is unfortunately true, however, that these methods have not proved widely applicable and they are not always effective as regards sulphide ores.

Cobalt, which has surprised the world by reason of the richness of the silver veins worked, is, because of the complexity as well as value of the ores, becoming a great field for development of new processes of treatment. In our issue of August 9, Mr. Fraser Reid reviewed the present situation as regards milling in the district. The ores include native silver with nickel and cobalt, in the form of arsenides, arsenates, sulphides, sulpharsenides, sulpharsenites, antimonides, sulphantimonides, sulphobismuthites, and alteration products; truly a mixture to give the metallurgist pause. At the Nipissing high-grade mill a successful combination of amalgamation in an excess of mercury and of cyanidation has been developed and 170 tons, some of it containing over 2000 ounces per ton, was treated in August. By reason of the cost, this process is not applicable to low-grade ores. For some time experimental work has been under way at the Nipissing low-grade mill, with a view to discovery of a simple, cheap, and effective method of desulphurizing cobalt ores. We print this week the first account of these experiments and of the process that has been developed and is now in regular commercial operation, 7824 tons having been treated in August. For the same month the total refinery product from the two mills of the Nipissing company amounted to 553,698 ounces of silver.

The account of the new process has been written by Mr. J. J. Denny, metallurgical chemist for the Nipissing Mines Company, and the discoverer. The process will be seen to be interesting from many points of view, and we consider it the most significant advance in cyanidation made this year, just as the combined amalgamation-cyanidation process perfected at the Nipissing high-grade mill, was the sensation of 1912. As to the process itself, Mr. Denny's description is so clear as to need no comment. It has been in the textbooks for years that caustic alkalies reacted to decompose sulphides, though little use has been made of the knowledge. In 1910 a patent was issued to Messrs. Paul W. Avery and Eugene C. Knowles for the use of caustic soda in the presence of a suitable oxidizing agent, to decompose sulphides preparatory to cyanidation. This was based upon work done on the so-called 'blue' or telluride ores of the Black Hills. The supply of the ore proving inadequate, no large mill to utilize the process was built. Mr. Denny uses caustic soda but so as to generate nascent hydrogen, a powerful reducing agent, by the reaction between it and metallic aluminum. It might be thought that the aluminum acts merely as a catalytic body accelerating a normal work of the alkali, but the equations written by Mr. Denny show that instead it enters into the series of reactions, and is slowly consumed. How widely useful the new process may prove is uncertain. In the Nipissing mill it results in an additional saving of one to four ounces of silver at the price of one. This is a satisfactory but not large margin. This may, however, be a factor of the particular ore treated, and elsewhere larger savings may result. Certainly there is little to be gained in the metallurgy of simple ores and any process such as this, that shows improvement in treating complex ores, is in line with what must be the main developments of the future. We congratulate Mr. Denny on his discovery, and we felicitate the Nipissing company. Any concern has little to fear that, in addition to large mines of rich ore, possesses in its regular and consulting staff a body of engineers that in two years perfects the amalgamation-cyanidation process of one mill, and the desulphurizing-cyanidation plan of treatment in another.

Desulphurizing Silver Ores at Cobalt

By James J. Denny

Until about a year ago there was no successful all-cyanidation process for the treatment of Cobalt silver ores, the metal content from the low-grade wall rock being recovered largely by mechanical concentration. These ores were found to be fairly amenable to cyanidation, but the working solution rapidly became foul and lost its dissolving efficiency, and the consumption of cyanide was heavy.

Owing to these difficulties, until the advent of the Nipissing low-grade mill in the latter part of 1912, cyanidation had played a minor part in the silver production of the camp, being employed in three mills, the O'Brien, Dominion Reduction Co., and the Buffalo, and in each case merely as an adjunct to mechanical concentration. In the fall of 1911, therefore, I undertook a series of experiments in connection with the projected Nipissing low-grade mill to test the possibilities of several proposed methods of treatment and to discover, if possible, an all-cyanidation process that would improve on the general practice.

THE NIPISSING LOW-GRADE MILL.

Variations in Results of Experimental Work

After a considerable amount of experimenting I found that my results varied greatly, and to determine the cause I ran separate tests on the principal silver-bearing veins. My experiments showed that while some veins gave excellent results by ordinary cyanidation methods, the tailing from the treatment of other veins was persistently high, owing to the presence of varying amounts of the complex minerals, pyrargyrite, tetrahedrite, proustite, dyscrasite, and argentite. Some of the veins on the Nipissing property contain considerable amounts of these minerals, and my experiments were therefore directed to discover some inexpensive chemical or electrical process for breaking up these refractory compounds and so rendering them amenable to cyanidation. Working along these lines, I finally discovered that all of these minerals excepting dyscrasite were readily decomposed into their respective elements when brought into direct contact with aluminum in an alkaline solution. This preliminary reducing treatment left the silver in a spongy metallic state, and when followed by the usual cyanidation process the results were found to be very satisfactory.

In order to study their behavior in detail, specimens of exceptional purity of each of these minerals were secured, and samples for further experiments were prepared by grinding the minerals with quartz, in a porcelain mortar, to pass a 100-mesh screen. The attempt was made in each case to dilute the silver-bearing mineral so as to give as nearly as possible a sample that would assay 30 oz. silver per ton. The results of three sets of experiments are given below.

In experiment A, ordinary cyanidation is used; experiment B is straight cyanidation with the addition of enough lead acetate to combine with the calculated amount of sulphur in the sample. In experiment C the sample was given a preliminary reducing treatment for ten hours in a 0.25% solution of caustic soda, dilution 2 to 1 in an open-mouth bottle in which were placed three 6 by ½ by 1/32-in. strips of sheet aluminum. The strips

were then removed, the sample filtered and given the ordinary cyanidation treatment without washing or drying.

In each case 100 gm. of sample was taken. The ordinary cyanidation treatment in all the experiments consisted of treating the ore with a 0.25% cyanide solution, dilution 3 to 1, and agitating for 48 hours, lime being added at the rate of 5 lb. per ton. Agitation was effected by rolling in large open-mouth bottles.

(2) Argentite.

$$6H + 3Ag_2S + 6NaOH = 3Na_2S + 6H_2O + 6Ag$$

(3) Pyrargyrite.

$$6H + Ag_3SbS_3 + 6NaOH = 3Na_2S + 6H_2O + 3Ag + Sb$$

(4) Proustite.

$$6H + Ag_3AsS_3 + 6NaOH = 3Na_2S + 6H_2O + 3Ag + As.$$

The reactions being reversible, probably the arsenic and antimony are not completely reduced to the metallic state in practice, and the investigation of the subject is rendered difficult by reason of secondary reactions by which the arsenic and antimony are possibly redissolved to form arsenates and antimonates by the excess caustic of the reducing solution, and the protective alkali of the cyaniding solution. The working solution shows the presence of these compounds, but in practice they are found to have no detrimental effect either in the reducing or the cyaniding treatments. The solution assays, antimony 0.0084% and arsenic 0.026 per cent.

TABLE No. 1

		A. Plain cyanide.			B. Plain cyanide and lead acetate.		C. Desulphurizing and plain cyanide.	
No.	Mineral.	Ag. oz. per ton.	Residue, oz. per ton.	Extraction, per cent.	Residue, oz. per ton.	Extraction, per cent.	Residue, oz. per ton.	Extraction, per cent.
1.	Pyrargyrite	27.40	19.60	28.46	22.40	18.24	3.29	88.70
2.	Proustite	31.4.	15.15	51.90	21.20	32.70	0.59	98.00
3.	Tetrahedrite	29.97	24.21	19.20	28.23	5.80	6.44	78.50
4.	Argentite	26.70	8.20	69.28	0.54	97.97	5.18	80.59
5.	Average	28.89	16.63	42.21	17.87	38.70	3.87	86.45

Discussion of Results

Experiment A, giving results from ordinary cyanidation treatment, requires little comment. All the results are low, and only in the case of argentite does the extraction approach a commercial figure.

Experiment B shows that the addition of lead acetate in every case is a detriment as compared with ordinary cyanidation except with argentite where the extraction is raised to a marked extent. It is interesting to note that similar results were obtained by Theo. P. Holt at the Utah School of Mines in 1909.[1]

Experiment C shows a remarkable increase in extraction as a result of the preliminary reducing treatment in every case except with argentite, where the results are lower than in experiment B. This was owing to the poor contact with aluminum sheets during the preliminary reducing treatment as a result of the tendency of the mineral to float as a black scum. Further experiments where granulated aluminum was substituted for the sheet metal gave 90% extraction as a result of the better contact obtained.

In practice, the system of agitation employed gives a better contact and therefore a better reduction and higher subsequent extraction than the rolling agitation employed in these experiments.

The Reducing Treatment and Probable Reactions Involved

By the preliminary treatment the silver, and in part at least, the antimony and arsenic, are reduced to the metallic state, and are so found. The reduction is accomplished by the nascent hydrogen resulting from the action of caustic soda on the aluminum according to the following equation:

(1) $2Al + 2NaOH + 2H_2O = Na_2Al_2O_4 + 6H.$

The probable reactions involved in complete reduction are indicated by the following equations:

[1]See *Mining and Scientific Press*, April 17, 1909, and 'More Recent Cyanide Practice,' p. 186.

Necessity of Fine Grinding

Further experiments along these lines established the necessity of fine grinding to raise the extraction to the desired point. The results of one series of experiments are given in table No. 2. As the samples used in the previous experiments were used up, new samples had to be prepared. These were ground to pass a 200-mesh screen, 12.4% of this product being a fine –200-mesh sand, and were calculated to have as nearly as possible the same silver content as the former samples. The experiments with the addition of lead acetate were discontinued and the plain cyanide treatment was run against cyaniding after the desulphurizing treatment. The same conditions were maintained as described in experiments given in table No. 1.

TABLE No. 2

		Plain cyanide.			Cyanide after desulphurizing.	
No.	Mineral.	Head assay, oz. Ag.	Residue, oz. per ton.	Extraction.	Residue, oz. per ton.	Extraction, per cent.
1.	Pyrargyrite	24.40	10.75	60.00	1.48	94.60
2.	Proustite	30.90	9.80	68.20	0.22	99.20
3.	Tetrahedrite	28.40	12.47	56.10	2.95	89.60
4.	Argentite	27.04	4.74	82.40	2.14	92.10
	Average	27.68	9.44	66.67	1.69	93.87

My experiments also established the fact that

the degree of fineness required varies with the amount of antimony present. Some results from plain cyaniding that show this clearly are given in table No. 3. The method of preparing the samples and the conditions of the experiments were the same as before.

TABLE No. 3

		Crushed through a 100-mesh screen.			Crushed through a 200-mesh screen.		
No.	Mineral.	Head assay, oz. per ton	Residue, oz. per ton	Extraction, per cent.	Sb, per cent	Residue, oz. per ton	Extraction, per cent.
1.	Dyscrasite	28.40	14.20	50.00	17.64	5.40	80.98
2.	Impure silver	27.60	4.90	82.24	9.64	1.49	94.60
3.	Impure silver	31.49	1.40	95.50	5.15	0.76	97.50
4.	Clean silver	31.49	0.28	99.10	0.63	....	....

Commercial Tests

I then undertook a large number of tests on a commercial scale, using ordinary run-of-mine ore to determine the following points: (a) the effect of the reducing treatment; (b) the time of treatment; (c) the degree of comminution required to give the best economic results.

In table No. 4 are given the results of two series of experiments, showing the effect of the reducing treatment as against plain cyaniding, and giving the results of different times of treatment. In these tests 50-lb. charges were used, and desulphurizing was effected by agitating for ten hours by mechanical means in a small tank, 24 by 18 in., with paddles to which were tacked 4 by 8-in. sheets of aluminum. When not otherwise stated, the conditions maintained were the same as in previous experiments. The samples used in these experiments were ground in a pebble-mill to pass a 200-mesh screen.

Table No. 5, giving the results from plain cyaniding on sized material, shows this clearly. For these experiments, two 50-lb. samples of mine ore were crushed, one to pass through a 150 and the other a 200-mesh screen, after which they were treated for 48 hr. in a 0.25% cyanide solution (dilution 3:1) with the addition of 15 lb. of lime per ton of ore.

TABLE No. 5

J Through 150 mesh. Sand + 200 mesh, 0.84% Sand — 200 mesh, 42.44%			K Through 200 mesh. Sand — 200 mesh, 16.36%		
Head assay, oz. per ton	Residue oz. per ton	Extraction, per cent.	Head assay, oz. per ton	Residue oz. per ton	Extraction, per cent.
25.6	3.6	87.4	25.6	2.48	91.3

The same fact was established by means of detailed screen analysis of mine ore, the results of which are not included here.

Aluminum Precipitation

The circumstances that led to the adoption of aluminum precipitation in connection with this process together with the results of some of my experiments, have already been published by R. M. Hamilton,[2] but a few further remarks at this point may be of interest.

In my preliminary experiments, zinc was used for precipitation and for a time all was well, but at the conclusion of a series of experiments on ore that contained considerable amounts of the complex minerals, I was surprised to find my working solution badly fouled and proceeded at once to investigate the cause. The deterioration of the working solution has usually been attributed to the

TABLE No 4

Head assay, oz. per ton	Residue after 24 hours...	Extraction, per cent...	Residue after 48 hours...	Extraction, per cent...	Residue after 72 hours...	Extraction, per cent...	Residue after 96 hours...	Extraction, per cent...	Residue after 120 hours...	Extraction, per cent...
H—Plain cyanide treatment. Cyanide strength, 0.25%; dilution, 3:1. Lime, 5 lb. per ton of ore.										
26.13	5.8	77.80	3.76	85.61	2.76	89.43	2.6	90.04	2.3	91.19
25.45	6.2	75.65	4.90	80.74	3.80	85.06	3.6	85.85	3.1	87.81
I—Desulphurized before cyanide treatment. Cyanide strength, 0.25%; dilution, 3:1. Lime, 5 lb. per ton of ore.										
26.13	2.8	89.28	1.64	93.70	1.58	93.95				
25.45	3.0	88.21	2.22	91.22	1.70	93.3				

These results show clearly that on the run-of-mine ore the desulphurizing treatment raises the extraction appreciably and greatly reduces time. These and similar experiments establish the efficacy of the desulphurizing process and point to 48 hours as the most economic time of treatment.

Degree of Comminution

It was early apparent in this preliminary investigation that extremely fine grinding was absolutely essential to give a high extraction in the desired time (48 hours), and this fact has been substantiated by many later experiments.

complex silver minerals, and one writer explains the action as due to the formation of soluble sulphides, sulphocyanides, and ferrocyanides. My investigations showed that not only were these compounds formed to some extent, but, which is more important, proved the presence in small amounts of soluble arsenites, thio-arsenites, antimonites, and thio-antimonites. These compounds are strongly reducing and are oxidized to arsenates, antimonates by the dissolved oxygen of the solution, the action being accompanied by the decomposition of cyanide.

[2] *Eng. & Min. Jour.*, May 10, 1913.

The complex minerals were clearly not to blame, as those had already been reduced to their respective elements by the preliminary desulphurizing treatment, and, while the formation of the above-named compounds accounts, in part at least, for the heavy consumption of cyanide, they are not present in amounts large enough to seriously affect the efficiency of the working solution. In any case, the oxidation of these compounds by aeration and the use of oxidizers would restore the solution to normal efficiency if they were the cause of its deterioration, but these were found to be without effect. The cause of the trouble then was evidently to be found elsewhere.

I then started a new series of experiments with a fresh solution and followed the action closely, testing the solution after each step in the process. The results proved favorable in every case until the solution passed over the zinc-box, after which it was found that its dissolving efficiency was greatly impaired. The cause of the trouble was therefore shown to be the use of zinc as a precipitant, and further experiments, given in the article already referred to, proved this conclusively.

Fatigue of Solution

In what form the zinc exists in the solution, and why, in conjunction with arsenic and antimony, its deteriorating effect on the dissolving power of the solution should be so marked is not apparent.

It was found that while the addition of oxidizers to the solution had no effect, after allowing it to stand for eight days the solution recovered its original dissolving power. No explanation of this peculiar phenomenon has suggested itself, and as by this time it had been proved that the use of aluminum dust instead of zinc as a precipitant would solve the whole difficulty, investigation of this very interesting subject was dropped for lack of time to continue it further.

The method of treatment as outlined above was immediately put into practice at the Nipissing low-grade mill on the recommendation of Charles Butters, the consulting engineer. As this is the first and as yet the only commercial application of the desulphurizing process, a brief description of the practice followed here will be of interest.

Nipissing Low-Grade Mill

The Nipissing low-grade mill is at Cobalt, Canada. The high-grade ores of this property have been treated for the last three years in the high-grade mill by an amalgamation and cyanidation process yielding the silver content directly as bullion.[3]

The object of the new low-grade mill was to treat the low-grade wall rock by cyanidation and likewise recover the silver in the form of fine bullion. The mill was designed and constructed by James Johnston of the Butters Engineering Co., and owes much of its success and smoothness of operation to his experience and foresight. Operations on a small scale were commenced on November 16, 1912, and after a short period of minor adjustment started at full capacity. Up to the present it has continued to run with gratifying success.

Nature and Analysis of Ore

The rock is mainly the Cobalt series of conglomerate and is very hard and tough. The following is an analysis of the average run of mine ore:

	Per cent.		Per cent.
Ag	0.106	Pb	0.064
Cu	0.270	CaO	9.020
As	1.880	MgO	4.330
Fe	1.920	Al_2O_3	10.030
S	0.640	CO_2	11.060
Bi	0.010	Insolubles	59.840
Ni, Co	0.730	Hg	Trace

Washing Plant

The washing plant, where the ore is crushed in breakers and given a preliminary jigging treatment, is not a part of the mill proper, as the concentrate from this section is credited to the mine. The ore from the mine averages about 60 oz. per ton, and the tailing from the washing plant as sent to the mill proper averages about 28 oz. per ton.

Stamping and Fine Grinding

In the mill proper, the ore is crushed by stamps in a 0.25% solution of caustic soda, lime being added to the extent of 5 lb. per ton of ore. The lime is used merely for settling, to facilitate subsequent decantation of clear solution back to the battery storage tank, the alkalinity for cyanidation treatment being furnished by the caustic solution. The fine grinding is effected by a closed system of tube-mills and classifiers, two of the tube-mills being used to regrind the battery discharge, and the other two for the ultimate fine grinding. Of the final product, only 0.5% remains on a 200-mesh screen, 16 to 20% is a fine –200-mesh sand, and the remainder an impalpable slime. After settling and decanting the solution, the thickened slime passes on to the reducing treatment.

Desulphurizing Process

The pulp is given a preliminary desulphurizing treatment by being passed through a tube-mill which is charged with aluminum ingots. The final treatment is given by lining the filter stock tank with aluminum plates and agitating for about ten hours by mechanical means. From the stock tank the pulp is drawn off by the filters as required. After filtering, the cake carries 26% alkali solution as moisture, and is thence discharged without washing to the cyanide tanks.

Cyanide Treatment

The cyanide treatment consists of agitating the pulp for 48 hr. in a 0.25% cyanide solution, dilution 2.5:1. The pulp is then settled, the excess solution decanted, and after being again agitated the pulp is pumped to the stock tank for filtering.

Precipitation and Treatment of Precipitate

As already mentioned, the pregnant solution is precipitated with aluminum dust. The details of the mill practice, together with a statement of costs, are included in the article by E. M. Hamilton. The

[3]For a description of this mill, see T. A. Rickard, *Min. Mag.*, June 1912; R. B. Watson, *Eng. & Min. Jour.*, December 7, 1912.

precipitate is then sent to the refinery of the high-grade mill, where it is melted in a reverberatory and refined, the bullion averaging 999 fine.

Early Difficulties

When the process was first put into operation, the mechanically agitated stock tanks were depended on for the desulphurizing treatment. Here the aluminum plates were soon found to form a coating which was thought to be a calcium aluminate, and the reducing action was seriously retarded. To overcome this difficulty, the tube-mill charged with aluminum ingots was added. This kept the aluminum clean and bright, but the aluminum consumption was increased as a result of the wear on the ingots. Lately, however, the trouble has been found to be due to impure aluminum containing iron and silica; sheets of pure aluminum are found to remain clean and to have no tendency to form a coating.

Comments on Practice

Crushing a neutral ore in an alkaline solution is unusual, though not unknown, in cyanidation, and the 26% of the alkali solution passing over with the cake to the cyanidation tanks will be criticized as being contrary to general practice. However, instead of being detrimental as is ordinarily maintained, in this particular case, namely, with Cobalt ores where the native silver is associated with antimony, the addition of alkali to the cyaniding solution has proved to be a decided benefit. Daily tests, running the working mill solution against fresh cyanide solution, show in every case an increased solvent power of from 0.2 to 0.5 oz. of silver per ton of ore in favor of the mill solution. In this connection, the behavior of the mineral dyscrasite is interesting. As mentioned at the beginning of this article, the reducing treatment has no effect on this mineral, probably due to the fact that it is a complex of variable composition of the metals, silver and antimony, and does not contain sulphur. However, the results from treating this mineral by plain cyaniding, compared with the results of similar treatment, after the preliminary reducing treatment, show a decided advantage in favor of the latter, owing to the beneficial action of the caustic soda solution during cyanide treatment. A further advantage of the caustic in the cyanide solution is the fact that it is necessary to precipitation with aluminum dust and saves the addition of caustic at that point.

Summary

The outstanding essential principles of the practice followed at the Nipissing low-grade mill are, therefore: (1) the extremely fine grinding; (2) the preliminary reducing treatment before cyanidation; (3) the use of aluminum-dust precipitation. In July the mill treated 234 tons per day of 27-oz. ore, and below the stamps made an extraction of 93.16% actually recovered in bullion.

Costs

As the mill has been running less than a year, the compiling of representative figures showing costs is a matter of difficulty. In connection with the desulphurizing treatment, treating 7268 tons per month, the following data are available:

Collecting, Desulphurizing, and Transferring of Pulp

	Per ton.
Labor	$0.050
Supplies (aluminum, 0.81 lb.; caustic soda, 1.46 lb.; lime, 5 lb.)	0.347
Power	0.027
Workshop	0.008
Total	$0.432

Alkali Solution, Filtering and Transferring

	Per ton.
Labor	$0.069
Supplies	0.006
Power	0.028
Workshop	0.002
Total	$0.105

The desulphurizing treatment effects a saving of from one to four ounces per ton, depending on the amount of refractory minerals present, at a total cost of 54c. per ton.

Application to Gold Cyaniding

A promising field for investigation is the possible application of this desulphurizing process to the cyanidation of refractory gold ores. A sample of sylvanite was found to reduce readily to metallic gold and tellurium, but lack of time and the difficulty of obtaining a pure sample of the gold telluride for experiments, have prevented further investigation on these lines. However, I have every confidence that the desulphurizing process will prove to be a valuable adjunct to the treatment of these ores by cyanidtion.

In conclusion, I wish to acknowledge with gratitude the interest taken by R. B. Watson, general manager, in my preliminary investigations and encouragement afforded by him during the development of the process as established above.

Flooding Culebra Cut

All steam-shovel operations in Culebra cut proper in the Panama canal were discontinued on September 15, and between that date and October 5, when water will be admitted, all equipment and other material to be recovered, including more than 36 miles of track, must be out of the 9-mile channel between Gamboa dike and Pedro Miguel locks. It is the intention to retain 10 of the best conditioned shovels in service, using them in the work of removing material from the east and west banks, near Culebra, to lessen the danger from slides. About six of these machines will be employed on the east bank, and four on the west bank, probably until May 1914, and an organization sufficient to man and look after the shovels is now under consideration. Water will be admitted to Culebra cut, under the above schedule, on Sunday, October 5, five days in advance of the date set for the destruction of Gamboa dike. The means employed will consist of four 26-in. pipes extending underneath the dike, now used in pumping the drainage water out of the canal.

Origin of Lead, Zinc, and Silver in the Cœur d'Alene—I

By Oscar H. Hershey

Originally the lead, zinc, and silver, whose sulphides now constitute the commercial ores of the Coeur d'Alene district of Idaho, were widely diffused in the igneous rocks of the earth. Unless one seriously entertains the hypothesis that important quantities of these metals have been brought to the earth in the course of ages by meteorites and cosmic dust, it must be conceded that practically all of them were present in the crystalline rocks before the presumed beginning of erosion and sedimentation on the earth's surface. That minute quantities of these metals are widely disseminated in igneous rocks today has been demonstrated by the careful work of the chemists. F. W. Clark[1] has gathered much of the evidence. He mentions that G. Forchhammer found traces of silver, lead, and zinc, with other metals, in a series of rock samples; and it is well known that F. Sandberger, in an elaborate series of researches, found that lead and silver are contained, with other metals, in the dark silicates of many rocks. Lead was detected by G. F. Becker in the fresh granites near Steamboat Springs, Nevada, and W. F. Hillebrand found it in the porphyries of Leadville, Colorado. Silver, and in one sample zinc, were also found. J. D. Robertson determined an average content of 0.004% lead and 0.009% zinc in granite, porphyry, and diabase from the Archean deposits of Missouri. L. Dieulafait claims that zinc may always be detected in rocks. In a large series of igneous and metamorphic rocks from British Guiana, J. B. Harrison found lead in 5 out of 23 samples tested for it, and 8 rocks yielded silver. Traces of silver in diabase and diorite near Washoe, Nevada, have been reported by G. F. Becker; in the quartz porphyry of Eureka by J. S. Curtis; in the eruptive rocks of Custer county, Colorado, by S. F. Emmons; in volcanic ash from two points in the Andes by J. W. Mallett; and it is known in ash from Cotopaxi and Tunguragua.[2] Mr. Clark concludes that "the heavy metals are widely disseminated, both in old and in recent igneous rocks, from which, by proper methods, they can be concentrated." A similar opinion is expressed by C. R. Van Hise,[3] who says: "As to the original source of the sulphides, it is well known that sulphide of iron occurs as an original constituent of igneous rocks. Probably the same is true of other sulphides, but as their quantity is very much less they have been little noticed."

Presence of Metal in the Archean Rocks

For the purpose of this discussion, it is only necessary to go back to the era of the known Archean rocks. As these rocks included a great amount of igneous material, it may be presumed that lead, zinc, and silver salts were present in a diffused form in large masses of them. In distribution, the salts of the metals probably did not approach uniformity, considerable areas being perhaps nearly free from them, while in others they may have been present in amounts comparable with those found in the Archean rocks of Missouri.

Influence of Weathering

Weathering and erosion cut deep into these ancient rocks and swept their disintegrated particles into bodies of water to form the Algonkian sedimentary rocks. The breaking down of immense bodies of lead, zinc, and silver-bearing rocks must have freed the sulphides of these metals, and, in an oxidized condition, they were necessarily carried into the permanent bodies of water, chiefly the sea. They may have traveled in solution or as exceedingly finely divided particles of sediment. It matters not which view one entertains, there seems no escape from the conclusion that, if these metals are and always have been diffused widely in igneous rocks, considerable quantities of them were present in the water-basins of the Algonkian period. The same argument applies to all subsequent time. If these salts were carried as sediment and did not go into solution, they must have settled with the other sediments and become a portion of the stratified rocks. If carried in solution and never precipitated, they have been accumulating in the ocean for many millions of years. Minute quantities of lead and zinc are known to be present in sea water, but there is no very definite evidence as to the amount. The presence of silver (with gold) is better known, and, according to A. Liversidge,[4] it amounts to 1 to 2 grains per ton. It may be that the quantity of gold and silver is not such as to necessarily imply precipitation from sea water since the Archean era, but it is my impression that in the case of lead and zinc this could hardly be true. At any rate, it is reasonable to suppose that lead and zinc followed the same course as iron, manganese, and copper.

Occurrence of Coeur d'Alene Deposits

The ore deposits of the Coeur d'Alene district occur in the Belt series of altered sediments of pre-Cambrian age. The petrography of these rocks has been thoroughly studied by F. C. Calkins,[5] who has subdivided them into the Prichard formation, composed in greater part of argillite, overlain in order by the Burke quartzites and silicious shales, the Revett quartzite, the St. Regis indurated shales and sandstones, the Wallace calcareous shales, sandstones, impure limestones, and argillites, and the

[1] 'The Data of Geochemistry,' Second Edition, by F. W. Clark, Bull 491, U. S. Geol. Surv., 1911, pp. 600-602.

[2] For references, see Clark, *Op. cit.*

[3] 'A Treatise on Metamorphism,' by C. R. Van Hise, Monograph XLVII, U. S. Geol. Surv., 1904, p. 1105.

[4] *Proc.* Roy. Soc. New South Wales, Vol. 29, 1895, pp. 335, 350.

[5] 'The Geology and Ore Deposits of the Coeur d'Alene District, Idaho,' by F. L. Ransome and F. C. Calkins, Prof. Paper 62, U. S. Geol. Surv., 1908.

Striped Peak sandstones; the whole having a presumed thickness of over 17,200 ft., of which over 8000 ft. is accredited to the Prichard. My section of that portion of the series which is present in the vicinity of Wardner comprises a thickness of 19,800 ft.[6] The microscopic features of these rocks are very well treated by Mr. Calkins. He shows that they consist chiefly of variable proportions of only two minerals, quartz and sericite. There are beds of practically pure quartzites over 100 ft. thick, but usually the quartz grains are separated by flakes of sericite. In the shales and slates there is a relatively large amount of sericite, and all the grains are very fine and tend to be developed in alternate layers of different fineness. It is evident that these sediments originally varied from practically pure quartz sand to fine mud. Whether they were laid down under marine, lacustrine, or continental conditions is of no importance in this connection, for in any case they are clearly the fine débris from a great land area of Archean rocks, and if lead and zinc are as widely distributed in igneous rocks as they appear to be, salts of these metals must have been present in the water in which the Belt sediments were deposited, and it is entirely reasonable to suppose that to some extent they became incorporated with the sediments. I would expect them to be deposited with the fine mud rather than with the clean sand. If these minerals came into the waterbody as sediments, they were doubtless in an exceedingly finely divided condition, and in the sorting of the materials by wave and current action, would go into the mud instead of the coarser quartz sand, just as in the concentrating mills the sulphides of lead and zinc go proportionately more into the slime than into the sand. If the lead and zinc salts were in solution in the waterbody, it would seem that conditions for their precipitation would be much more favorable on the mud-flats than on the clean quartz sandbars.

The Quartzite Rocks

In the relatively pure quartzites and ordinary sericitic quartzites, nearly all the material is transparent in thin section. Carbonate of iron is widely disseminated in these rocks, and minute quantities of lead and zinc in the form of carbonates might occur with the siderite and not be apparent under the microscope. However, the distribution of the ore deposits leads me to the conclusion that this is not the form in which lead and zinc may be diffused in the rocks of the district. The St. Regis, and in places the Burke, contains purple bands in which the coloring matter, as shown by Mr. Calkins, is hematite dust. Without doubt the iron was an original constituent of the sediments, though not necessarily as hematite. It may have been precipitated as limonite, from iron carbonate, and converted into hematite during the regional metamorphism of the rocks. The same conditions which precipitated the iron might have precipitated lead and zinc salts. However, the ore deposits cannot be traced to the purple Burke and St. Regis as a source. The frequent association of lead and zinc ores with limestones might point to the calcareous Wallace formation as the horizon of the presumed diffused mineralization, but to this I have the same objection as above, namely, that the distribution of the ore deposits emphatically precludes the Wallace calcareous shales, limestones, and even the carbonaceous argillites from serious consideration in this connection. The one formation in the Coeur d'Alene district which does not seem open to any of the above objections is the Prichard argillite. This contains opaque dust, doubtless chiefly carbon. The formation is also characterized by the presence of considerable pyrite, which, in its present form, is secondary to the regional metamorphism, but in some form was probably originally present in the sediments. Mr. Calkins mentions also as accessory minerals rutile, zircon, tourmaline, siderite, magnetite, biotite, chlorite, and a very small amount of calcite. The two minerals which may be presumed to have been originally present in the Prichard mud and to have been capable of influencing the deposition of lead and zinc sulphides, are carbon and iron sulphides.

Metal Occurrence

There is no very definite evidence of as wide diffusion of lead and zinc in the sedimentary as in the igneous rocks. F. W. Clark mentions, in the volume before cited, that L. Dieulafait detected zinc in hundreds of samples of Jurassic limestone from central France; that J. B. Weems found by analysis of nine samples an average of 0.00326% lead and 0.00029% zinc in limestones and dolomites of the Dubuque region, Iowa; that J. D. Robertson found in the Silurian limestones of Missouri lead up to 0.00346% and zinc up to 0.1536%; and that A. M. Finlayson secured similar results in his study of the British lead and zinc deposits. It is recognized that in all these cases at least some of the diffused mineral may have been introduced in connection with the formation of the commercial ore deposits. H. F. Bain[7] argues that in the Wisconsin district the commercial ores have been concentrated from diffused mineralization that was deposited with the sediments, because of the known absence of igneous rocks of as late date as the sedimentary beds, of the absence of deep extending faults, of the presence under the area of unbroken sheets of artesian water in sedimentary beds, and of the sufficient evidence of the origin of the ores by this agency. G. H. Cox[8] holds that "the Maquoketa shale contains lead and zinc compounds as original minerals." E. R. Buckley[9] thought that the ore deposits which are found in the Mississippian limestone in Missouri were concentrated from diffused deposits in the Pennsylvanian shale, limestone, and coal. C. R. Van Hise[10] expressed the opinion that the lead and zinc sulphides of the Mississippi Val-

[6] 'Genesis of Lead-Silver Ores in Wardner District, Idaho,' by O. H. Hershey, *Mining and Scientific Press*, June 1, 8, 15, 1912.

[7] 'Types of Ore Deposits,' 1911, p. 100.

[8] Illinois State Geol. Surv., Bull. 16, pp. 36-39, 1910.

[9] 'Types of Ore Deposits,' p. 127, 1911.

[10] 'A Treatise on Metamorphism,' p. 1105.

ley "are segregated from sulphides in limestones. These sulphides were derived from the sulphides of earlier rocks which were probably transformed to sulphates, transported to the sea, and in the sea, as shown by T. C. Chamberlin, precipitated as sulphides at the same time the limestone was formed."

Carbon as a Precipitant

As to the precipitant in the segregation of the diffused minerals, he says: "Another clear case of the direct reduction of oxidized salts by organic matter is that of the lead and zinc deposits of the Mississippi Valley. In Wisconsin, as shown by W. P. Blake, lead and zinc were precipitated by the organic matter of the oil rock, and in Missouri, as shown by H. F. Bain, by the organic matter of the Devonian shales." Thus there is precedent for the suggestion that in the Idaho region lead and zinc sulphides may have been precipitated from the Prichard waterbody either by the direct action of the carbon in the mud or by the carbon precipitating iron sulphides and the latter being partly replaced by lead and zinc sulphides. It is possible that these metals are much more irregularly distributed in the sedimentary than in the igneous rocks as they were only precipitated when and where conditions were unusually favorable. In this connection it must be noted that they are more likely to occur in the older than in the younger sedimentary rocks because the former were more directly and extensively derived by the erosion of igneous rocks. The Belt and the early Cambrian sediments were especially favored in this regard, but even in the Idaho region, conditions favorable to the formation of diffused deposits may have been limited to a very small part of Algonkian time and to a relatively small portion of the Belt waterbody.

Since early Tertiary time some millions of tons of lead and zinc have been eroded from the Coeur d'Alene district. Rather elaborate tests made in connection with some débris litigation have shown that exceedingly small quantities of lead have remained in the alluvium of the Coeur d'Alene river, and that there is practically no lead in solution in the river water, that is, scarcely any detectible by ordinary means. There is underground evidence that very little of the lead and zinc have gone to form new deposits in the district; it is, therefore, incontrovertible that the Coeur d'Alene river has carried millions of tons of these metals out of the district. Some of them may have found a temporary resting place on the bottom of Coeur d'Alene lake, but all must ultimately reach the Pacific ocean, where they may be precipitated as diffused deposits in the sediments. If, instead of being derived from a small number of highly concentrated deposits, the minerals came from the disintegration of many cubic miles of lead and zinc-bearing igneous rock, the result so far as the lead and zinc content of the marine sediment is concerned, might be the same.

Genesis of Lead-Zinc-Silver Deposits

Two principal working hypotheses as to the genesis of the lead-zinc-silver ore deposits of the Coeur d'Alene district are before the public. One is a modification of what would be termed by H. F. Bain the sedigenetic hypothesis, and the other is the magmatic hypothesis. Both refer the ultimate source of the metals to igneous rocks. The former implies that the lead, zinc, and associated silver minerals became diffused in certain bands of the Belt sediments, by the process described in the preceding pages, and subsequently concentrated into the present commercial ore deposits as suggested in my paper on the Wardner district.[11] The latter hypothesis implies that these minerals remained below the Belt rocks until a comparatively late period when they were expelled from the deep-seated portions of a magma, which crystallized into quartz monzonite and related rocks, and were deposited in the Belt rocks. F. L. Ransome is the chief exponent of this magmatic theory.[12] Others have supported it in oral communications. Another geologist has advanced the theory that the ore deposits were derived by downward leaching from diffused minerals either in a basalt cover, long since removed from the Coeur d'Alene, or in the higher portions of the Belt rocks themselves. As this hypothesis has not been formulated publicly, and as it is so strongly opposed by evidences that the mineral-bearing solutions have moved upward instead of downward, I will not discuss it further.

Prichard Type of Lead-Zinc Deposits

The Prichard areas in the Coeur d'Alene district are characterized by what may be called the Prichard type of lead-zinc ore deposits. In this type, zinc sulphide, presumably sphalerite, is abundant, and the silver ratio is very low. The blende varies from a pale yellowish gray to a dark-brown color. In some veins there is a rather intimate mixture of the blende and galena, but usually they are fairly well separated. In one mine in the valley of the north fork of the Coeur d'Alene river which I have visited, the zincblende is often in masses 1 to 3 ft. thick and 6 ft. long. Elsewhere in this mine, blende and galena with some quartz and calcite are intergrown. In other places the galena tends to follow seams and may be later than the blende. There are small quantities of chalcopyrite and pyrite, but no siderite. There are said to be 8 to 10 oz. silver per ton to 70% lead in the lead shipments, and practically no silver in the zinc shipments. A specimen of blende assayed 61.5% zinc, 4.3% iron, and no silver. At the Surprise mine in the valley of the east fork of Pine creek, lead concentrate carries about 58% lead and 16 oz. silver per ton, and the zinc concentrate about 44% zinc and 3 oz. silver per ton. Mr. Ransome states that at the Bear Top mine the ore consists of galena, associated with sphalerite, pyrite, chalcopyrite, and calcite, and that a carload sorted and shipped in 1904 carried 6 oz. silver per ton and 72% lead. I do not have similar specific information about any other mine in the Prichard areas, but I am frequently told, as objections to certain prospects in the Prichard formation, that the ore is very zincy and the silver ratio low. There are a few quartz-

[11] *Mining and Scientific Press*, June 1, 8, 15, 1912.

[12] Professional Paper 62, U. S. Geol. Surv., 1908.

galena veins free from blende in the Prichard rocks, but far the larger number are of the zinc-bearing type. In fact, until recently, practically all of the zinc production of the Coeur d'Alene district has come from mines in the Prichard formation. There are, in the Pine Creek group, veins in which the ore is almost exclusively blende, galena only occurring in isolated small shoots. It is probable that in time there will be a considerable zinc production from a number of small mines in the Prichard areas.

Relation of Ores to Small Fractures

The ores under discussion are invariably connected with small fissures in the Prichard rocks. The ore-shoots frequently are confined to the places where the fissures cut across quartzite bands. The reason for this is the purely mechanical one that the quartzite fractured better than the slates and gave rise to less gouge, as pointed out by Mr. Ransome. As fissures, they do not materially differ from the fractures with which the ores in higher formations are connected, but in mineralogical composition the Prichard veins contrast rather strongly with the veins in the Burke and Revett formations. Only one mine in the latter makes a zinc product, the Morning mine near Mullan. I am not familiar with this mine, but Mr. Ransome describes the ore as containing galena, sphalerite, pyrite, and a little pyrrhotite in a gangue of siderite, barite, and quartz. The galena is fine grained, much of it of a steel-like texture. The silver ratio is 3 to 4 oz. to 7 to 9% lead. This deposit, therefore, is not of the Prichard type. The nearest approach, mineralogically, that I have found in rocks higher than the Prichard is certain disseminated zinc-lead mineralization in Revett quartzite in the Wardner district, in which the zinc is generally several times as abundant as the lead, and the silver ratio is very low. The mode of occurrence, however, is quite different from the Prichard type. It is beyond question that this type is strictly confined to the Prichard formation. In this formation it is widely distributed, not in one continuous area, but in separate areas on opposite sides of the great mining districts whose ores are found in the Burke and Revett quartzites. There is an important group east of Murray,[13] another west of Sunset Peak, and a third in the Pine Creek basin. The type is also represented in the extensive Prichard area on both sides of the south fork of the Coeur d'Alene river near Kellogg and in Moon Creek basin. It is, furthermore, widely distributed in Prichard areas beyond the Coeur d'Alene district, in northern Idaho and western Montana nearly to British Columbia.

Mines and Prospects

There are comparatively few producing mines, but small prospects are numerous. In the Burke and Revett quartzites, the ores are in larger deposits connected with a much smaller number of fissures. There are, in the Coeur d'Alene district, no mines and relatively few prospects in the St. Regis formation. In the Wallace there is one mine, the Gold Hunter, near Mullan, but extensive areas of the formation are without traces of lead or zinc prospects. In this respect, the Wallace contrasts strongly with the Prichard, although both formations contain argillites. There is nothing in the structure to explain this contrast. It leads me to the conviction that the Prichard is much nearer, stratigraphically, to the source of the minerals than is the Wallace. The many small deposits in the Prichard suggest that they constitute the roots of the vein system, that they combine upward into fewer and larger veins in the Burke and Revett quartzites, and that few of these veins survived as high as the Wallace formation. This is purely figurative, but conveys the idea that the Prichard has been the source of the lead, zinc, and silver in the entire vein system.

The Prichard type of mineralization is not controlled by altitude. It ranges from less than 2300 ft. near Kellogg to about 3500 ft. at the Surprise mine, 4400 ft. at the Monarch mine, 4900 ft. at the Terrible Edith mine, and 5100 ft. at the Bear Top mine. Other types of ore mineralization in the district are known to range from about 1600 ft. in the Bunker Hill & Sullivan mine to 5250 ft. at the Standard-Mammoth mine, 5750 ft. at the Morning mine, and over 6000 ft. at the Hercules mine.

Types of Mineralization

In my Wardner paper, already cited, I have described 75 faults distributed among nine systems and have discriminated 12 'types' of mineralization. I do not recognize any important mineralization as connected with the first, third, fifth, and sixth systems. I find first a disseminated siderite of an early but rather indefinite age. After that I place some deposits that may be of a contact metamorphic character. The first zinc-lead mineralization is a dissemination in quartzite and is considered older than the second fault system. It reaches an altitude of 4000 ft., but has not been much explored underground. The Sullivan disseminated pyrite and Phil Sheridan siderite and pyrite are connected with the second system of faults. The Blue Bird, Buckeye, and Ontario types represent a single stage of ore deposition connected with the fourth fault system. The Jersey type is connected with the seventh system. The Alhambra and Bunker Hill types represent a third important stage of ore deposition due to the eighth fault system. Finally I connect the Jackass type with the ninth system. I have recently learned that there is, locally associated with another of the great faults of the ninth system, an ore consisting of quartz, galena, sphalerite, pyrite, and calcite. The presence of considerable calcite and the tendency to develop much pyromorphite in the zone of oxidation, set this deposit apart, mineralogically, from all others in the Wardner district, though there are some features about it that lead me to place it tentatively in the Jackass type. These various types are clearly distributed without any reference to altitude, and as they all occur in quartzites, they show little change due to rock formation. Their differences are mainly due to their having been deposited at different periods

[13]See map accompanying Prof. Paper 62, U. S. Geol. Survey.

of time when conditions of heat, pressure, and source of material differed. The point I am trying to make is that in the Coeur d'Alene district, a range of altitude of 3000 or 4000 ft. has scarcely any noticeable effect on the character of the deposits except such as may be traced to the influence of different formations. The Prichard type owes its characteristics solely to its environment.

Distribution of Zinc-Lead Deposits

There is a very unequal distribution of zinc-lead deposits in the Prichard formation. Practically all the mines and the vast majority of prospects occur in the upper portion of the formation. The deposits that may be said to have some promise are generally distributed near the borders of the large Prichard areas, though the zone of prospects extends farther in, while the central portions of the areas are notably barren. It appears in the Coeur d'Alene district that these deeper portions of the formation are characterized by gold and copper prospects rather than lead and zinc. I refer particularly to the Murray region and to the Elk Creek district near Kellogg. It may, however, be a fact with no genetic significance. But if one spends much time examining prospects and mines in northern Idaho and western Montana, the conviction will grow in his mind that if he finds in Prichard areas a deposit of any promise, it is almost certain to be in the upper 1000 ft. of the formation. This leads me to think that the minerals, if diffused in the Prichard, were largely confined to the upper portion of the formation.

Relations of the Deposits to Faults

The question will be asked why the known ore deposits are absent from large areas of the Coeur d'Alene and neighboring regions, if derived from diffused mineralization in the sediments. My reply to this is that in the large areas free from prospects, the strata almost invariably will be found at low angles of dip. The mineral belt of the Coeur d'Alene is a comparatively narrow zone that has been excessively faulted. The same formations in broad belts to the north and south lie at similar altitudes, but relatively undisturbed attitudes. Take the United States Geological Survey map of the district and note the dips near the mines, as follows: Bear Top, 75 to 90°; Paragon, 75°; Monarch, 60°; Tiger-Poorman, 65°; Standard-Mammoth, 72°; Helena-Frisco, 80°; Black Bear, 80°; Morning, 75°; and Gold Hunter, 80°. At the Terrible Edith, the strata dip 45°, near the Surprise about 55°, at the California mine 50°, and at the Granite mine 55°. There appear to be some exceptions, such as the Hercules, Sunset, and Sixteen-to-One mines, where the strata are relatively flat. In the Wardner district most of the orebodies are associated with faults that dip southerly and with a system of cross-fissures. I have noted that the latter are practically confined to those blocks in which the Prichard slate lies deep, in other words, in those blocks in which the strata dip southerly at angles which enable the Revett or Burke quartzites to penetrate deep within the block. The other ore deposits bear a similar relation to the structure. In blocks whose strata dip north there are scarcely any commercial deposits. I interpret these facts as meaning that if the minerals were disseminated in the Prichard formation, in order that they should be sufficiently concentrated to make commercial orebodies or even merely prospects that might attract attention, it was necessary that the rock be tilted at a considerable angle so that ascending solutions would be in contact with the diffused mineral for a considerable depth; in other words, it was necessary to leach a large mass of rock to make an orebody. The northwestern quarter of the Coeur d'Alene district as mapped is practically free from lead and zinc prospects, because the strata, although considerably faulted, have relatively low dips. In ascending the North Fork river nearly to The Forks, I found St. Regis, Wallace, and perhaps higher strata lying nearly flat; there are no lead prospects, though at Britt creek there is a quartz vein carrying chalcopyrite. Of course, some of this barrenness may be due to the presence, at the surface, of the higher members of the Belt series, but the same members have lead prospects, where highly disturbed, in the Mullan region. Taking into consideration the probable inequality in the distribution of the supposed diffused mineralization, then the necessity of greatly disturbing and highly tilting the rocks, the further necessity of exposing them to strong ascending currents of water, and finally the fact that many of the deposits evidently did not ascend much above the Prichard formation, it is not surprising that the mines and prospects are highly localized. I will rest the case for the sedigenetic hypothesis.

Missouri has by far the most important and extensive barytes mining districts in the United States. In 1912, according to statistics compiled by H. A. Buehler, the state geologist, this state produced 24,530 tons of barytes, valued at $117,035. This is 65% of the production in the United States, which totaled 37,478 tons. Missouri ores were valued at $4.77 per ton, while those of other states varied from $2.34 to $2.99. The larger deposits of barytes in Missouri occur in the residual clay overlying the solid-rock formation. These deposits sometimes overlie fissure veins in the limestone which carry barytes and galena. The old Virginia mines in Franklin county were worked to a depth of 500 ft. for lead ore, the gangue mineral being barytes. The Enterprise mine, near St. Clair, is opening a fissure containing both barytes and galena.

The Montana Power Co. has spent over $100,000 at Thompson Falls this summer in the erection of comfortable buildings for the accommodation of 600 men to be employed in the construction of the dam at Clarksfork river, where a large power-plant is to be erected.

The Sulphide Corporation, Broken Hill, milled 26,496 tons of ore during the six weeks ended June 28, yielding 4472 tons of lead and 7961 tons of zinc concentrate. The Cockle Creek smelter produced 1659 tons of lead, 5019 oz. gold, and 163,883 oz. silver.

Resoiling After Dredging

Considerable attention has been paid to resoiling in Victoria, Australia, and the following notes are from the government report on dredging for 1912.

At the Collegian dredge, working at Dry creek, near Bonnie Doon, the appliance in use for replacing the soil is a shoot made of sheet iron ½ in. thick. Advance stripping operations are systematically carried on, and earthy matter, intermixed with some gravel, is being replaced on the dredged ground to an average depth of 18 in. Sand shoots are also used, but for the most part the gravel and sand are covered with the replaced overburden. Owing to varying depths to rock bottom the surface of the redeposited material is rather uneven. The total area thus dealt with to date is about 16 acres.

The Briseis No. 2 plant is the most up-to-date for resoiling on Yackandandah creek. The soil conveyor deposits an average depth of 4½ ft. of overburden, which is eventually leveled off. The area treated is 18 acres.

The soil shoot at the Harrington plant is about 95 ft. long, 48 in. wide, and 21 in. deep, made after the pattern of that on the Collegion dredge. The upper 20 ft. in length has a pitch of 3 in. to the foot, the remainder having about 1¼ in. per foot. This appliance is systematically used, and good work is being done in the way of resoiling. Earthy overburden to an average depth of 3½ ft. is being put back, on a fairly even grade. In September 1912 about 6 acres of the resoiled area had been plowed, and to a great extent leveled. According to the inspector's report, this ground looked well. It was intended to plow the rest of the treated ground when it became firm enough to support the weight of horses. Total area resoiled at that date was about 12 acres.

The Porepunkah dredge has operated in a difficult position, but has resoiled 12 acres in patches. Good results are being obtained at Hinnomunjie No. 1 plant, working on Livingstone creek, a few miles downstream from Omeo. In this case the ordinary wooden sluice box is utilized to conduct the soil from the buckets to the dump, but an additional length of 30 ft. is brought into use when advance stripping of the overburden is in progress. This admits of the earthy material being deposited well back from the face of the dump, and there retained on top of the gravelly wash, in place of being sluiced back into the operating pond at the stern of the dredge, which would otherwise necessarily occur owing to the large quantity of water required to force the material along the comparatively flat slope of an ordinary sluice-box. The ground being treated in this locality was originally a low-lying marshy area of good black soil. As a result of the early mining operations conducted upstream more than 50 years ago, the surface of the flat is covered by mining débris to depths of 3 to 4 ft. Owing to the tenacity of the clayey-black soil, and to the fact that much of it is matted and held together with roots of former vegetation of the swamp, good results are being obtained in the way of resoiling, as this black soil brought up from below the old mining débris is deposited in a 2 to 4-ft. layer on top of the coarse tailing in large solid lumps, practically unchanged from its virgin state. After reasonable exposure to atmospheric action and weathering, this ground will be in a more useful condition than it has been for more than fifty years. About 32 acres of resoiling has been done at this place.

The Myrtle Queen dredge has treated 7 acres of ground. A heavy screw is worked in a chute, which churns the soil into soft mud and is easily deposited. The resoiled area of the Buffalo Star Dredging Co., Lower Buckland, yielded a crop of oats averaging 4 ft. high, and when cut into chaff the yield was more than 2 tons per acre, and the estimate of grain was 60 bushels per acre. The Confidence dredge on the Ovens river has resoiled 20 acres.

Iridosmine From New Randfontein Mine

By C. Baring Horwood

This mineral, which has been found in several South African gold mines, is an alloy or intimate mixture of iridosmine and osmium, generally with some ruthenium. It was collected from battery concentrate, black sand residue, and die sand, where, because of its high specific gravity, it was with difficulty separated from the gold. The amounts found were too small for it to be of other than scientific interest. A quantitative analysis of concentrate, after removing the Hg used in amalgamating, gave Au 1.24, Pt 0.61, Fe (as Fe_2O_3) 1.29, Ni (as NiO) 0.66, and osmiridium, 95.52, the last containing about 45% of iridosmine, which indicated that the mineral was essentially iridosmine. Part of the iron was in the free state and probably came from the stamps used in crushing the ore. The iridosmine and associated metals have not been recognized underground nor in hand specimens. They are associated with gold and pyrite, and they seem most likely to occur in that auriferous banket reef known as Carbon Leader, which is distinguished by the abundance of carbon, and further they carry nickel. These metals are of secondary origin and occur in minute amounts as primary segregations formed by magmatic concentration in basic eruptives. By the last or pneumatolytic phase of eruptive activity they were extruded from the dikes by superheated gases. Later hydrothermal action probably played an important part in concentrating them in the banket reefs.—*Chemical News.*

Gold and silver production of the Auckland province, New Zealand, during the first half of 1913 totaled $2,092,000, a decrease of $153,000 compared with the same period in 1912. The producing districts during July were Ohinemuri, $336,000, Thames, $18,200, and Coromandel, $7700. The principal producers during the month were.

	Tons.	Yield.
Waihi	14,568	$120,000
Talisman	3,850	96,000
Grand Junction	9,096	83,000
Waihi-Paeroa	13,400*	24,000
Crown	1,227	13,000

*Tube-mill plant treating tailing from Ohinemuri river, 6 to 15 miles from the above mines.

The Nitrate Fields of Chile

By Walter S. Tower

*The importance of Chilean nitrate depends on a curious whim of nature. Nitrogen is needed by all plants and animals, and though the atmosphere is nearly four-fifths nitrogen, few plants and no animals can draw directly on that universal supply. Animals secure their nitrogen through the medium of plants, and most plants must get it from the soil. Some cultivated crops rapidly use up the soil nitrogen, and in such cases the easiest way to maintain productivity is by applying fertilizers. Nitrogenous fertilizers once were made largely from guano, fish scrap, slaughter-house refuse, etc., but their manufacture now depends mainly on natural nitrates. These occur in many parts of the world, but they have been found in large amounts only in the northern provinces of Chile.

For Chile itself no other thing has been more important than nitrate in affecting national progress. Nitrate has led to costly wars which established the prestige of Chile as the leading nation on the west coast of South America.

Chile Saltpetre

Chile saltpetre, nitrate, or *salitre* as it is called, is when pure a glistening white compound, salty and bitter to the taste, like some sea plants, and capable of absorbing a great amount of moisture. Chemically the substance is sodium nitrate ($NaNo_3$). Pure nitrate is found only in small quantities or 'pockets.' Commonly it is mixed with earthy materials and various saline compounds, as common salt, Glauber's salt, and borax. A small amount of iodine compounds also is present in most cases. This impure raw material is known as *caliche* to the nitrate miner.

Caliche, unlike many raw forms of minerals, is easy to get at, for it lies on or near the surface. In some places, the caliche is covered with 25 or 30 ft. of fine dust (*chuca*) and coarser rock waste (*costra*) which must be thrown aside by the miner. In such places, an area which has been worked looks as though it had been badly furrowed by gigantic ploughshares. In other places, there is almost no overlying material to remove. The layer of caliche may be as much as six feet thick, but for the most part it varies between one and three feet. The beds in some parts are fairly continuous over large areas; in others they are of limited extent. Some caliche contains more than 70% of nitrate, but 50 to 60% is considered high; the average is nearer 20 to 30%, and even as low as 15% is worked profitably. Hence the conditions of production, costs of operation, and profits to be made vary widely from place to place. With few exceptions, however, it is true that the costs of operation are low as compared with many other mining industries, while the profits are large.

WORKING CALICHE DEPOSITS.

Situation of Nitrate Deposits

The main nitrate fields lie in two provinces, Tarapacá and Antofagasta, between latitudes 19° S. and 27° S. Other deposits doubtless will be found farther south in Atacama, and there are said to be small nitrate areas in Tacna, the most northerly province of Chile. The total area of these four provinces (105,000 square miles) is about equal to that of Colorado, and its population (316,000) gives about two per square mile.

The nitrate beds lie in a belt, commonly less than ten miles wide, about 500 miles long north and south, and 15 to 100 or more miles back from the coast. This short distance from the coast is important in making shipment cheap. Between the Coast moun-

*Abstract from *The Popular Science Monthly.*

tains and the base of the towering Andes lies lower land, known as the *pampa*, which slopes westward from the Andes to the Coast ranges. The nitrate deposits lie along the western side of the pampa, its lowest part, associated with what were once the bottoms of water-filled basins, either lakes or arms of the sea. Lines of flats, covered with dazzling white salt beds, or *salares*, extend over many square miles. The presence of nitrate is easily determined. In a manner much like that of using flint and steel on tinder, particles of any supposed caliche are brought in contact with a strip of burning cotton wicking, or *mecha*. If nitrate is present, the particles ignite sharply, and with no further test an expert can tell approximately the percentage of nitrate present.

Solubility of Nitrates

The nitrate is so readily soluble that the deposits could not exist even in a moderately rainy region, but there is little trouble on that score in northern Chile. The high Andes on one side and the cold Humboldt or Peruvian current on the other make Chile north of the 30th parallel one of the driest regions in the world. Some places have passed more than a decade without a drop of rain. If absolute desert exists in the world, it lies in the nitrate pampa.

In crossing this region one cannot help feeling the utter helplessness of man in the face of such great expanses of waterless and lifeless wastes. All directions lead to sand, more sand, even to the border of the ocean itself. One fails at first to understand how men are willing to live there year after year; why those who go away generally come back again to this apparently limitless desolation. But almost the first day's stay reveals part of the reason. The day is not unpleasant despite the heat and the intensity of the sunlight, for the extreme dryness makes temperatures of 90° or more quite comfortable, and the colors—the grays, yellows, violet—playing over the sands, help make up for the lack of living green. The nights are wonderful—cool, crisp, refreshing, with the brilliancy of sky that only deserts can have; while the moonlight gleaming from millions of salt crystals lights up the land with an effect of half day and renders into attractive forms the most prosaic objects.

Presumably dryness also was a factor in the formation of the nitrate beds. It seems certain from the kinds of rocks found there that the area between the Coast ranges and the Andes once was occupied by a bay or long arm of the sea. Then the land began to rise, cutting off the bay and converting it into a lagoon, entered perhaps by every high tide. About its borders great flocks of birds congregated—as they do now along the neighboring ocean—to feed on the prolific life in the shallow, warm waters. Enormous deposits of bird guano accumulated about its shores as the years went on. Meanwhile, however, the land was rising higher and higher, water came into the lagoon only from the land, bringing with it soluble nitrates from the guano. But this supply of water was too small to keep up the level; and as the region became drier and drier, evaporation reduced the original sea to a string of lakes occupying isolated basins in the lower parts of the pampa. As evaporation went on, these waters became too salty for life to endure. With their food supply gone, the birds were forced to seek other haunts, and the accumulation of guano stopped. Streams and occasional rains, perhaps more frequent then than now, washing away the guano, brought together in the lakes compounds of nitrogen and soda, and the formation of nitrate of soda was the result. Eventually these waters became saturated with the different salty compounds, and as evaporation still continued, the different salts began to deposit on the pampa, in the salitreras and salares, much as they are today. Then as a final step, sand and rock fragments from neighboring hills covered the beds with their present capping of loose waste.

Other explanations of the origin of the nitrate have been advanced. One ascribes it to natural chemical processes accompanying decomposition of different minerals. Another suggests that the wonderful electrical discharges in the Andes are responsible, for the odor of nitric acid in the air is not uncommon after severe electrical storms, and electricity even now is being used to extract nitrogen from the air. But the enormous amounts of nitrate in Chile and the geological conditions of its occurrence fit in best with the idea of origin from guano, as stated above.

History of the Industry

Prior to the nineteenth century the outside world knew little or nothing of these nitrates. Fertilizers were then quite unheard of in most places; industrial uses of nitric acid and its compounds were few; and for making explosives—then gunpowder was the only one—small, scattered deposits of true saltpetre provided the raw material.

About 1826, a Frenchman is credited with having established the first real nitrate works in the pampa back of Iquique. A little more than 8300 tons of nitrate is said to have been exported in 1830.

The nitrate fields then were divided among three countries. Peru owned Tacna and Tarapacá. Bolivia owned most of what is now Antofagasta, while Chile owned from Atacama southward. This last region was then not known to contain nitrate, and still is the least important part of the fields. Peruvians and Chileans became most active in the industry, perhaps because the fields were more easily reached from Peru and Chile than from the highlands of Bolivia. Important concessions were granted by Bolivia to Chilean interests, and in 1874, in return for the cancellation of a debt owed Chile, Bolivia agreed not to impose any export tax on nitrate for twenty-five years. Four years later, however, attempts were made to levy a tax of ten cents per 100 pounds on all nitrate exported. When the Chilean companies refused to pay the tax, the Bolivian authorities seized their property and declared that it would be sold. Chile then undertook to protect the interests of her citizens. Since Bolivia had entered some years earlier into a treaty with Peru against Chile, Peru also was dragged into

the quarrel, the result of which was the beginning of war by Chile against both Peru and Bolivia in 1879. The treaty of peace, signed in 1883, found Bolivia driven out of her seacoast province, Peru deprived of her nitrate lands, and the Chilean boundary pushed more than 400 miles northward. It was predicted then that possession of the nitrate lands would ruin Chile, as guano and nitrate were believed to have ruined Peru, but this gloomy forecast has not been verified.

Recent Progress

Since the war, and especially in the last fifteen years, a number of things have led to great progress in the nitrate industry. Foreign capital, English, German, Belgian, French, Austrian, and some from this country, has been added to the large investments made by Chileans. Thus more than £20,000,000 of English capital alone is tied up in this business. Methods of manufacture have been improved, and the scale of operations has been increased greatly. New railroads have been built and old ones extended, until now there are about 2000 miles of railroads, most of which have no other use than to serve the nitrate trade. But perhaps most important of all has been the vigorous campaign to advertise the merits of nitrate as a fertilizer.

Nitrate Exports

The exports of nitrates in 1830 are said to have been about 8300 tons. At the time of the Peruvian war, fifty years later, the amount had increased to 226,000 tons yearly—or less than the amount that two establishments might turn out now. Since 1880 the exports have reached enormous proportions. The million-ton mark was passed in 1890; almost a million and a half tons was shipped in 1900; and in 1911 the exports were but little short of two and a half million tons. To take care of this greatly increased demand, plant after plant has been built, until now more than 100 are in operation, several of which can produce in a month more than the whole exportation amounted to in 1830. With all this enormous growth and prosperity, the process of production still is almost as simple as when the industry began. The first step is to make a hole about six to ten inches in diameter through the layer of caliche. The bottom of the hole is enlarged so that a charge of powder may be put under the caliche. Most of the powder is made locally from nitrate, charcoal, or coal dust and sulphur, for here it is so dry that the nitrate cannot absorb enough water to make it unfit for powder. The explosion of the charge heaves up the caliche,

INTERIOR OF NITRATE WORKS, SHOWING BOILING TANKS.

commonly in blocks which must be broken into smaller pieces with a heavy hammer. This is the process of nitrate mining. No operation could be simpler.

Labor in the Nitrate Fields

If the miner works by the day, he is known as a *barretero*, literally a 'crowbar man.' If he is paid according to the amount of caliche mined, as the most energetic prefer to do, he is a *particular*, or private worker. The former earns about ₱6 to ₱7 per day, while the latter, under favorable conditions, often makes ₱9 to ₱12 per day. A group of particulares, working early and late, quickly dispels any idea that no people of that part of the world will work hard.

Carts or trains of small dumping cars carry the caliche to the *maquina*, as the refining plant is called. Here it is first crushed into pieces no larger than a man's fist. From the crushers it goes up inclined planes to the boiling tanks, or *cachuchos* as they are

still known, though earthen pots have been replaced by great iron affairs 32 ft. long, 9 ft. wide, and 8 ft. deep, capable of holding 70 tons. The newest maquinas have twenty to thirty of these tanks. When the charge of caliche is in, water is added, steam is turned into a coil of pipes which runs around inside the tanks, and the boiling process begins to dissolve the soluble nitrates from the insoluble and worthless earthy substances. Thus the industry, which in one respect owes its existence to absence of water, must have water in order to operate, for nowhere are there large amounts of caliche rich enough to ship without refining, and the process of leaching is the only economical method of refining.

Fuel

Much Australian and English coal, costing ₱35 to ₱50 or more per ton, is used to generate the steam. About half a million tons of coal has been imported for this purpose in recent years; but the possibility of substituting California petroleum, already used to some extent, is being considered seriously by many operators.

To get water for the maquinas is not everywhere easy, for the water-supply always has been the chief problem in this region. The first railroads had trouble getting water for their engines, some resorting to the distillation of salt water; but now for the railroads, and the chief cities and towns, piping of water 100 to 200 miles from the Andine streams has relieved the situation greatly. In the pampa, wells yield a good deal of water, commonly more or less salty, but this source cannot be counted on everywhere. Thus in central Antofagasta one plant secures more than 35,000 gal. of water per day from three wells, the deepest of which is less than 100 ft.; but another plant, less than a mile away, found no underground water after spending ₱250,000 in the attempt.

Precipitation of Impurities

After the water in the cachuchos has boiled for several hours, it is passed to another tank where it encounters fresh caliche, and so on, until a saturated solution known as *caldo*, or broth, eventually is secured. When this point is reached, the water is run off to a series of tanks, known as *chulladores*, where the use of wheat flour, stable manure, or other substances, causes the precipitation of the miscellaneous soluble impurities, except ordinary salt, which have been dissolved out with the nitrate. From this purification process the solution goes to the crystallizing tanks, or *bateas*, which are placed ten or twelve feet above the ground to permit free circulation of air and promote cooling and evaporation. Thus dryness which figures in the origin and preservation of the caliche, also has an equally great value in the process of manufacture. As the solution cools and the water evaporates, the nitrate begins to crystallize on the surface, so a 'stirring boy,' or *rayandero*, is employed to break up the film and make it settle. Five or six days is necessary to complete the crystallizing process. A large plant may have 300 or more bateas, capable of holding more than 1,000,000 gal. of caldo, and yielding at each full charge as much as 2500 tons of nitrate.

When crystallization has gone as far as it will, a valve in the bottom of the batea is opened and the liquid is drawn off, leaving behind a thick layer of glistening white crystals. This is the nitrate, or salitre, of commerce, being 95% or more of pure nitrate of soda; the remainder is largely water and salt. The liquid which is drawn off, known as *agua vieja*, or mother liquor, still contains a large amount of nitrate in solution, and is used over and over again in the boiling tanks. In fact, no water is ever thrown away, the only loss being that which passes into steam from the boiling tanks and evaporates from the crystallizing pans. The finished nitrate is shoveled from the bateas into cars, and there, after drying for several days, is bagged ready for shipment. Shipment in bulk is impracticable because the nitrate so readily absorbs water. Even when shipped in sacks it sometimes becomes caked in the holds of ships and has to be taken out with picks.

Iodine By-Product

From the mother liquor, iodine is extracted by a simple process of precipitation with chemicals (mainly sodium sulphites). It figures only as an important by-product of the industry, for the 'iodine trust' makes an annual allotment to each establishment, commonly less than what could be made in a month, if there were no restrictions on production.

The only other important step in the refining of nitrate is the clearing and recharging of the boiling tanks. First, fresh water is run through to take out what it will of the remaining nitrate, this water being used subsequently, with mother liquor, in the boiling process, for the more nitrate in solution at the outset the easier it is to get a saturated caldo. After the washing is over, a trap in the bottom of the tank is opened and the waste is removed. This process is the most bothersome in the industry, because for each charge of 70 tons of caliche, 50 tons or more of waste must be removed. It is hard on the men who work in the steaming hot tanks, and the disposal of the waste after it is removed, not uncommonly 1000 to 2000 tons per day, soon comes to be a problem. None of the operators succeed in getting much more than 75% of the nitrate originally in the caliche, hence the waste commonly contains 4 to 10% of nitrate, and the great piles containing millions of tons of waste some time may be re-worked if conditions in the industry should make economies necessary.

A good deal of capital is needed to start a nitrate business on a large scale. Many of the older *oficinas*, as the establishments are called, are small, representing an investment of not more than ₱25,000 to ₱50,000. But a large modern plant may cost ₱6,000,000 or more. For this reason the industry tends to remain in the hands of companies, about 80 in number, of which a few large ones really dominate the industry. In all, there are about 160 oficinas in existence, English, Chilean, Austrian, German, etc., but for one reason or another not all of

them are being operated. Exhaustion of the supply of caliche is the most common reason, for as a general rule an oficina is built for a given tract of nitrate land, with the idea of abandoning it when that supply is exhausted. It does not pay to haul caliche any considerable distance, for a ton of average caliche will yield only about ₱30 worth of nitrate, on which the profits may be ₱10. There are only one or two American companies. United States capital invested in western South America seems to have been attracted more strongly by other kinds of mining.

Production of Modern Plants

A modern plant, like the Aníbal Pinto, in central Antofagasta, running 24 hours at full capacity, may have a daily output of 5000 Spanish quintals (quintal = 101 lb.) of nitrate. The cost of production in May 1912 at this plant was stated to be about ₱2.50 per quintal, covering everything up to the time of shipment. To this figure must be added the transportation charges to the vessel in Antofagasta harbor, about ₱1 per quintal, and the export duty of ₱2.50 per quintal, making total costs on board vessel ₱6 per quintal. At that time the selling price, on board ship, was ₱7.50 to ₱8 per quintal. Under favorable conditions, therefore, this oficina could market about 2,000,000 quintals per year, with profits amounting to ₱4,000,000. This particular plant cost more than ₱6,000,000, but with the trade good it would pay for itself in two years and give annual dividends of 10% at the same time.

The construction of a modern plant uses supplies from widely separated places. Most of the buildings are of corrugated iron, for it withstands the intense dryness better than wood does. It commonly comes from Europe. The timber which is used is likely to be Oregon pine, for it is strong, durable, and about as cheap as the Chilean product. German steel for tanks, cement from the United States, boilers from England, Belgian locomotives to haul the tiny cars, and United States electrical equipment are found at one plant.

Most of the laborers are Chileans, Peruvians, and Bolivians, attracted there by the higher wages than are to be had elsewhere in most other pursuits. In fact, the complaint is often made that the nitrate industry has retarded development of other activities in Chile, especially greater agricultural progress in the south, by absorbing not only the capital, but the labor as well. About 40,000 persons are said to be employed directly in the nitrate establishments, some of the larger of which have more than 1000 hands each. Wages run from about ₱3 to ₱4 per day for boys and ₱6 per day for the poorest paid men, up to as high as ₱15 for some of the men working in the mill. Perhaps ₱10 is a fair average for the majority. Houses are provided by the company, but heat, light, and water must be paid for by all except salaried employees.

Though wages and salaries appear high in units of currency, the prices of foodstuffs also are necessarily high, since next to nothing can be raised anywhere in the nitrate region. A good many of the cattle used here come overland from Argentina. Kerosene from the United States costs about ₱1 per gallon, but the tin in which it comes also must be considered, since it serves a multitude of uses, from waterpail to roofing material and baking oven.

The laborers generally are paid not in money, but in *features*, discs resembling poker chips and bearing the company name, together with the equivalent value in actual currency. These features are used almost solely at the company stores, but if any workman desires his wages in money he may draw at any time all that is due him. Large establishments,

LA DEMOCRACIA WORKS NEAR IQUIQUE.

with their many hands and the families, may make communities of 2000 to 3000 persons. Schools are provided by the government.

Exportation of Nitrate

Ships of many nations come to carry away the nitrate, while many coastwise vessels bring supplies from the fertile valleys farther south. Nearly half the companies operating in 1912 shipped their product through Iquique, giving this port more nitrate traffic than is carried on by any other two ports combined. Antofagasta and Tocopilla are next in order. The value of nitrate exports is more than 70% of the total value of Chilean exports, and its tonnage is as great as that of any other South American export. As the nitrate goes out, the Chilean government levies an export duty, just as Bolivia tried to do when Chile took up arms on that account. The export duty sometimes is regarded as a device for checking overproduction, whereas it is simply an effective means of raising revenue for the national treasury. For a long time nitrate duties and proceeds of sales of nitrate lands have amounted to more than half, and in some years to not less than 85% of the total national income. These revenues alone represent more than $10 per capita, or as much as the United States Government spends from all sources of income. It is easy to see, therefore, why Chile often is charged with extravagance. Yet large sums have been employed wisely in the building of state railroads; something has been done, and much more is now being undertaken, to improve port facilities, especially at Valparaiso; and much of the money has been used in building up an army and navy to insure Chilean leadership and prestige among the West Coast countries. It is estimated that in the thirty years following 1880 the

total revenue from nitrate duties has been more than $300,000,000 (U. S. gold), while with the present rate of production and the same tax continued, the next twenty-five years will give Chile nearly $750,000,000 (U. S. gold) more.

Control of the Production

One check on overproduction may be exerted through a law providing that Government nitrate lands are open to exploitation only after such lands have been disposed of at public auction. But, at the same time, this law has tended to check individual effort in exploring thoroughly the limits of the nitrate deposits. Another check on overproduction has been the nitrate trust, or *Combinacion Salitrera*, an agreement entered into in 1901 by the larger companies, concerning the limitation of annual output and its allotment among the different companies. For a number of years prior to 1909 the trust worked well, but since then, despite all efforts to keep them in line, a good many companies have limited their output only by the maximum capacity of their plants. As an official of one of the largest Chilean companies aptly said: "There is no need for agreements when the demand is so heavy and the prices so good. If the price goes down—well, perhaps agreements can be revived then."

The nitrate business is so vital to the northern provinces of Chile, and even to the whole country as it is now organized, that the future of the industry has been a question of much concern. Some believe that the opening of the Panama canal, with the resulting shortening of voyages from Iquique and Antofagasta to the United States, United Kingdom, and Germany, will stimulate the commerce in nitrate materially, for those three countries now take about 80% of the exports. Optimistic prophets, noting also the increasing popularity of nitrates, forecast a new era of greater prosperity than ever before. The more pessimistic, on the contrary, foresee the speedy exhaustion of the nitrate supplies and a crisis for Chile unless adequate preparation is made for the inevitable readjustment.

Available Supplies

Most estimates of the available supplies of nitrate range between 70,000,000 and 100,000,000 tons, which at the present rate of production would insure the life of the industry for 35 to 40 years. Some estimates, however, place the amount as high as 200,000,000 tons. The totals given are about equally divided between Tarapacá and Tacna on the one hand, and Antofagasta and Atacama on the other. Private lands, however, are estimated as covering more than half the total, though it must be remembered that the state lands are less well known. The smaller estimates make little or no allowance for discoveries of new nitrate deposits, which is quite likely to happen, nor do they count on any improvements in processes of manfacture, which readily might prolong by many years the duration of supplies now known. It is also possible that ripio, nitrate-bearing costra, and low-grade caliche, thrown aside in the past, may be worked profitably in the future. Should all these things develop favorably, the nitrate industry could thrive for a good many decades to come. Otherwise, its span of existence is not likely to extend much beyond the middle of the century, for increased production, which is entirely probable, must hasten the end.

Another possible 'rock' ahead for the business has been found by some people in the production of nitrates from atmospheric nitrogen by an electrical process. Where water power is abundant and cheap, nitrates from this process can be made to compete with the Chilean product. It is being done now in Norway. But for most parts of the world which have large water-power resources, the use of this power will be more valuable for other purposes as long as Chilean nitrates continue to be abundant and reasonably cheap.

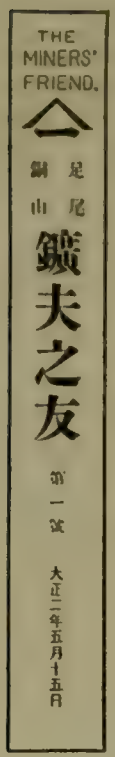
Value of the Production

It has been suggested that when the nitrate is exhausted irrigation may turn the pampa into a highly productive farming region. This may be possible for limited areas, but from what is known of the water-supplies available, it seems unsafe to look for any extensive agricultural development. Exhaustion of the nitrate apparently means a general decay of the region unless other mineral resources are discovered and developed. It means for Chile the loss of $100,000,000 (U. S. gold) in annual exports and $30,000,000 (U. S. gold) of government revenue. For the world it means turning to some other source of nitrogen for supplies to fertilize its crops. Happily the way already is open for the latter change.

Tin production of 13 mines in northern Nigeria in July amounted to 227.6 tons of concentrate. Some of the companies report slight damage from flooded water, and this has interrupted the working of the hydraulic plants where these are installed. The rainy season has now definitely commenced. Labor supplies are scarce despite the comparatively high rate of 18c. per day paid for native workers. Transport difficulties, of course, still operate, as is only natural in the development of a district which is situated such a long way inland in unsettled country. Even with the extension of the Nigerian railway to the edge of the plateau, many mines are still only to be reached from the terminus by a seven or eight days' walk, all machinery having to be carried on the heads of native *pagan* or *Haussa* bearers.

A new mining ordinance for the encouragement of mining in the Northern Territory, Australia, came into operation on June 26, which provides a reward of $480 to any prospector who discovers a new mineral field that will support a population of 100 people for one year within a period of five years from date of discovery, and $4.80 per head for every additional person thus supported, up to $24,800. Also a reward up to $480, and a reward claim or area for the discovery of a valuable deposit in a locality where mining operations have practically ceased, or in a new locality where no mining operations have been conducted. This territory is controlled by the Commonwealth Government of Australia.

A Japanese Contemporary



We present herewith the title page of the *Miners' Friend*, a modest little paper published by the staff of the Furukawa Mining Co., at Ashio, Japan, and of which copies for the months of June, July, and August are now at hand. For fear that some of our readers may be a bit rusty on the vernacular, we translate as follows: "The Miners' Companion of the Ashio copper mine. Edition number 1. Published on the 15th of May in the second year of the Taisho dynasty."

The paper itself consists of ten pages, all in Japanese, and the table of contents for August includes articles on 'Miners Ethics on the Occasion of the first anniversary of the late Meiji-Emperor'; 'Rules and Regulations of the Ashio Mines'; 'Maxims and Mottoes'; 'Practical Considerations—Catechism on the Acetylene Lamp'; 'Biography of Self-Made Men'; 'Hygienic and Sanitary topics'; 'Current News of the Mines', and a literary column.

A paper published for the employees of a mining company is unusual, although a number of the American railways and larger manufacturing concerns print and circulate excellent little magazines. As a stimulus to *esprit de corps* and as a medium for inculcating the rules and precepts of efficiency, such papers are useful. It is rather characteristic that the Furukawa company, which has led in so many things in Japan, should be the first to occupy this field. To M. Otagawa and his staff we extend our good wishes.

The Role of Pressure in Chemical Reactions

By John Johnston

High pressure has been adduced by geologists as an 'explanation' of many phenomena otherwise not readily accounted for; just as many chemists have attributed actions which they did not understand to colloids or to some catalytic element. There is considerable experimental evidence which, when rightly interpreted, shows that high pressure alone—uniform pressure, especially—is incompetent to produce many of the effects ascribed to it; that its effects have been much over-rated, especially in comparison with those produced by change of temperature. For instance, the influences of temperature and of pressure on solubility of solid substances are such that a pressure measured in thousands of atmospheres is required to equal the effect consequent upon a few degrees change of temperature. In many cases—as, for instance, the system water-silicate at 400 to 450°—the main rôle of pressure is to ensure an appreciable concentration of the volatile component; whether its influence is in such cases subordinate to that of temperature or not depends, of course, upon the stability relations of the various substances involved. Existing knowledge of the domain of high pressures is confined almost entirely to qualitative generalities deducible from theoretical principles; its scope can be increased only by careful quantitative investigation, which, it may be added, is certain to yield valuable results, technical and economic as well as scientific. A recent volume, 'Die Anwendung hoher Drucke bei chemischen Vorgängen und eine Nachbildung des Entstehungsprozesses der Steinkohle,' by Friedrich Bergius, is therefore to be welcomed for the extension of knowledge which it brings as well as for its suggestiveness.

It records work on the equilibrium relations of the system $2CO_2 \leftrightarrows 2CO + O_2$ at temperatures ranging up to 420°C. and gas pressures up to about 140 atmospheres, and on the effects of water at 300 to 350° and the corresponding pressure on carbon, peat, and cellulose. The main results of these investigations have already been published elsewhere, but the following points are noteworthy: Water at temperatures of 300 to 350° and the corresponding pressure reacts with carbon according to the equation $C + 2H_2O \leftrightarrows CO_2 + 2H_2$, no appreciable amount of carbon monoxide being formed. Under the same conditions it gives, with peat or cellulose, products which closely resemble natural coals, the type of coal produced depending mainly upon the duration of heating. This process goes on to a certain limiting composition only (corresponding to a soft coal); but it was found that the percentage of carbon can be further increased by exposing the product to stress, a fact which tends to show that natural anthracite was formed from a soft coal by the action of the stresses to which any deep-lying bed must have been subject. A rise of temperature of 10° doubles (as usual) the rate of formation of this artificial coal; whence it is calculated that the age of the natural coal beds is of the order of eight million years, an estimate which is no more uncertain than any of the existing estimates of the age of the earth. In conclusion, it may be pointed out that investigations similar in character to those described by Bergius may be counted on to contribute something toward the solution of the still mooted question of the origin of petroleum.—*Jour.* Am. Chem. Society.

Phosphate ranked first in the list of exports from Tunis, northern Africa, during 1912, the aggregate value of the shipments amounting to $9,216,703 as compared with $7,427,589 for the preceding year. The principal purchasing countries were France, Italy, England, and Germany. The most important concern engaged in this industry is the Société des Phosphates et du Chemin de Fer de Gafsa. It may be stated in this connection that Tunis is, after the United States, the world's largest producer of phosphates.

A large deposit of cinnabar (sulphide of mercury) has been opened on the Maroni river, near Paramaribo, Dutch Guiana. Transportation and native labor in this district is said to be cheap.

Discussion

Readers of the MINING AND SCIENTIFIC PRESS are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment. Insertion of any contribution is determined by its probable interest to the readers of this journal.

Mining and the Big Exposition

The Editor:

Sir—In 1915 the big exposition will be staged in San Francisco. By the time this bit of news appears in print, it will be getting well along toward the end of 1913, which seems to leave a little more than one year in which to prepare our mining exhibit. Please ask your readers to Fletcherize that word 'our.' Also, let us all stop and consider that one year is not any too long a time in which to prepare a mining exhibit worthy of the state of California in particular, and of the Western states in general. It is ample time if all get busy and work together, but we must be getting right at it.

It is 'our' mining exhibit because it is going to be done by *us* or it will not be done at all. For purposes of an exhibition, mining differs inherently from manufactures, agriculture, and transportation. There is plenty of incentive to the latter industries to exhibit in order to advertise their products, and the wise ones will all be on hand. There is no competition in selling gold, and the copper or lead produced by any company is so nearly like that of its competitors that no commercial advantage is gained by exhibiting the product. Consequently there is but little commercial incentive to the successful mining companies to exhibit. But the advantages to be gained from advertising our mining resources and thus enlisting money for their further development are none the less real because they are spread fairly evenly over the entire state, and all lines of business prosper when the miners prosper. When a gold mine produces a thousand dollars worth of gold it has done something which enriches the world. The stockholders are not the only ones who profit from it. The money is divided among the workmen, the supply houses, the state, and the stockholders. This is newly created wealth, which was not previously in existence; the world is enriched and no one has had to pay the bill. The money moves from hand to hand, through all lines of trade, and benefits everyone. A merchant who receives part of it from a customer may not stop to consider where it came from, but that does not alter the fact that if the mine had not produced it, the merchant would not have made that particular sale. Clearly, then, it is to the interest of everybody in business in a mining community to help the mining exhibit.

To the mining engineers and to the promoters of real mining, the situation will appeal without argument. To the successful mining companies, and to the individuals on whom fortune has smiled through the mining and oil industries—and there are enough men in California to whom great fortunes have come through these industries to finance a marvelous exhibition without serious sacrifice—there is presented an opportunity to worthily show their gratitude, and to encourage and assist others to help the world by helping themselves on to success in mining. Mr. Mine Owner, you have made a fortune in your chosen branch of the mineral industry; you are proud of your record, you are proud of yourself—and justly so; also you are proud of the state and of the industry which gave you your untainted money. The privilege of expressing your pride and of advancing the interests of the mining industry is now offered you. Those who helped you earn your fortune have known you for years, and they know what your answer will be—if you will but take five minutes alone and think it over!

Mr. Van Barneveld, who is in charge of the Department of Mines and Metallurgy, says there will be 200,000 sq. ft. of space in the Mining and Metallurgy building available for exhibits. There will also be space outside the building. The Exposition has no funds to spend in securing exhibits to fill this space. What are we going to do about it? The East expects great things of California in the way of a mining exhibit. I was in the East last winter and found everybody planning, or hoping to plan, to come out. There they still think that California means 'gold' (the real estate men have not yet beaten us entirely), and one thing we must show them is a very unusual collection of gold specimens, both nuggets and gold-quartz. A loan collection of such specimens should not be difficult to get together, provided their safe return is absolutely assured. This could be arranged by having their return guaranteed by some insurance company. Meanwhile it is worth while for everyone to make note of all good specimens that he sees, with the name of owner and a description.

A big exhibit of gold specimens seems to be demanded of us. Aside from this, Mr. Van Barneveld has already outlined what he wants to accomplish in the exhibit. But when are we going to get started? What has become of the California Miners' Association? Is it slumbering, or is it hiding its light under an ore sack? At its San Francisco meeting last December, a committee on Panama-Pacific International Exposition was appointed. The committee duly met; some one offered a resolution extending the coöperation of the Association to the Exposition officials in securing a suitable mining exhibit; the resolution passed the committee, passed on the floor of the Association, and the committee passed out! (At least so far as one member of it is informed.) "The mountain labored and brought forth a mouse."

We must have $200,000 or $300,000 for that mining exhibit, and as much more in work and ability to execute. This is not a San Francisco matter; it is not a California matter. It is a matter for the mining industry of the Western states, with a cordial invitation to the steel and the coal industry, and to foreign countries to join us. The money involved is ridiculously small as compared to the fortunes recently won from the oilfields, from alkalies of the desert, from Goldfield, from Tonopah,

from Bisbee, from Butte, from Jerome, from Alaska, and from less important districts. We should show mining as it is, in actual operation. We want models of mines, models of stopes, quartz mills in operation, certainly we need a gold dredge, an oil well in operation, as well as models of oil refineries. The money involved is considerable, but this is California! Let's get started. We are waiting for the San Francisco mining men to call a meeting and start things, so that we can join them.

J. Nelson Nevius.

Pasadena, California, September 16.

Universal Safety Signs

The Editor:

Sir—I submit herewith a design for a universal safety first sign, and would be glad to know your opinion as to the value of such a sign and of the particular design submitted.

If agreement can be reached as to a standard, a manufacturer would be justified in getting out cuts and stock signs in such large quantities as would make the cost much less than if each got out his own designs and printing.

J. W. Stonehouse.

Denver, Colorado, August 23.

[The desirability of uniform conventional signs for use in mines and works in marking danger points is beyond doubt, and the movement is one that deserves every support. Miners form a roving class and constantly learning new signals, rules, and signs leads to confusion and is productive of accidents. The value of a danger signal is increased in proportion as it produces an automatic action on the part of the one who is warned by it. Men do not run into danger when they are thinking of it, but when they are not. It is the universal experience that most accidents occur because some one's wits are wool-gathering. To be effective, a danger signal should suggest just one thing to the one to be warned. It should always make the same suggestion, and the latter should come so promptly and regularly that the man will unconsciously heed the signal. It is evident that this cannot be accomplished if different signs are used, especially if a sign or signal at one mine or in one plant means danger and at another safety. There should be some standard, so that a workman in a new situation will find the danger signals in accord with his acquired mental instincts rather than in discord. The value of a red light is greater than a green one in marking danger spots, because of widespread custom, and it is distinctly worth while to attempt to develop a whole system that will in the same way have universal meaning.

Some years ago the geologists found that because of language difficulties and lack of standards in cartography, the maps made in one country were not intelligible in another. The International Congress of Geologists worked at the problem and evolved a color scheme that is now widely used. As a result, an English or American geologist can read a Russian or Japanese map as well as one made in his own country. In view of the confusion of tongues underground in a modern mine, it would seem that mine managers might well take a hint from what has been accomplished by the geologists. The United States Bureau of Mines, the American Institute of Mine Inspectors, the American Mine Safety Association, and other organizations would do well to attack the problem in earnest. - Editor.]

Inclined Baffles

The Editor:

Sir—In your issue of August 2, John E. Rothwell writes under the head of 'Inclined Baffles,' to which I should like to add a few observations. There can be little doubt that inclined baffles greatly accelerate the settling of a dense slime, forming a channel for the rising of the clear solution on the under side of the baffle and a corresponding one for the downward movement of the solids on the upper side of the baffle. The inclined baffle has been successfully applied for this purpose in the Kyloe settler in Australia for concentration work where great capacity within a small area was desired and where a cloudy overflow was not detrimental.

If the first rapid settling is to be continued until a clear overflow is obtainable, the principles involved in the settling change completely. The particles are then far apart and each is free to settle so far as any interference from its fellows is concerned. Time and a quiet settling medium would seem to be the requisites for this kind of settling. Baffles are, I believe, a disadvantage in this kind of settling, as they tend to form currents by restricting the free flow of water, and they also form places of lodgment for the extremely fine material.

As the baffle is strictly a mechanical, or physical, device, I have purposely ignored chemical and electrical theories of slime settlement. Mechanically considered, I believe that the ability of a particle to settle in a cloudy solution is limited only by its infinitesimally small weight and by the viscosity of the settling medium.

L. B. Eames.

Waxhaw, North Carolina, August 10.

Simple Smelting in Arizona

The Editor:

Sir—I really feel that general attention should be called to a new smelting device that has been invented in Arizona by a 'distinguished Eastern metallurgist,' whose only regret is, that he never saw our great state before. The new device is extremely cheap and simple and is bound to revolutionize mining and smelting in this state, and others situated as fortuntely. Here it is: "Mix ore and a small amount of coke (charcoal will do where the mines are hidden in thriving forest reserves), expose the mixture to the sun for three consecutive days, and dig the metal out of the ground at whatever depth the coolness of the ground is sufficient to allow it to solidify." Patents are pending. Any infringements will be prosecuted!

Bisbee, September 10. D. Thomas.

Special Correspondence

TORONTO, CANADA

Dome Lake Finances.—Rea, Cobalt-Frontenac, and Mann Mines.—Capital for British Columbia Properties.

Dome Lake shareholders, on receiving a financial statement showing the indebtedness of the Company to be $61,000, have agreed to the plan proposed by the directors for financing the Company. The General Asset, Ltd., will receive 45,000 shares at par in payment of a debt of $41,000, and 100,000 shares are to be disposed of at 35c. each to raise the funds to settle other liabilities and proceed with development. The Rea Leasing Co., which is operating the Rea property, has been treating the ore from the dump in the 5-stamp mill, and the result has been so satisfactory that an addition of five more stamps has been decided upon.

BUFFALO MINE, COBALT.

A winze is being sunk on the vein below the 200-ft. level and stoping is being done at that depth.

At the Cobalt-Frontenac, in the Elk Lake district, two orebodies giving good assays in gold and also containing platinum have been found on each side of the shaft at the 100-ft. level. They are stated to be 14 and 36 ft. wide. The shaft is being sunk to the 200-ft. level. The Mann, in the Gowganda district, has three cars of high-grade ore ready for shipment as soon as the winter roads are found.

Hugh Sutherland, of Toronto, and a syndicate of British capitalists, including Sir James Sievewright, the Earl of Denbigh, and Major Frank Johnson, have gone to inspect a copper property on Vancouver island, B. C., in which they have invested $1,000,000, and which promises to become an important enterprise.

JOHANNESBURG, TRANSVAAL

Results of Labor Troubles and Gold Production.—Underground Conditions on the Rand.—Future of Rand Mining.

The Rand Gold mines have passed through the aftermath of the strike, but although it only lasted a few days, the disorganization, extra expense, and loss of profits were larger than expected. Work on the mines continues somewhat disorganized, although operations were resumed over a month ago largely due to time-expired natives imitating their white masters and refusing to renew their engagements except at exorbitant rates of pay. The mines are gradually, therefore, becoming short of unskilled labor, white men in consequence are being discharged and are reaping in an unexpected manner the results brought about by their own action in bringing about the strike. The disorganization will take many months to overcome, as the Government has temporarily put a stop to recruiting natives, which has added somewhat to the difficulties experienced at the mines. In loss of profits and extra expenses incurred during the strike, the figures for July show a direct loss of about £250,000.

The decreased gold output for the month of July, as declared by the Transvaal Chamber of Mines, was 91,160 oz., value £387,223, and for the first time this year the total gold output for the Transvaal fell materially below three million sterling, namely, £2,783,917. This was the case, despite the fact that the number of stamps dropping during July was 115 in excess of those at work in June, an increase largely due to a resumption of work at the New Kleinfontein mine. Next to the colored labor trouble on the Rand, the underground health conditions are attracting most attention, and all kinds of proposals are being made with the idea of dealing with the dust evil. One proposal is to adopt firing shots by electricity so as to avoid the fume and dust bothering the miners. From what is being said by the Rand press, mining and otherwise, one would almost conclude that the idea of firing shots by electricity is quite a new and novel idea. As a matter of fact, it was used long before the Rand was discovered, and as far back as thirty-five years it was largely used for shaft-sinking purposes in many mining fields of the world. So firm a grasp on some of the mine managers has this idea of electric firing underground obtained, that it is seriously proposed to withdraw all the men from underground at the time of blasting, and fire the shots from the surface. It has been recognized that the concussion caused by blasting underground largely contributes to the dissemination of the finer particles of dust difficult to be caught by respirators and to which miners' phthisis is now admitted to be largely due. That the underground health conditions of Rand mines have been materially changed for the better, by the more general use of water sprays and introduction of artificial ventilation, goes without saying; but in this direction there is still considerable room for improvement. Some interest has also been aroused locally by the announcement that W. C. Gorgas, chief health officer for the Panama Canal zone, has been engaged by the Transvaal Chamber of Mines to inspect and report upon the health conditions prevailing on the Rand mines in the hope that he will be able to suggest some solution to the difficult health problems still unsolved on the Witwatersrand goldfields.

In the July issue of *The Mining Magazine*, London, appears an article from G. A. Troye on the future of Rand mining, dealing particularly with the prospects of different individual mines which it may be pointed out have not been dealt with in an over-sanguine manner. Few will, for instance, agree with treating the West Rand Consolidated Mines as negligible in the matter of future profits, as with an increased scale of working, this particular group of mines possesses a promising future. Even the Roodepoort Main Reef cannot be dealt with in an off-hand manner, considering the manner in which the mine is opening. Out of the nine mines indicated as doubtful dividend payers, at least six are expected to return something to the shareholders. In dealing with the future of the Rand, the possibilities of the Far Eastern Rand does not receive adequate credit, but perhaps the method of handling the prospects of the East Rand Proprietry Mines will attract most attention. Mr. Troye is evidently of the opinion that the East Rand Proprietary Mines will cease as a dividend payer in five years when the outcrop properties are exhausted. That the Hercules and Angelo Deep properties have proved disappointing is well known, but Mr. Troye has evidently overlooked the promising prospects of the ground lying west of the water dike, as well as the improved deep level and below the Hercules and Angelo Deep properties. Nor can it be said that the Crown Mines have been dealt with in an equitable manner in fixing the life at thirty years, as most engineers are of the opinion that the Crown Mines will last almost as long as mining operations will be successfully conducted on the Rand. At all events, Mr. Troye's estimate of the future of the Rand may be regarded as useful if taken as an indication of what is clearly the least optimistic estimate made on careful lines of the Rand's future in recent times. That Mr. Troye has given considerable attention to the subject is self-evident, and most authorities will agree that, while the gold output of the Rand will for years continue to increase, the resulting dividends in the future will not show a proportionate increase, in fact, it is the general opinion that unless something unforeseen happens, future dividends will not be materially increased beyond their present total.

LONDON

The Royal School of Mines and Its Staff.—Carn Brea & Tincroft Affairs.—Development Work in the Dolcoath Mine.

From time to time during the past few years I have referred to the difficulties of the Royal School of Mines in connection with the appointments to the professional staff. Four years ago the governing body upset the arrangements by unwarrantably falling foul of William Gowland, one of the professors, who had done excellent service in the metallurgical department, and calling for his resignation under the age limit, which is customary in connection with most of the English public appointments. He was succeeded by W. A. Carlyle, who only held the position for three years or so, and then retired. Without reflecting in any way on Mr. Carlyle, it seems to me that the incumbents of professional positions should consider them as permanencies, and in fact their life's work. It is difficult to pick a good professor, and difficult for him to train himself to the requirements; so it seems a pity that Mr. Carlyle should have decided to go back to private practice. The appointment of a successor to him caused more trouble than your readers would have anticipated. More than one possible applicant was deterred from applying for the position, or even allowing his name to be mentioned, knowing that for personal reasons he was *hors de combat*. Eventually an appointment was made that promises to prove successful. H. C. H. Carpenter, the professor of metallurgy in the Manchester University, has been selected. As he is chiefly conversant with iron and steel, and with the physics and metallography of the non-ferrous metals, he has been given two years of what might be called 'half time' before he assumes the full professorship, and in the meantime he is to travel the world studying the methods of extracting gold, copper, and other metals from their ores, which after all is the department of metallurgy that requires special attention at the Royal School of Mines. In order to fill the gap thus caused, Mr. Gowland is being recalled from his retirement, a fact that constitutes a victory of science and personal charm over officialdom.

The present policy of the governors in connection with the professorship of mining is highly to be commended. It comes as a pleasant surprise to find that S. J. Truscott has been appointed assistant professor. William Frecheville was made professor a year ago, on the retirement of S. Herbert Cox by reason of ill health. He is not as young a man as he used to be, so a successor would be required at the expiry of the age-limit, so the governors have acted wisely in securing the services of Mr. Truscott when the opportunity offered. Mr. Truscott is twenty years the junior of Mr. Frecheville and is well known as the author of the book on Rand mining practice. Besides, he is an unusually facile speaker. In the ordinary course of events, he will be available as a successor to Mr. Frecheville whenever his time comes for retirement.

In my last letter I referred to the decrease in the recovery at the Carn Brea & Tincroft mine at Camborne, Cornwall, and mentioned that some of the directors and shareholders were inclined to doubt their wisdom in appointing E. S. King to the position of general manager two years ago, alleging that in spite of his high salary the content of the ore had declined and the profit turned into a loss. At the time, I stated that this attitude of the directors was unreasonable. At the meeting of shareholders this week, the directors exhibited a more cheerful tone, and Mr. King repeated his previously expressed contention that development on an expensive scale was required. When he was appointed two years ago, he called for £75,000 additional capital, two-thirds of which he wanted for development and one-third for new plant. He has obtained £25,000 for new dressing plant, but it may be legitimately doubted whether this money would not have been spent more advantageously in underground work; for it is obvious that a recovery of 19 lb. of black tin per ton will not provide profits, even at the present high price of tin, and that is all the present reserves are calculated to yield. In the meantime, operations are to be pushed without abatement as far as funds will allow.

In my last letter I also referred to the results at Dolcoath. At the meeting of shareholders, R. Arthur Thomas gave supplementary information relating to the new discoveries. The developments at depth have been more hopeful recently than for the past year or two, and 300 ft. more sinking is to be done. With regard to the exploitation of the parallel lodes to the north, it is timely to remind your readers that there are a great number of parallel lodes in the Camborne district. The lodes now to be developed by the Dolcoath company used to be worked by the Entral company as far back as 1720, and the records, though incomplete, show that large quantities of copper ore were extracted from the slates. The cross-cut started six months ago is at the 1260-ft. level below the adit, and it was arranged at this depth in order to strike the lode within the granite where tin would be found. So far the ground developed contains 35 to 40 lb. black tin per ton by vanning-shovel assay, and it is as free from pyrite, arsenopyrite, and wolfram as the Main lode. Cross-cuts are now being driven 120 ft. above and below, and the first cross-cut is being continued in order to intersect the East Pool series of lodes. These lodes when worked at other places do not contain such clean ore as the Entral and Main lodes. Both directors and shareholders exhibited a much more cheerful frame of mind at the meeting than could have been predicted three or six months ago, when the outlook as regards future supplies of ore was indeed gloomy.

NEW YORK

Increase in Value of Mining Shares.—Copper Figures.—Litigation at Cripple Creek.—Silver and Gold Movements.

Tonopah shares have been overshadowed by copper mining stocks in the New York share market during the past few weeks. Practically all the important copper companies show a marked advance in prices; Braden, for example, having advanced from less than $6 to over $8.50. All the brokers are busy figuring how much the shareholdings of the big companies have appreciated, one estimate being that the shares in 61 of the leading copper mines have increased $128,000,000 in selling value. The copper-metal market may well be proud of its powerful influence over the 'Street.' As a matter of fact, the copper market weakened toward the end of last week, and on September 18 the A. S. & R. Co. was booking good-sized orders for November copper at 16.9c., though the figure generally asked was 17c. per pound. There is still a good deal of November-December copper to be sold, and there is no rush to place orders. Excitement was caused abroad by the report of a strike at Rio Tinto, probably based upon the strike of some employees on the railway to the mine. This is not likely to have any effect on the mine output. The fortnightly statistics show that copper stocks in England and France on September 15 were 26,010 tons, a decrease of 490 tons since September 1. Exports from this country between September 1 and 18 were 20,036 tons, as compared with 15,553 tons in the same period last year. In other words, exports have increased five or six times the normal yearly increase of consumption. It is not unreasonable to assume that Europe will get stocked up after awhile. Lake Superior and Mexico are below normal as producers, but with some of the big companies making high records for output there seems little probability of any real copper famine. Reports from Lake Superior are encouraging, and Calumet & Hecla is said to have 80% of its old employees back on its payroll. The operators continue firm in the intention to have no dealings with the Western Federation, and more ore is being hoisted than at any time since the strike began. The difficulty in securing trammers is still acute, the union having pursued its usual tactics of reducing the supply of labor of this class to a minimum before calling a strike. Even if the dispute is settled soon, it will be a long time before the Lake output gets back to normal.

The Cripple Creek district has had an unusual crop of litigation recently. The suit of the Portland against the Stratton's Independence has been finally settled after the federal court had held that the suits which had been brought against the old English company were of more effect and must be started all over against its American successor. Now R. A. C. Peterson has brought suit against the El Paso Con. Mining Co., alleging that he was defrauded of 10% of the profits derived from the recent merger. He is also suing the Colorado Mines, Railways & Utilities Co. for $600,000 commission. The suit in the Montana courts to set aside the arrangement by which the Giroux secured control of the Butte & Ely has been dismissed, the presiding justice holding that the plaintiff had no right to begin the suit. Work on developing the properties of the New Copper Mines merger is in rapid progress, and local enthusiasts are already talking of mills and smelters. It is safe to assume, however, that the Company will not begin any plant construction until it has demonstrated an adequate ore reserve and thoroughly tested the methods of treatment to be adopted.

Nipissing is to begin shipping its silver to New York instead of to London. The point involved is merely a question of rates, the Company having found that it can send its bullion to New York at a greater profit. If the other Cobalt mines follow suit, New York can begin to compete with London as a silver market. At present London is the leader and the rest of the financial centres nowhere. Mexico, Tonopah, and Cobalt are geographically tributary to New York, and theoretically conditions ought to favor the increase of New York's importance as a silver market. Often, however, the really important conditions are not theoretical ones. It is interesting to notice that nearly $500,000 in gold was received from Cuba last week. Normally gold is imported from France and shipped down to Cuba, and the reverse flow is another instance of the changing conditions which recently caused Argentina and Brazil, normally gold importers, to ship gold to Europe. Egypt is a heavy gold importer just now, and will probably take $40,000,000 in return for this year's cotton crop. The output of gold in the United States last year showed a decrease of nearly $3,500,000, and as the decline is general the world over, except in South Africa, the money markets will soon have to adjust themselves to a decreasing gold supply. In speaking of money, it should be mentioned that the old sound-money controversy was reopened last week, when the New York *Sun* discovered that some one had slipped into the currency bill a provision that Government notes could be redeemed *in lawful money*, instead of gold. When this joker was discovered, such a storm of protest went up that the bill was at once amended to provide that nothing in it should be held to be contrary to the gold-standard law. While on the subject of national legislation, it should be mentioned that ferro-manganese has been restored to the free list in the financial conference on the tariff bill, and the many hypotheses as to the probable development of the domestic manufacture of ferro-alloys become groundless.

The Inspiration Consolidated Copper Co. has applied to the New York Stock Exchange to list $6,000,000 worth of its ten-year 6% convertible bonds. The North Butte has postponed its directors' meeting, at which an increase in capital was to have been considered. The Mines Company of America took no action on the dividend due to be declared last week, and with all the Mexican plants except one shut down, seems to be in for less prosperous times.

DEADWOOD, SOUTH DAKOTA

SUNDAY LABOR AND THE HOMESTAKE COMPANY.—BISMARCK CONSOLIDATED, WASP NO. 2, OLD IRONSIDES, AND GOLDEN REWARD CONSOLIDATED COMPANIES' MEETINGS.

Criticism of the Homestake Mining Co. by Bishop Busch, at a recent meeting of church people in Milwaukee, has been the cause of a great deal of discussion at Lead City, and culminated in a mass-meeting of citizens of that place, called by the mayor, when resolutions were unanimously adopted that censured the bishop for what was termed his unwarranted attack upon the Company. On the evening of the meeting, and since, the resolutions have been signed by hundreds of employees and numbers of citizens whose sympathies were with the Company. Nearly a year ago, the bishop, who was at that time a resident of Lead, started a campaign for Sunday observance, in which he had the support of the clergy of the city. A committee waited upon the superintendent, T. J. Grier, and requested that the work of the Company be suspended on Sundays. After consideration, Mr. Grier refused to do this arbitrarily, but stated that the men would at any time be allowed a day off, if they arranged with their shift boss. The bishop made a strong plea from the pulpit for his church members to take advantage of this, but not many availed themselves of the privilege. It further appears that, some years ago, Mr. Grier thought it would be a good idea for the men to rest on Sunday, and orders to that effect were given. After a few Sundays the orders were rescinded at the request of the men, who realized that it was an expensive luxury, costing them $12 to $17 per month in possible earnings.

At the annual meeting of the Bismarck Consolidated Mines Co., held at Chicago, the following directors were elected: F. B. Hitchings, Deadwood, South Dakota; Nicholas Hampe, Rock Rapids, Iowa; W. T. Upton, Chicago; M. P. Richardson, Janesville, Wisconsin; and Irving T. Crosby, Sheffield, Illinois. The officers are: F. B. Hitchings, president and general manager; N. Hampe, vice-president; and Martin H. Kendig, of Chicago, secretary and treasurer. The property of the Company adjoins the Wasp No. 2, at Flatiron, and has been operating a 250-ton dry-crushing cyanide mill since early in the past spring. Satisfactory results have been obtained, and a surplus is being accumulated from which dividends may be expected at an early date.

At the monthly directors' meeting of the Wasp No. 2 Mining Co., held at Deadwood on September 15, Chambers Kellar, general counsel for the Homestake Mining Co., was elected to the vacancy on the board caused by the death of K. G. Phillips. The board is now composed of the following gentlemen: D. A. McPherson, John Gray, T. J. Grier, R. H. Driscoll, and Chambers Kellar. At this meeting the regular monthly dividend of 1c. per share and an extra dividend of a similar amount was declared. On the issued capital of $500,000, this calls for the disbursement of $10,000, the largest dividend paid by the Company this year. It is stated that $13,000 of the earnings of the present year have been spent in extraordinary improvements, from which the stockholders will in the future draw substantial dividends.

The Old Ironsides Mining Co. has been incorporated to take over the lease and other holdings of Ringley & Co. on Squaw creek. The officers are M. T. Phillips, Central City, South Dakota, president; W. J. Ringley, Carbonate, South Dakota, vice-president; John Caretto, Lead, treasurer; and H. A. Koskie, Lead, secretary. The lease on the Old Ironsides property has until January 1, 1915, to run, and it should be productive of a large amount of good ore in the interval. Several shipments have been made, and it is the intention to continue them, and in the meanwhile an adit will be driven 500 to 600 ft. to cut the ore in quartzite and give a better opportunity for working. It is probable that the Company will purchase the property and erect a mill.

The Golden Reward Consolidated Mining & Milling Co. had a profitable year. A new mill is contemplated to handle the product of the roaster, but up to the present time its situation has not been definitely settled; it may be erected either at the roaster or at Deadwood.

Work is progressing favorably at the Heidelberg group, the property which the Deadwood Business Club is assisting to develop. The new road to the mine is nearly completed, one of the unexpected results of which was the disclosure, in the course of the work, of a body of porphyry ore which gave some startling assays. A small crew is employed in development work at the mine. This crew will be augmented when the road work is completed, which will probably be before the end of September.

General Mining News

ALASKA

JUNEAU

The Alaska Treadwell Gold Mining Co. will install in the power-plant at its mines a 225-kva. alternating-current generator and switchboard which will be furnished by the General Electric Company.

Development west of the Alexander cross-cut in the Alaska Gold Mines property has opened ore above the estimated average value of the mines' reserves. The last cross-cut, 600 ft. west of the shaft, has opened an orebody for 150 ft. and is still in ore.

SHUSHANA

The new placer district was recently examined by D. Cairnes, of the Canadian Geological Survey, who gave the following description on arrival at Dawson, Yukon. The region proper comprises an area of about six by twelve miles. The 'diggings' are bounded on two sides by Wilson and Johnson creeks, and on the other two sides by the Chisana river and the summit. Within this area are most of the creeks which have been staked, including Little Eldorado, Bonanza, Coarse Money, Gold Run, and Too Late. Some prospecting has been done on some of the creeks other than Eldorado, where the discovery was made, but the work has been retarded because of the scarcity of men and provisions. On discovery claim, the prospectors are taking out about $300 per man per day. Many of the stampeders, Mr. Cairnes said, were wandering about the country looking for claims to stake, but were unable to find them, because everything in the immediate vicinity of the find had been located before their arrival. Sufficient supplies should be placed within easy reach of the district before the freeze-up, so that they can be taken in easily during the winter.

In the *Cordova Daily Alaskan* of August 28 is published a description of the new field by George C. Hazelet, who recently visited the district. From Cordova the actual traveling time was 6½ days. The James claim, on Little Bonanza creek, had produced 358 oz. gold from an area 2½ by 16 by 80 ft. Apparatus used is crude, and the tailing will yield from 10 to 50c. per yard. Carl Whitam is cleaning-up satisfactory returns. His gravel is shallow and the creek bed is narrow. J. MacLellan and associates are sluicing on No. 3 Bonanza, and while the gravel is narrow, three men are getting 10 to 20 oz. per day. There are two main creeks with their tributaries that constitute the explored region, namely, Wilson and Johnson. These creeks

MAP OF SOUTHEASTERN ALASKA. THE SHUSHANA DISTRICT IS ABOUT 90 MILES FROM KENNECOTT AND 260 MILES FROM DAWSON.

are tributaries of the Chisana, from which the find takes its name. The gold-bearing district is about 15 by 50 miles in extent, and Mr. Hazelet visited an area of about 5 by 10 miles. The ground is frozen below a depth of 5 or 6 ft., and it is believed by him that the gravel will be deep and require thawing. There are two serious drawbacks to the entire region, namely, lack of wood and water. Mr. Hazelet is sure there is good 'pay' on Bonanza from No. 1 to No. 10, and on Little Eldorado on No. 1 and 2. All this is on the Johnson side. On the Wilson side good prospects are found on Big Eldorado, Gold Run, and Glacier, with some of their tributaries, but bedrock has not been reached and nothing can be told until it is. If the camp is a permanent one the pay will largely be found in the deep bench ground, and it will take from one to two years to determine the value of the district.

ARIZONA

Gila County

(Special Correspondence.)—At the Inspiration work has been started on the installation of a No. 8 gyratory crusher and Symons 48-in. disc-grinder near the Scorpion waste dump. This machine is intended to crush ore hoisted through the Scorpion shaft, which will then be transported to the new test mill. Work is now in progress on this test mill and it should be ready for operation within a few months, as practically all crushing machinery has been received and unloaded.

Globe, September 13.

The developments for the past six months at the property of the Superior & Boston Copper Co. have been very encouraging, and there are possibilities of finding a large body of ore with depth, according to E. B. Tinker, the superintendent. On the 600-ft. level the vein is 600 ft. long, from 10 to 30 ft. wide; on the 800-ft. level the vein is 400 ft. long; the stope between No. 8 and 6 levels has so far yielded 15,000 tons of 6% copper ore, daily extraction being 150 tons; and on the 1000-ft. level the vein was not clearly defined at its contact with the McGaw cross-fault, but after driving east, 2 ft. of 15% sulphide ore was opened. Ore deposition on contacts usually occurs in the form of pockets, and the fact that in places the vein is found barren only goes to show that its occurrence at the Superior & Boston mine is no exception to the rule.

Probably a mill will be erected at the Magma within a few months, while the new electrical equipment at the mine is nearly ready for connection with the transmission line from the Roosevelt dam. With the completion of the transmission lines and installation of power plants, this power scheme will be a boon to the district.

Graham County

Mining in this county is gradually getting more active. Twelve miles from Safford, is the Arichise group, and churn-drilling is under way to prospect the copper deposits. Some claims on Turnbull mountain have been bonded to Globe people.

Greenlee County

Work is to be started at the Twin Peaks. The main shaft is down 250 ft., and from 600 to 700 ft. of cross-cutting has been done. Probably a 250-ton mill will be erected to treat the gold-silver ore.

Pima County

It is stated that churn-drills have already proved the existence of 27,000,000 tons of 1.7% copper ore in the Ajo properties of the Calumet & Arizona Copper Company.

CALIFORNIA

Butte County

The 25-ton cyanide plant at the Triumph mine, near Lumpkin, is nearly completed. Development at the mine is satisfactory.

Placer County

The Iowa Hill district is quite active. The Progressive Placer Mining Co. of Ohio, in Rossi's cañon, is meeting with success. Gravel that yields $2 per cubic foot has been opened, and the capacity of the plant will be increased to 500 cu. yd. per day. A big drag-line scraper is to be used in the work. The Big Dipper is working a small force of men at present. The old Gleeson mine is about to be started again after being closed for lack of water.

Sacramento County

It is reported that Calumet & Hecla, Michigan, engineers have bonded 1300 acres of land near Michigan Bar, and men are now prospecting with a view to future dredging. During July the Natomas Consolidated dredges produced $175,231, the net return being $96,222.

Shasta County

A telegraph despatch from Redding states that, owing to defects in the gas-generating plant, the Hall desulphurizing process trials are postponed temporarily.

Tuolumne County

(Special Correspondence.)—The Springfield Tunnel & Development Co. has met with another flow of water in its deep gravel mine near Columbia, and may retard the progress of mining work. The three large pumps have been working steadily, but the increased amount of water seems more than they can handle. A report from Groveland states that a bed of gravel 80 ft. wide and 6 ft. thick, that will yield $5 per cubic yard, has been uncovered in the Gold Ship gravel mine, of which William J. Graham has long been manager and superintendent. Accompanied by a mining engineer, Thomas Lane, Sr., of Angels, and John Greenhaigh are this week making an inspection of the Sonnet and Riverside mines, with a view to purchasing the properties. Recent development work at the Sonnet has resulted in opening good orebodies, and it is believed likely that a deal will be made. Active operations are to be resumed at the Columbia Basin gravel mine by A. B. Johnston, of San Francisco, who, according to report, has acquired the property. The Garfield mine, near Tuolumne, has resumed operation, and it is understood some new machinery is to be installed. William Floyd, of Soulsbyville, is the owner of the property.

Sonora, September 6.

COLORADO

Chaffee County

The Mary Murphy mine is owned by the Mary Murphy Gold Mining Co., Ltd., an English company, and is situated at Romley, three miles above St. Elmo, and 24 miles from Buena Vista. Recently John R. Curley, state mine inspector, visited the property and on his return reported to the *Herald Democrat*: "The Mary Murphy mine is developed by a series of adits running from No. 1 to No. 22, the latter being the lowest and driven a distance of 5400 ft. into the hill. From the breast a raise has been driven 400 ft., in order to make connection with the old workings, and has still 400 ft. to go before connections are made. At No. 14 adit, the lower portion of which was in the old workings of the Mary Murphy, was started a short time ago, and at 1000 ft. from the portal at this point a large and new orebody was opened for 300 ft., and there are no signs of its diminishing. The average width of the vein is from 12 to 14 ft., worth up to $30 per ton. This ore is shipped direct to the smelter. The character of the ore is a lead sulphide carrying gold, silver, lead, and zinc, and with the exception of the ore from No. 14 adit, all of the ore from the mine is sent to the mill with an average value of from $8 to $10 per ton, including all minerals. The mine produces 150 tons per day of crude ore, the mill product being $40 per ton in gold, silver, and lead. There are a series of aerial tramways from 2000 to 5000 ft. long, which convey the ore from the upper workings to the mill below. Seventy-five miners are employed in the mine, while 40 men are engaged at the mill. In addition to the work done by the Company, four sets of lessees are at work on adits No. 1, 2, and 3. The tonnage from the whole property is 4500 tons per month."

Conejos County

A recent executive order, signed by President Wilson, takes 160 acres from the Rio Grande National Forest of Colorado to provide a site for a new town, Platoro. It is pointed out that this elimination furnishes an example of how land is taken from the national forests when needed

for a townsite, or for other important public use that does not conflict with national forest purposes. This site is in the midst of a district in which recent discoveries of mineral veins are reported to have been made, and the resulting revival of mining activities created the demand for a townsite.

EAGLE COUNTY

Reports from the Brush Creek district state that the lessees on the Dakotas, said to be the western extension of the Lady Belle, have an 18-in. streak of ore that assays 300 oz. silver per ton and that a shipment will be sent out in the near future.

LAKE COUNTY (LEADVILLE)

(Special Correspondence.)—The St. Kevin Mining Co. will experiment during the winter on its silver sulphide ores, and probably erect a mill next spring.

Leadville, September 15.

TELLER COUNTY (CRIPPLE CREEK)

The tenth annual report of the Jerry Johnson Gold Mining Co. for the fiscal year terminating August 31, has been issued, and shows a production for the year of 4380 tons of ore with a gross bullion value of $86,136. Deducting $27,533 for freight and treatment, the net value of the ore was $58,592, and the total amount in royalties paid into the treasury of the Company was $14,444. The cash balance in the treasury on September 8 amounted to $21,058. No development work has been done below the 650-ft. level; nearly all of the ore that has been shipped has been taken from the old workings at various points and not from permanent bodies, and although a large amount of dead work was done, little new ore has been found. If the property is leased again, the management will endeavor to provide for the development of the virgin ground between the 650-ft. level and the present bottom of the shaft, which has attained a depth of 975 feet.

Telluride ore assaying up to $216 per ton has been opened on No. 13 level of the Mable M. shaft of the Gold Dollar Consolidated Mining Co. on Beacon hill. A vein of altered granite cut by a phonolite dike has shown 3 ft. of ore at the Cardinal mine, Gold hill. The additional Chilean mill is now working at the Portland mill.

The Golden Cycle Mining Co. has increased its monthly dividend rate from 2 to 3c. per share, equal to a total of $45,000. No. 1 shaft of the Portland company is now down 1300 feet.

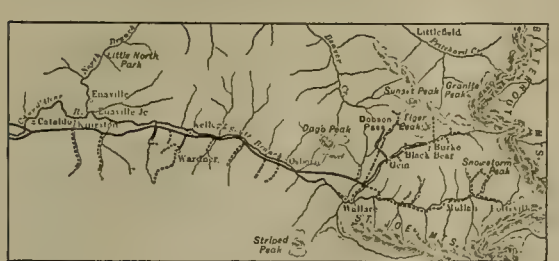
IDAHO

BLAINE COUNTY

The Boulder Creek Mining Co. is operating a lead property of 500 acres on Boulder creek, near Ketchum. In the Lucky Boy claim, an adit has opened high-grade galena ore, and an open-cut shows 4 ft. of carbonate and galena ore. Regular shipments are made.

SHOSHONE COUNTY

The complaint of the Federal Mining & Smelting Co. against the new schedule of the Washington Water Power



MAP SHOWING TRANSMISSION LINES OF THE WASHINGTON WATER POWER CO.

Co. increasing the rates for electricity furnished for power and lighting purposes to the mines, is the most important case to come before the Public Utilities Commission. Every mining company in the Coeur d'Alene district is interested in the outcome, and several have joined in the complaint. The commission has ordered the new schedule suspended pending the outcome of the hearing, the date of which has not been set. The issue involved, briefly, is this: The Washington Water Power Co. has been selling electricity to the large operating mining companies in the Coeur d'Alene on contract at wholesale prices, the mining companies in turn using the power on their properties and disposing of the surplus. Some idea of the magnitude of the electrical business that has been developed is shown by the fact that the Federal company, since it made its contract for electricity with the power company, August 10, 1908, has paid that company $900,000, and power consumers have paid $2,200,000. On August 6 of the present year the power company filed a new schedule of electric power rates with the Public Utilities Commission, showing an increase in these rates of approximately 10%, and it canceled and superseded all preceding rates. The contract the Federal company has with the power company has not as yet expired, although made in August 1908. D. L. Huntington, president of the power company, states that the Company will oppose any reduction in rates, which are much lower than the average rates in mining districts in the United States. The service given is certainly not surpassed and rarely equaled by any other company in the country.

A much-desired report from the Hercules Mining Co. states that in August the production was as follows: concentrate, 1169 tons; slime, 907 tons; and crude ore, 1731 tons; a total of 3807 tons. Cave-ins at the mine have curtailed production during the spring. The No. 5 long adit is far from completion, having reached a length of about 6000 ft. with probably 2000 ft. yet to be driven. This will require at least another year, including the necessary connections. Eugene R. Day is manager.

The Reindeer Copper-Gold Mining & Milling Co. and the Copper Queen Mining & Milling Co. have been consolidated. The new company, the Reindeer-Queen Mining Co., has a capital of 2,000,000 shares at 10c. each, and owns 15 claims near Mullan.

The miners' rescue car of the U. S. Bureau of Mines, in charge of J. M. Anderson, arrived at Wallace during the previous week, and has been to Nine Mile, where the miners of that district, and especially those of the Tamarack, Success, and Interstate mines, were instructed in underground rescue work, the first aid, and the use of the oxygen helmet. After a week of instruction work the car was taken to Mace, where it will remain from September 23 to October 1; from there to Burke, October 1 to October 8, and then to Mullan, where it will remain until October 18. In this way the car will visit all the large mines in the district to the south.

Repairs had only been made to the 800-hp. hoist at the Greenhill-Cleveland mine, when the brakes again refused to work and the skip of steel being hoisted fell 2000 ft., the engine being badly damaged. The real cause of the accident is being investigated, while in the meantime 375 men are out of employment.

MICHIGAN

HOUGHTON COUNTY

The most important step toward the mediation and settlement of the labor troubles in the copper country was taken on September 13, when the Copper Country Commercial Club appointed a committee to investigate the strike situation and bring about an adjustment of differences. It is thought that this committee will be able to act as mediator between the mine managers and the men still on strike. The club is an influential body in Houghton and Keweenaw counties.

On September 20 the Circuit Court granted an injunction against the Western Federation of Miners from interfering in any way with the miners now at work in the district. The strikers were not pleased with this decision. The mine-owners have refused to arbitrate their differences with the men.

MONTANA

LINCOLN COUNTY

(Special Correspondence.)—C. E. Lukens, of Libby, has

purchased a half-interest in 520 acres of placer ground from William Criderman. The ground is situated 16 miles south of Libby, on Libby creek, and is believed by those interested to be rich in gold. The property is to be developed as rapidly as possible, the intention being to install a hydraulic plant, utilizing the water of Libby creek. On this placer ground there are also large deposits of a fine quality of marble, and recently a vein of onyx was discovered.

Libby, September 8.

(Special Correspondence.)—Paul D. Pratt has recently completed the work of surveying the pipe-line and ditch on the William Criderman placer claims, 16 miles south of Libby, and the development work is in progress. C. E. Lukens, of Cut Bank, Montana, recently purchased an interest in these claims, and it is the intention at once to install a hydraulic plant. According to the agreement between Lukens and Criderman, this plant must be completed by September 1, 1914.

Libby, September 16.

HILL COUNTY

(Special Correspondence.)—A company has been formed to prospect for gas near Havre. The success of the natural-gas supply at Red Cliff, Alberta, has encouraged the Havre people in the hope that their drilling will meet with good results.

Havre, September 20.

MADISON COUNTY

(Special Correspondence.)—The Mount Meadow group of claims on Willow creek, four miles southwest of Pony, is being worked by lessees. Concentrate from the 10-stamp mill is being shipped to the East Helena smelter of the A. S. & R. Co. The contents are gold, silver, and copper.

Pony, September 20.

MISSOULA COUNTY

(Special Correspondence.)—A trial car of ore from the St. Lawrence mine, near Saltese, has been shipped to the Tacoma plant of the A. S. & R. Company.

Saltese, September 20.

NEVADA

HUMBOLDT COUNTY

(Special Correspondence.)—Frank Treyer, Charles Kolback, and George Stackel are developing the old Tellulah mine in the Sierra district. It is a silver property, and after making the ventilation better, they mined some $59 ore near a fault, the quartz vein being 3 to 4 ft. wide, of which 12 in. contained the rich ore. This shoot has tapered to a narrow streak, and it is probable that 150 ft. will have to be driven to the next shoot. Faulting has proved troublesome in this ground.

Mill City, September 6.

LANDER COUNTY

(Special Correspondence.)—The Kimberly Consolidated Mines Co. has taken over the properties of the Philadelphia Western Mining Company.

Hilltop, September 16.

NYE COUNTY

At Manhattan, the Big Four mill is crushing 100 tons of ore per day, only five men being needed for its operation. During August, 11 mines at Tonopah treated 53,182 tons of ore, valued at $1,046,600. The Millers plant of the Belmont company is kept working full time on custom ore. On the 850-ft. level, the Extension has cut the Murray vein in the north cross-cut. It is 16 ft. wide, and on the hanging wall is a rich shoot 4 ft. wide.

NEW MEXICO

SOCORRO COUNTY

(Special Correspondence.)—The average value of the ore milled from adits B and C (East End Tunnel group) of The Oaks Co. in August was $16.12 per ton. Average grade from adit A winze during the past month was $20.80 per ton. A is the deepest adit now being driven on the vein. The Clifton adit of the Socorro Mining & Milling Co. being driven on the 'Mother Lode' of the district, is expected at any time to encounter and drain the large flow of water found on the 500-ft. level in the mine last year, and which was bulkheaded at the time. It is reported that a body of ore averaging $40 per ton was recently cut on the 800-ft. level. The mill is treating 175 tons per day.

Mogollan, September 20.

NORTH CAROLINA

MONTGOMERY COUNTY

(Special Correspondence.)—The Uwarra Mining Co., at Candor, is operating a gold-quartz property with well equipped plant. A 50-ton cyanide plant is nearly completed.

Candor, September 20.

UTAH

SALT LAKE COUNTY

(Special Correspondence.)—Another metallurgical change is impending at the Lark plant of the Ohio Copper Co., according to the rumors in circulation since M. H. Atwater completed his investigation of the mining and milling conditions of the Company. The Ohio has used no less than three systems of reducing its low-grade copper ore since the mill was put into service. As originally constructed, the Blake crusher was employed for coarse work and Chilean mills for regrinding. Then E. A. Wall had a series of rolls installed for this work, and 16 were in operation early in 1912, with an addition of four more later in the year. The Wall rolls were then removed and another type of machine tried, but is said not to have helped the recovery of copper. The mill is treating about 2250 tons per day of 1% copper ore, with an extraction of 60%, at a cost of 80 to 85c. per ton. The August production was 650,000 lb. of copper. Oil flotation has been spoken of as an aid to higher recoveries.

Salt Lake City, September 14.

The Utah Copper Co. produced 10,620,981 lb. of copper during August from the treating of 21,000 tons per day at the mills at Garfield. The Western Federation of Miners has officially declared off the strike of miners at Bingham, which started about a year ago, but full work has been under way for about nine months.

WASHINGTON

JEFFERSON COUNTY

(Special Correspondence.)—At the Tubal Cain the adit is in 2000 ft., and another 150 ft. must be driven to cut the vein. South of Mt. Constance a company is mining a manganese-copper-gold ore, the latter mineral being largely in a native condition. The vein is 5 ft. wide and from 25 to 30 tons per day of 4% ore is being stacked on the dumps. It is planned to use auto-trucks for ore transport, and the ore will then be sent to the Tacoma smelter.

CANADA

ONTARIO

The Alexo nickel mine, Iroquois Falls, shipped 550 tons of ore during August. In the Keeley mine, South Lorrain, a high-grade vein 6 in. wide has been opened. The country rock is Keewatin, and the rocks of the property are similar to those near the Temiskaming mine. The Keeley is under option to the Associated Gold Mines Co. of Western Australia. It is stated that the Wettlaufer mine will be shut down at the end of October. This mine has produced some rich ore down to the 200-ft. level, but below this the vein carried no silver content. Diamond-drilling is now being done, and 80 tons of high-grade ore awaits shipment. Since the draining of Kerr lake was started, six new veins, some containing rich silver content, have been exposed in hitherto unprospected ground.

COLOMBIA

The gold yield from three dredges of the Oroville Dredging Co. during the weeks ended August 23 and September 2 was $5689 and $13,650, respectively.

COSTA RICA

During July the Abangarez Gold Fields of Costa Rica

Co. crushed 6347 tons of ore, leached 657 tons of sand, and filtered 5152 tons of slime, yielding a total of $50,249. The loss on operation was $7295.

KOREA

The August clean-up of the Oriental Consolidated Mining Co. was valued at $148,715, and details of the July yield are as follows:

Ore treated, tons	25,066
Tabowie mill	$ 28,585
Taracol mill	19,699
Kuk San Dong mill	4,282
Maibong mill	17,438
Taracol tube-mill	58,159
Kuk San Dong cyanide plant	5,504
Kuk San Dong dump plant	6,713
Total	$140,380

The Candlestick mill was shut down during the whole of the month, owing to the scarcity of miners. That mill is now running, and it was hoped to keep it working the whole of August on ore broken last month and during the present month. The extraction in the Taracol tube-mill plant for July was 91%. The electric power-plant gave power for lights only up to July 28, when there was seven inches of rain which gave sufficient water to operate the power-plant at full capacity from that date. The Chorrie reservoir still lacks 31½ ft. of water of being full, so that more rain is needed. The season has been unusually dry up till now.

MEXICO

CHIHUAHUA

The San Toy Mining Co. reports net returns of $196,075 from the sale of ore during the first half of 1913. The total income was $205,642; expenditure, $106,433; net earnings, $99,209; dividends, $57,500; and cash on hand $464,-521. The statement says that operation at the mines, which was interrupted by Constitutionalists in June, was resumed on July 22. From that date shipments have been made regularly. Twelve cars of ore were shipped in July and 30 in August. On September 1 regular railroad and mail service had not been resumed between El Paso and Chihuahua, and telegraphic communication is intermittent.

GUANAJUATO

(Special Correspondence.)—At three of the properties of the Mexican United Co., namely, the Continuacion, Aguila, and Westward, new shafts are being sunk. New equipment, including a double-drum electric hoist, air-compressor, and machine drills, is to be installed.

Guanajuato, September 12.

SONORA

The Tigre Mining Co. reports that during August the stamp-mill crushed 5557 tons of ore, and the cyanide plant treated 5184 tons of current and 1743 tons of dump tailing, yielding a total, including shipping ore, of $119,429. The estimated profit was $44,471.

PERU

An examination made by Carl Hand for the McCune-Haggin interests in the Huánuco goldfield, northeast of the Cerro de Pasco copper district, shows that the previous reports of rich gravels are not corroborated, and the samples taken must have been salted. It seems that in shipping the gravel to Lima and Casapalca for assaying, little if any attempt was made to prevent the operations of a 'salter.' The placers in question are along the banks and in the bed of the Huallaga river in the vicinity of Ambo, about 48 miles from Cerro de Pasco and the same distance from Goyllarisquisga. The proposed line of the Amazon Pacific railway would cut directly across the land included in the claims. Several thousand acres of land had been denounced by the various claim-holders. The McCune-Haggin interests purchased the original claims for $67,000, while the Huánuco Gold Mines Syndicate spent a fair sum in prospecting.

Personal

Professional men are invited to send news of their engagements and travels. Such news is interesting to friends.

J. F. B. ERDLETS, JR., is in Hamburg.

HERMAN A. KELLER is in Switzerland.

HOVAL A. SMITH is in New York City.

F. LYNWOOD GARRISON is in California.

H. L. HOLLIS has been in San Francisco.

THOMAS F. COLE is visiting Bisbee, Arizona.

OLAF WENSTROM was in New York last week.

ROBERT RAYMOND was in San Francisco last week.

WILLIAM B. PHILLIPS is in New York from Texas.

L. A. DECOTO has returned to Oakland from Colombia.

F. W. GRIFFIN and S. L. G. KNOX have gone to London.

STEPHEN BIRCH has returned from Alaska to New York.

ALBION S. HOWE has returned to San Francisco from Costa Rica.

E. R. LEACH has resigned his position with the San Francisco Mint.

R. A. F. PENROSE, JR., is engaged in professional work in the Western states.

RALPH NICHOLS, of the Latest Out mine, Gilmore, Idaho, was at Butte recently.

R. KEMP WELCH has removed from Elk City, Idaho, to Fort Bidwell, California.

JAMES QUIRK has been appointed superintendent at the Prince Consolidated mine.

E. H. EMERSON has returned to Santiago de Cuba after a holiday in the New England states.

M. C. GODBE has been appointed assistant general manager at the Prince Consolidated mine.

J. H. HARTLEY has returned from Abangarez, Costa Rica, to Berkeley, California, for a three months vacation.

J. H. HOLMAN was not drowned in the wreck of the *State of California* as announced in our issue of August 23.

W. R. C. BEADON has been elected president of the newly formed Lower Burma Chamber of Mines, at Tavoy, India.

HOWLAND BANCROFT will be for five weeks at Boulder, lecturing on economic geology at the University of Colorado.

G. B. STREET has returned from Alaska and was at San Francisco this week investigating sulphur and pyrite supplies.

L. V. BENDER and C. D. DEMOND, of the Washoe Reduction Works, have returned from a trip of inspection to various Eastern metallurgical plants.

A. P. COLEMAN is suffering from a broken leg due to a fall while with a party from the International Congress of Geologists in western Canada.

FREDERICK G. CLAPP has returned from the gasfields of Hungary, and has gone to New Brunswick in company with MYRON L. FULLER and LLOYD B. SMITH.

ALFRED S. GUGGENHEIM, F. H. MAYNARD, H. L. ROGERS, and C. D. WETMORE were among those who returned from Europe on the *Lusitania*, September 19.

R. B. BRINSMADE has been examining the Las Minas district of the state of Vera Cruz, Mexico, with a view to reopening one of the antigua mines there.

W. L. CREDEN has been appointed managing director for the Utah-Apex Mining Co., at Bingham, Utah, but he will retain his headquarters at Butte, Montana.

J. W. FINCH, R. D. GEORGE, FRED SEARLES, and A. C. LAWSON are among those present at Jackson in connection with the Argonaut-Kennedy Extension litigation.

W. G. ANDERSON, recently with the Elko Prince Development Co. at Midas, Nevada, is now superintendent for the Moccisan Consolidated Gold Mining Co., at Jacksonville, Tuolumne county, California.

GEORGE E. FARISH has returned to British Columbia and is now engaged in examining the properties of the Queen Mines Incorporated, at Sheep Creek, West Kootenay, British Columbia.

ROBERT P. ROBERTS, recently with the Great Falls smelter, Montana, has taken up his duties as metallurgist to the Mt. Lyell Mining & Railway Co., Tasmania, in place of A. L. DEAN, resigned. Mr. Dean was recently in San Francisco.

The Metal Markets

LOCAL METAL PRICES

San Francisco, September 25.

Antimony	12—12½c	Quicksilver (flask)	$39.50
Electrolytic Copper	17½—17¾c	Tin	46—47½c
Pig Lead	5.60—5.95c	Spelter	7½—7¾c

Zinc dust, 1400 lb. casks, per 100 lb., small lots $9.50—9.75; large $7.50—8.50

EASTERN METAL MARKETS

(By wire from New York.)

NEW YORK, September 25.—The copper market is quiet, the producers holding firm and the dealers are underbidding. Prices are being maintained, but few sales recorded. One of the largest selling agencies has quoted electrolytic copper for delivery at 16⅝c. A slight weakening in copper stocks is noted. Yesterday closed with October at 15.50 to 16.37; November, 15.50 to 16.25; electrolytic, 16.87 and lake, 17; castings, 16.62 to 16.75. Lead and zinc are being pressed for sale. Tin is quiet and irregular, with spot at 41.80 to 42.10. The London market closed with spot copper at £72 12s. 6d. and futures £72 10s.

SILVER

Below are given the average New York quotations, in cents per ounce, of fine silver.

Date.		Average week ending	
Sept. 18	61.00	Aug. 14	59.12
" 19	61.50	" 20	59.16
" 20	61.37	" 27	59.46
" 21 Sunday		Sept. 3	59.60
" 22	62.12	" 10	59.58
" 23	61.87	" 17	60.20
" 24	61.67	" 24	61.59

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	56.25	63.01	July	60.67	58.70
Feb.	59.06	61.25	Aug.	61.32	59.32
Mch.	58.37	57.87	Sept.	62.95	....
Apr.	59.20	59.26	Oct.	63.16	....
May	60.88	60.21	Nov.	62.73	....
June	61.29	59.03	Dec.	63.38	....

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.		Average week ending	
Sept. 18	4.70	Aug. 13	4.48
" 19	4.70	" 20	4.68
" 20	4.70	" 27	4.75
" 21 Sunday		Sept. 3	4.75
" 22	4.68	" 10	4.73
" 23	4.68	" 17	4.73
" 24	4.68	" 24	4.69

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	4.43	4.28	July	4.71	4.35
Feb.	4.03	4.33	Aug.	4.54	4.60
Mch.	4.07	4.32	Sept.	5.00	....
Apr.	4.20	4.36	Oct.	5.08	....
May	4.20	4.34	Nov.	4.91	....
June	4.40	4.33	Dec.	4.20	....

ZINC

Zinc is quoted as spelter, standard Western brands, St. Louis delivery, in cents per pound.

Date.		Average week ending	
Sept. 18	5.53	Aug. 13	5.45
" 19	5.53	" 20	5.51
" 20	5.50	" 27	5.60
" 21 Sunday		Sept. 3	5.63
" 22	5.48	" 10	5.65
" 23	5.48	" 17	5.59
" 24	5.48	" 24	5.50

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	6.42	6.88	July	7.12	5.11
Feb.	6.50	6.13	Aug.	6.96	5.51
Mch.	6.57	5.94	Sept.	7.45	....
Apr.	6.63	5.52	Oct.	7.36	....
May	6.68	5.23	Nov.	7.23	....
June	6.88	5.00	Dec.	7.09	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California, being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending			
Aug. 27	40.00	Sept. 10	40.00
Sept. 3	40.00	" 17	39.50
		" 24	39.50

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	43.75	39.37	July	43.00	41.00
Feb.	46.00	41.90	Aug.	42.50	40.50
Mch.	46.00	40.20	Sept.	42.12	....
Apr.	42.25	41.00	Oct.	41.50	....
May	41.75	40.25	Nov.	41.50	....
June	41.30	41.00	Dec.	39.75	....

TIN

New York prices control in the American market for tin, since the metal is almost entirely imported. San Francisco quotations average about 5c. per lb. higher. Below are given average monthly New York quotations, in cents per pound:

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	42.53	50.45	July	44.25	40.70
Feb.	42.96	49.07	Aug.	45.80	41.75
Mch.	42.58	46.95	Sept.	48.64	....
Apr.	43.92	49.00	Oct.	50.01	....
May	46.05	49.10	Nov.	49.92	....
June	45.76	45.10	Dec.	49.80	....

COPPER

Quotations on copper as published in this column represent average wholesale transactions on the New York market and refer to electrolytic copper. Lake copper commands normally from 1-5 to 1-4c. per lb. more. Prices are in cents per pound.

Date.		Average week ending	
Sept. 18	16.45	Aug. 13	15.53
" 19	16.43	" 20	15.59
" 20	16.43	" 27	15.51
" 21 Sunday		Sept. 3	15.69
" 22	16.40	" 10	16.32
" 23	16.38	" 17	16.44
" 24	16.38	" 24	16.41

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	14.09	16.54	July	17.19	14.21
Feb.	14.08	14.93	Aug.	17.49	15.42
Mch.	14.68	14.72	Sept.	17.56	....
Apr.	15.74	15.22	Oct.	17.32	....
May	16.03	15.42	Nov.	17.31	....
June	17.23	14.71	Dec.	17.37	....

The report of James Lewis & Sons, of Liverpool, dated September 1, shows the following copper situation in Europe:

STOCKS OF COPPER (TONS FINE)

	Sept. 1, 1910.	Sept. 1, 1911.	Sept. 2, 1912.	Sept. 1, 1913.
Chilean in—				
Liverpool and Swansea	13,585	4,374	5,558	1,674
France	684	661	981	436
American in—				
Liverpool and Swansea	28,599	18,215	2,450	1,553
France	4,779	4,391	6,356	2,108
Sundries in—				
Liverpool and Swansea	1,291	1,007	1,202	354
London and Newcastle	15,039	7,355	3,840	1,413
Birmingham	105	360	470	210
France	842	676	549	633
English in—				
Liverpool and S. Wales	21,532	21,350	16,030	11,625
Total in England and France	86,456	58,389	37,436	20,006
Sundries in—				
Germany, Holland, etc.	*8,240	18,450	4,696	8,439
Total European stocks	94,696	76,839	42,132	28,445
Afloat (as advised by mail and cable to date)—				
From Chile	3,275	1,975	2,600	2,300
From Australia	7,775	6,550	5,600	4,200
Total visible supply	105,746	85,364	50,332	34,945

*Proportion of year's stock.

The last issue of the 'Financial and Economical Annual' of Japan contains the following interesting figures relating to gold and silver, given in yen, one yen = 50 cents.

	1910.	1911.	1912.
Production of gold	5,671,806	6,059,497	.....
Production of silver	4,896,188	4,761,652	.....
Gold bullion and specie:			
Exports	22,577,124	21,801,564	21,201,849
Imports	17,494,098	4,938,672	10,380,596
Net exports	5,083,026	16,862,892	10,821,253
Silver bullion and specie:			
Exports	2,597,967	2,596,722	7,123,304
Imports	177,699	1,229,596	1,163,755
Net exports	2,420,268	1,367,126	5,959,549

The Stock Markets

SAN FRANCISCO STOCKS AND BONDS

(San Francisco Stock and Bond Exchange)

BONDS

September 24.

Listed.	Bid	Ask	Unlisted.	Bid	Ask
Associated Oil 5s	$100	--	General Petroleum 6s	$86	86½
E. I. du Pont 4½s	83½	--	Natomas Dev. 6s	97½	--
Natomas Con. 6s	--	74	Pac. Port. Cement 6s	99½	--
Unlisted.			Standard Cement 6s	91½	--
Am. Oil 5s	76½	--	Santa Cruz Cement 6s	83	--

STOCKS

Listed.	Bid	Ask	Unlisted.	Bid	Ask
Amalgamated Oil	--	84	Mascot Copper	1½	2½
Associated Oil	42½	--	Noble Electric Steel	2½	--
E. I. du Pont pfd	86	92½	Natomas Consol	5	10
Pac. Cst Borax, com	--	100	Pacific Port. Cement	63	--
Pacific Crude Oil	22½c	--	Riverside Cement	45	--
Sterling O. & D.	70c	--	Santa Cruz Cement	41½	--

NEVADA STOCKS

(By courtesy of San Francisco Stock Exchange.)

San Francisco, September 25.

Atlanta	$ .14	Mizpah Extension	$ .38
Belcher	.21	Montana-Tonopah	1.20
Belmont	7.10	Nevada Hills	.88
Big Four	.28	North Star	.45
Cash Boy	.08	Ophir	.24
Florence	.23	Pittsburg Silver Peak	.45
Goldfield Con.	1.90	Round Mountain	.40
Goldfield Oro	.08	Sierra Nevada	.12
Halifax	1.55	Tonopah Extension	2.00
Jim Butler	.68	Tonopah Merger	.66
Jumbo Extension	.12	Tonopah of Nevada	4.75
MacNamara	.11	Union	.10
Mexican	1.12	West End	1.55
Midway	.43	Yellow Jacket	.28

COPPER SHARES—BOSTON

(By courtesy of J. C. Wilson, Mills Building.)

September 25.

	Bid	Ask		Bid	Ask
Adventure	$ 1½	1¾	Mohawk	$ 44	45
Allouez	36	37	North Butte	28½	29
Calumet & Arizona	67½	68	Old Dominion	52½	53
Calumet & Hecla	442	448	Osceola	82	83
Centennial	14	14½	Quincy	61	62
Copper Range	40	40½	Shannon	7	7¼
East Butte	12½	12¾	Superior & Boston	3	3⅛
Franklin	4	4½	Tamarack	32	32½
Granby	73½	74	U. S. Smelting	41	41½
Greene Cananea	32	32½	Utah Con.	9½	9¾
Hancock	18	19	Victoria	1½	1¾
Isle-Royale	19	19½	Winona	90c	99c
Mass Copper	2½	3	Wolverine	44	45½

NEW YORK QUOTATIONS

(By courtesy of E. F. Hutton & Co., Kohl Building.)

September 25.

	Bid	Ask		Bid	Ask
Alaska G. M.	21	21½	Mason Valley	5¼	6½
Braden Copper	7⅝	7¾	McKinley-Dar.	1½	1⅝
B. C. Copper	2½	2¾	Mines Co. Am.	2⅛	2⅜
Davis-Daly	1⅞	2⅛	Nipissing	8¾	9
Dolores	2	4	Ohio Copper	7¼	7½
El Rayo	1	2	San Toy	18	22
Ely Con.	6	8	Sioux Con.	1	2
First Nat.	3⅛	3⅜	So. Utah	⅛	¼
Giroux	1¼	1¾	S. O. Calif.	190	193
Greene Can.	6½	7	Tri Bullion	⅛	¼
Hollinger	16½	17½	Tuolumne	2⅛	2¼
Iron Blossom	120	130	United Copper	¼	⅝
Kerr Lake	4⅛	4¼	Wettlaufer	14	16
La Rose	2¼	2¼	Yukon Gold	2¼	3

LONDON QUOTATIONS

(By cable, through the courtesy of Catlin & Powell Co., New York.)

September 25.

	£	s.	d.		£	s.	d.
Alaska Mexican	1	17	6	Kern River Oilfields	0	8	9
Alaska Treadwell	8	5	0	Mexico Mines	5	17	6
Alaska United	4	0	0	Messina	1	10	0
Arizona	2	1	3	Oroville	0	6	3
California Amalg	0	2	6	Pacific Oilfields	0	2	6
California Oilfields	6	5	0	Rio Tinto	77	5	0
Camp Bird	0	16	9	Santa Gertrudis	0	18	9
El Oro	0	15	0	Stratton's	0	2	6
Esperanza	0	18	9	Tanganyika	2	10	0
Granville	0	11	3	Tomboy	1	6	3

AUSTRALIAN

September 25.

	£	s.	d.		£	s.	d.
British Broken Hill	1	18	9	Mount Boppy	0	15	0
Broken Hill Prop.	1	16	9	Mount Elliott	6	0	0
Golden Horseshoe	2	17	6	Mount Lyell	1	6	3
Great Boulder Prop	0	12	6	Mount Morgan	3	16	0
Ivanhoe	8	0	0	Waihi	2	5	0
Kalgurli	2	1	3	Waihi Grand June	1	1	3

Company Reports

MAYFLOWER MINING COMPANY

This Company was organized in 1899. H. F. Fay was formerly its president and Stephen R. Dow was a director. More recently it has come into other hands, C. J. Paine, Jr., being president and A. L. Dickerman consulting engineer. The Company owns 840 acres and has sunk four shafts on several different amygdaloid beds. Production has not yet begun, work being confined to exploration. Diamond-drilling has been in progress throughout the year, one drill having been at work until April 15 and two drills the remainder of the year. The total footage drilled was 13,615, covering a rectangle 1400 ft. along the strike and 650 ft. wide. In hole No. 22 the copper content from 1012 to 1151 ft., or over 139 ft., averaged 1.2%, and for 61 ft. averaged 1.89%. More drilling work is necessary before the data can be completely correlated and shaft-sinking started, but the results are very encouraging. Receipts totaled $97,612 and expenditures $41,966. Assets total $58,259 and liabilities $2613.

MURO MAGNETIC COMPANY, LIMITED

The Company was registered in 1909 to acquire from the Murex Syndicate, Ltd., the rights for Great Britain and its colonies of the Murex process for the wet concentration of ores by a magnetic method. The capital is £210,000, in 210,000 shares of £1 each. The report for 1912 states that the value of the process on lead ores and zinc ores has been established in actual work at the Grund mine, in the Harz district, and at the mines of the Malines company in France. The value for copper ores has been demonstrated at the Cordoba copper mines, and royalties were earned there. Royalties are expected shortly from the Whim Well mines, Western Australia. A scheme of reconstruction to provide more capital is proposed. This is to form a new Company with a nominal capital of £70,000, divided into 280,000 shares of 5s. each, to take over the undertaking and discharge the liabilities of the old company, the shareholders in the company to be entitled to claim as of right one 5s. share fully paid in the new company in respect of each £1 share held by him in the old company.

ST. MARY'S MINERAL LAND COMPANY

This Company was organized in 1901, with a capital of $5,000,000, of which $4,000,000 has been issued. It owns the St. Mary's Canal Mineral Land Co., which was organized in 1863 to take over the 180,000 acres of land in Houghton, Ontanogan, and Keweenaw counties, Michigan, which was given to that Company by the state of Michigan for the construction of the first canal at Sault Ste. Marie. Out of this territory have been developed the Calumet & Hecla, Baltic, Trimountain, Champion, Ojibway, Mayflower, La Salle, Franklin, Winona, Copper Range, and a number of other mines. Of recent years the Company has only sold its lands for stockholdings in the companies formed. The cash receipts in 1912 were $840,400, and expenditure on advances and assessments of various companies was $690,030. The cash on hand at the end of 1912 was $150,370. Only 160 acres was sold during the year, and the unsold land totals 93,224 acres, and mineral rights to 14,081 acres.

THE CENTRAL MINING & INVESTMENT CORPORATION

This Company was registered in 1905 to acquire the undertakings of the African Venture Syndicate. It carries on investment and general financial business in connection with South African gold mines, and is interested in the

Bantjes, City Deep, City and Suburban, Crown Mines, Durban Roodepoort Deep, Ferreira Deep, Geldenhuis Deep, Modderfontein B., New Heriot, New Modderfontein, Nourse, Robinson, Rose Deep, Village Deep, and Village Main Reef mining companies. The authorized capital is £5,100,000 in 425,000 shares of £12 each, all the shares are issued and fully paid. The net profit on the year's operations is £319,954. In August 1912 a dividend of 2½% was paid, amounting to £127,500, and at the end of the year another dividend of 2½% was declared, absorbing £127,500. The following summary of the work of these Companies forms an excellent review of general work on the Rand.

RAND MINES TOTAL

	1911.	1912.
Tonnage milled	23,888,250	25,486,361
Revenue from gold won	£33,324,460	£36,814,804
Working expenditure	21,908,540	23,791,517
Working profit	11,415,860	13,023,287
Dividends declared	7,763,085	7,952,994

CONTROLLED BY COMPANY

Tonnage milled	8,057,414	8,706,508
Revenue from gold won	£13,227,359	£14,564,700
Working expenditure	7,937,453	8,772,835
Working profit	5,289,906	5,791,865
Dividends declared	4,047,123	4,223,677

The above tables show results exclusive of the gold reserve, which was abolished at the end of the first quarter of the year by all of the mines of this group and the majority of the remainder. The separate declarations then made amounted, in the case of the Witwatersrand gold mines, to £367,991, and, in the case of the Central Mining-Rand Mines group, to £231,933, the latter being approximately the same amount as that brought forward at the end of 1911.

The total profits of the group for the year, including £236,000 gold reserve brought forward from 1911, show an increase over those for 1911 of about £734,000.

The fifteen mines comprising the group have a total maximum crushing capacity of 10,400,000 tons per annum, the chief additions during the year being at the Crown Mines and City Deep. Smaller increases of capacity have been effected at various other mines by additions to the plants and variations in the method of treatment. The average results, based on the number of tons milled for the group for the year 1912, were as follows:

	Per ton, shillings.
Average yield	33.6
Average working cost, inclusive of all current expenses incurred by the companies, except profits tax	20.6
Average profits tax (as estimated in quarterly reports)	1.3
Average net resultant profit	11.7
Average amount of dividend paid	9.7
Average amount reinvested on capital account as nearly as can be ascertained	1.2

The remaining 0.8s. per ton represents the unappropriated balance of profit earned during the year. The total increase on balance of the carry forward figures of the various companies amounts to about £730,000. It should be noted that the profit stated in this table and in similar statements of 'net resultant profit' in the detailed summary of the various companies given above is the net cash profit obtained from the tonnage milled, exclusive of any other revenue, which is available for dividend purposes and, where required, for reinvestment in improvements in the mines to provide increased capacity in the mine or plant, or in increased claim area acquired on an annuity basis or otherwise. Great care has been exercised in calculating the ore reserves on the basis of results obtained from actual stoping experience, so that the estimated valuations are now comparable with the returns of ore treated. Taking the yield and the assay returns of the residue as together comprising 100%, the average rate of extraction is 95.6%, and the original gold content of the ore treated is 35.14s. per ton milled. This result affords sufficiently conclusive evidence that the mines are being worked as nearly as possible to the average grade of the calculated ore reserves.

Decisions Relating to Mining

Specially reported for the MINING AND SCIENTIFIC PRESS.

COAL LANDS—NOT SUBJECT TO NON-MINERAL ENTRY

Where an entryman under a non-mineral public land law is so inexpert as to be unable to recognize existing mineral deposits upon the land, the mere fact that he has acted in good faith, and without knowledge of the existence of the mineral deposits, does not warrant the United States in allowing him to take mineral land under a non-mineral entry. In determining the character of such land, the Land Department may take into consideration not only surface indications of coal upon the particular land in question, but also the geological formation of and discoveries upon adjacent or nearby lands.

Don C. Roberts (Land Department), 41 Land Decisions, 639. March 13, 1913.

DEPOSITS OF LOW-GRADE GRANITE NOT LOCATABLE AS PLACERS

A corporation, regardless of the number of its stockholders, may lawfully locate no greater placer area under the mining laws than is allowable in the case of an individual, namely, 20 acres. It is the purpose of the mining laws to reserve from disposition and to devote to mineral sale and exploitation only such lands as possess mineral deposits of special or peculiar value in trade, commerce, manufacture, science, or the arts. Therefore an application for patent made by an electric power company for the patent of lands located under the placer laws as being valuable for the building stone therein contained was properly denied, where it appeared that the only stone thereon was vast deposits of low-grade rock of no special value for structural purposes and useful only for rough work in the immediate vicinity, while the land in question was desirable as a power-house site.

Stanislaus Electric Power Co., (Land Department) 41 Land Decisions, 655. September 4, 1912.

VOID JUNIOR LOCATIONS NOT VALIDATED BY SUBSEQUENT FORFEITURE OF SENIOR LOCATION

Where valid lode locations were made prior to 1909, and assessment work done thereon up to the present time, placer locations made in 1909 covering the same and other ground are, of course, void as to the area in conflict with the senior lode locations. The question is now asked as to what would become of the conflict area if the lode locator fails to perform his assessment work. Would such area, upon expiration of the time for performing the lode assessment work, fall under the existing placer location? This question may be answered in the negative on authority of the decision of the United States Supreme Court in the case of Farrell *v.* Lockhardt, 210 U. S., 142, which in effect overrules the former decision in Lavagnino *v.* Uhlig, 198 U. S., 443, on this point. The failure of the lode claimant to perform his annual labor within the time prescribed by law would leave his claim open to re-location under any location made subsequent to the date of forfeiture, but it would not operate to validate locations attempted to be made on said ground at any time prior to such forfeiture. The same may be said with reference to an additional lode location made in 1912 on ground already covered by placer locations. If those placer locations were valid locations on the date at which the lode claim was located, the lode claimant gained nothing and never can gain anything by that location. If, however, as a matter of fact, no assessment work had ever been done on placers located in 1909 and 1910, they were open to re-location in 1912, and the lode location took effect. The mere fact that the placer claimants have recorded proofs of labor in previous years does not establish the fact that the annual labor was actually performed. That is a matter of fact which may be determined according to the evidence. Recording the proof of labor merely raises a *prima facie* presumption that it has been done, which presumption may be rebutted by evidence to the contrary.

Concentrates

Most of these are in reply to questions received by mail. Our readers are invited to ask questions and give information dealing with the practice of mining, milling, and smelting.

HYDRO-ELECTRIC POWER INSTALLATIONS in the French Alps represent a maximum of over 475,000 hp., with a minimum at lowest water of 180,000 horse-power.

AFTER the valuable oil has been distilled from eucalyptus leaves in certain parts of Australia, the residue is found to contain a useful non-corrosive for steam boilers, which prevents the formation of scale.

A DRILLING CONTEST at Ely, Nevada, for a prize of $1000 was held on September 13, and won by W. M. Salverson and James Garnier, who drilled 34⅝ inches in 15 minutes, against 32½ in. driven by Otto Cruciani and Martin Karich.

TRANSPORT OF PULP to the Homestake slime plant is done by means of a 12-in. cast iron pipe, 3½ miles long. The grade is 1% and the proportion of solid matter to water is 1080 to 2506 parts. Details were printed in the *Mining and Scientific Press* of April 6, 1912.

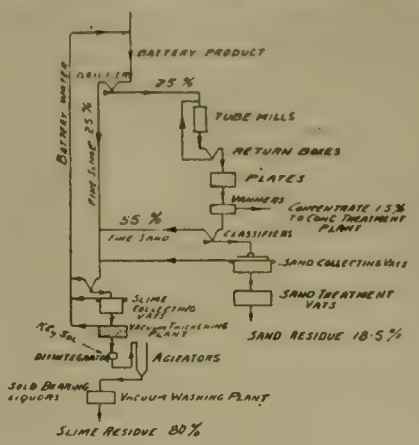
'GNAMMA HOLES' and 'soaks' are Western Australian terms meaning rock-holes containing water on bare exposed granite and porphyry surfaces, and containing water in sandy granite basins, respectively. The former depend on rain for replenishment, while the latter act as a sponge and often furnish a perennial though limited supply of fresh water.

THE Neal patent pebble-retaining outlet consists of two parts: a baffle made of suitable hard material placed inside the tube-mill, and a reverse screw which returns to the tube-mill any pebbles which might escape the baffle, although it permits of the free escape of water-borne pulverized pulp. Even if the tube-mill is filled with pebbles as high as 3 in. above the centre level, it is found that the baffle alone will retain the pebbles. The baffle is so designed that at whatever angle the pebble strikes it, the pebble is returned within the body of the mill, providing the mill is revolving at its due speed. In addition to the baffle, however, the reverse screw is so effective that, even if the mill is revolved slowly instead of at its proper speed, the spiral still retains the pebbles within the body of the mill.

ALL CLASSIFIERS which classify by a rising current of water have a feature which is called the sorting column, in which the sand is trying to settle, and is allowed to settle or is prevented from settling, according to the size and weight of the grains, by the velocity of the rising current of water, a stronger current lifting larger and heavier grains, a weaker current lifting smaller and lighter grains. This sorting column, whether square or cylindrical in shape, will have adverse downward currents of water carrying slime down into the spigot, thus defeating the whole object of classification unless some special provision is made to stop it. To obtain better classification and prevent the adverse down currents, two methods have been employed: (1) causing a vortex or horizontal rotation in the sorting column, and (2) using a pulsating rising current.

WHEN a strong alkaline solution has to be clarified with basic lead acetate, the solution must first be neutralized with acetic acid. This addition of acetic acid has to be made slowly and carefully, as the solution otherwise easily becomes acid, which prevents the formation of a lead acetate precipitate. This is entirely avoided if neutral lead acetate is substituted for basic. If neutral lead acetate is introduced into a solution containing oxide of lime or saccharate of lime, the lime combines with the acetic acid to form acetate of lime with formation of hydroxide of lead, which in its turn, when all the lime is neutralized and all combined sugar set free, reacts with the excess of the reagent, thereby producing basic lead acetate which precipitates the organic impurities.

THE accompanying flow-sheet is that of the Victoria mill of the Waihi company, New Zealand. As the result



FLOW-SHEET OF WAIHI MILL.

of the treatment, the percentage of each product sent to the cyanide plant is approximately as follows: sand 18.63%, slime 80.09%, concentrate 1.28 per cent.

UNDERGROUND WORK in the 15 mines controlled by the Central Mining & Investment Corporation, on the Rand, is summarized in the 1912 report as follows: Operations on seven mines of the group show that 984,650 tons of sand has been lowered into the worked-out stopes during the year at a cost, including all charges, of 1.28s. per ton. The application of this process has proved extremely valuable in supporting the ground in the vicinity of the main shafts and in controlling the settlement of the rock in worked-out areas. Eight of the mines of the group are now equipped with ventilating fans inducing a total delivery of 963,000 cu. ft. per minute into the mines they serve. This is equivalent to about 50 cu. ft. of fresh air per man per minute in addition to the natural ventilation of the mines concerned. Mechanical means for the transport of ore through the stopes and along the main haulage-levels in the mines is being increasingly adopted. On the thirteenth level of the Crown Mines the normal amount of ore transported by trains drawn by electric locomotives is 4000 tons per day. During the year an act was passed by the Union Parliament to provide for the establishment of a compensation fund for miners who have already contracted miners' phthisis, and an insurance fund for future requirements. In addition to providing for the levies under the first fund, the mines have, during the first two years, to contribute to the insurance fund a sum equal to 2½% of the employees' earnings, and after the first two years 5%, the employees contributing 2½% throughout. A committee was appointed by the Minister of Mines to inquire into methods for the prevention of miners' phthisis. A preliminary report has been issued by this committee containing recommendations for a comprehensive system of water spraying throughout the mine workings. This has already been adopted very largely with beneficial results. Rock-drills, air, and workshops costs have been the subject of close attention during the year, and improvements in organization have been effected, resulting in economy of air power for rock-drill requirements, and in a considerable saving in workshop costs. The saving effected in improved organization and equipment has assisted in meeting the increased charges on the mines due to the adoption of an eight-hour day underground, the increase of native wages, and in native recruiting costs, miners' phthisis legislation, water-spraying equipment, and other systems introduced for the further benefit of the underground employees.

Mineral Production of California

By Charles G. Yale

*The mine output of gold, silver, copper, lead, and zinc in California in 1912 was valued at $26,383,946, an increase of $1,209,269 over the corresponding value for the year 1911. The increase is due mainly to a gain in yield of gold from deep mines, increased value from copper and silver, and increased output of zinc. The greatest gain was in the value of copper and was due to an advance in commercial value of the metal, as the quantity produced was materially less in 1912 than in 1911. To a less degree the same may be said of silver, and the zinc quantities and values also increased.

The mine production of gold in 1912 was valued at $19,713,478, a nominal decrease of $25,430 from 1911. The output of silver was 1,300,136 fine ounces, valued at $799,584, an increase of 29,691 oz. in quantity and of $126,248 in value. The production of copper was 33,451,672 lb., valued at $5,519,526, a decrease of 2,864,464 lb. in quantity, but an increase of $980,009 in value. The output of lead was 1,144,731 lb., valued at $51,512, which is a decrease of 253,380 lb. in quantity and of $11,403 in value. The output of zinc was 4,345,591 lb., valued at $299,846, an increase for the year 1912 of 1,538,556 lb. in quantity and $139,845 in value.

There were 1041 metal-mining properties reported productive in 1912, of which 532 were deep mines and 509 placers of various kinds. This shows a total decrease of 140 producing mines in 1912. There were 470 deep gold mines, 12 silver, 24 copper, 25 silver-lead-zinc, and 1 zinc.

Of the placer producers, 141 were hydraulic mines, 65 dredges, 146 drift, and 157 surface or sluicing mines. There were 64 less deep and 76 less placers producing in 1912 than in 1911.

*U. S. Geological Survey Report.

The deep mines of California produced 2,641,497 tons of ore in 1912, a decrease of 155,764 tons. Of this output 2,225,429 tons was silicious ore, 408,622 tons copper ore, 974 tons lead ore, and 6472 tons zinc ore. The silicious ore output decreased 70,918 tons, the copper ore decreased 85,659 tons, the lead ore decreased 1034 tons, and the zinc ore increased 1847 tons.

The total average value of all ore sold or treated in California in 1912 was $6.71 per ton, against $5.49 per ton in 1911 and $6.71 per ton in 1910. At gold and silver mills in California in 1912 the tonnage milled was 2,077,300 short tons, yielding $10,371,347 in gold, and 307,306 oz. of silver valued at $188,993, or an average value in gold and silver of $5.08 per ton, compared with $4.64 in 1911 and $5.25 in 1910. Of this average value, $4.17 was recovered as bullion in batteries and on plates in mills. The smelting ores, 456,735 tons, produced all the copper and zinc and practically all the lead, as well as 955,067 fine ounces of silver, valued at $587,366, and $592,532 in gold. There were also treated 107,462 tons of old tailing, yielding $103,936 in gold, an average of 96c. per ton, and $1298 in silver, an average of 1c. per ton.

The placers of California in 1912 yielded $8,645,663 in gold and 35,652 oz. of silver valued at $21,926, a decrease of $339,895 from the placer output of 1911. The hydraulic mines showed an increase of gold output of $14,196, the dredges a decrease of $236,506, the drift mines a decrease of $91,908, and the surface placers a decrease of $26,646 in gold. The placers produced 43.86% of the total gold yield of the state and the deep mines 56.14%. The dredges produced 37.68% of the entire output of gold in the state in 1912 and 85.93% of the placer gold. The total gold-dredge output of California from 1899, when only $206,302 was produced, has been $55,415,191, including the $7,429,951 obtained from this source in 1912.

The following table shows the mine output of California by counties in 1912:

	Ore treated.	Gold.[a]	Silver.[a]	Copper.	Lead.	Total value.
	Tons.		*Fine oz.*	*Pounds.*	*Pounds.*	
Alpine	1,200	$1,764	2,300			$3,179
Amador	737,148	2,796,194	52,093	175,542		2,857,195
Butte	3,326	2,346,229	9,053			2,351,796
Calaveras	430,128	962,145	115,037	6,089,819		2,037,713
Del Norte		3,940	16			3,950
Eldorado	8,871	105,565	1,371			106,408
Fresno	603	6,094	37			6,117
Humboldt	50	31,271	243			31,421
Inyo	70,615	369,753	73,685	45,033	997,999	[b] 767,261
Kern	168,226	830,420	18,667	1,064	20,011	842,976
Los Angeles	457	3,236	64			3,275
Madera	1,580	9,162	1,890	232,347		48,661
Mariposa	31,094	160,541	11,051	300,062		216,847
Merced, Shasta, Siskiyou, and Stanislaus[c]		326,419	1,619			327,414
Modoc	2,171	27,893	803			28,387
Mono	32,399	377,518	114,800	7,866	24,445	450,518
Monterey	267	3,435	38			3,458
Nevada	270,148	2,081,958	37,122			2,104,788
Placer	27,729	367,383	7,790	75,000		384,549
Plumas	27,398	193,237	1,556	16,381	5,837	197,160
Riverside	1,645	20,202	413			20,456
Sacramento		1,712,587	5,762			1,716,131
San Bernardino	44,722	293,900	81,238	1,890,008	96,439	660,053
San Luis Obispo		976	8			981
Shasta	415,116	928,243	691,257	24,618,550		5,415,426
Sierra	76,606	732,988	4,515			735,765
Siskiyou	13,160	430,218	4,557			433,021
Trinity	57,307	723,503	12,185			730,997
Tuolumne	228,823	1,113,291	40,988			1,133,437
Yuba	708	2,753,408	10,078			2,759,606
	2,641,497	19,713,478	1,300,136	33,451,672	1,144,731	26,383,946

[a] Includes placer production.
[b] Includes value of 4,345,591 pounds of zinc.
[c] Includes only gold recovered by dredging in these counties; other output of Shasta and Siskiyou counties given below.

Although the origin of schists at Kalgoorlie has been often stated to be sedimentary, their occurrence only along shear or fault planes in igneous rocks invalidates this conclusion, and the graphite cannot be considered to arise from organic carbonaceous matter. Moreover, the occurrence of a quartz-carbonate fissure-vein carrying graphite in the Great Boulder mine, No. 12 level from Hamilton's shaft, is further evidence of its inorganic origin, according to J. Malcolm Maclaren. It would be idle to speculate on the source of the carbon, except to point out that the prevalence of carbonates in the rocks in which the graphite occurs and the deep-seated nature of the alterations that have produced them. The occurrence of marsh gas (CH_4) is probably to be considered as a result and not a cause of the presence of the graphitic schists. The vein occurrence of graphite, and its intimate association with igneous magmas are well known.

A useful species of the eucalyptus family on Western Australian goldfields is *eucalyptus salubris*, a spirally twisted variety which is exceptionally strong, and although the average tree is about 4 in. diameter, it is suitable for mine timbering, such as laths above drift sets.

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EDITORIAL

SMALL reverberatory furnaces for the smelting of copper ores are not in the fashion nowadays, and it is correspondingly interesting to learn that two furnaces with hearths 11½ by 23 feet are under construction at the Messina copper mines in the Northern Transvaal. Coal will be used as fuel, seven or eight tons being required to smelt the 20 tons of ore which it is expected each furnace will treat daily.

BUTTE citizens have recently gone on record to the effect that 'Boston Coppers,' through their oppressive methods, have proved themselves unfit to control and manage such a vast public trust as Lake Superior mines and are "firmly of the opinion that the time has come for the federal government to assume full charge of those properties." If a fair return to the shareholders is to be included in the criterion whereby the fitness of the management is to be judged, it would be difficult for the 'citizens' of Butte to establish their point.

IN West Virginia a workmen's compensation law has recently gone into effect, and three-fourths of the mining companies have already filed notice of their intention of complying with its provisions. The employer is required to pay 90 per cent and the workman 10 per cent of the assessment, which shall not exceed 1 per cent of the payroll. Injured employees receive half-pay, not to exceed $8 per week, and in case of death the state pays the necessary funeral expenses, the widow receives a pension of $20 per month, and each child receives $5 per month until it attains the age at which it can legally be employed.

PROPOSALS to place cyanides of potassium and sodium on the free list, discussed in our issue of September 13 by Mr. G. H. Atkins, are being vigorously protested in the East. In a recent letter to the *Oil Paint and Drug Reporter*, Mr. Jacob Hasslacher states that American production of cyanide of sodium amounted in 1912 to over 10,000,000 pounds. He also states that this was genuine manufacturing, as it would not pay to import the high-grade cyanide and merely dilute it. The American manufacturers use the Castner-Pfleger synthetic process and maintain that a reasonable tariff will permit the building up of a local industry that admittedly would be of importance. Further discussion of the matter is likely to be of academic interest only, as the tariff bill is expected to be completed this week. Looking upon protective tariffs, as we do, as necessary evils at best, our feeling is that no such tax should be levied except after the most complete demonstration of its need.

CHILE has undertaken to subsidize an Austro-Hungarian shipping company, which will maintain direct service to Mediterranean ports, in the hope of developing fresh markets for nitrate among the agricultural population of the countries bordering on that sea. During the year that ended on June 30, 1913, the production of Chilean nitrate was 59,450,454 quintals of 101.41 pounds each. The price declined from $2 to $1.84 per quintal during the year.

AMERICAN manufacturers have not made a strong showing lately in securing contracts for furnishing the equipment of American enterprises in South America. Not long ago the power-plant contract for the Chile Copper Company went to German bidders, and now Mr. C. M. Schwab has gone to Germany to arrange for the building of ten ore-carrying steamers of 15,000 tons capacity each, for the transport of iron ore from Chile to the Atlantic coast of the United States.

REMOVAL of the injunction against picketing in the Lake Superior district has been construed by the striking miners as the granting of a license for disorder and riot. After several weeks of comparative calm, the strikers have abandoned peaceful methods, and negotiation has given place to rioting. Just what will be gained by this change in attitude is a question, but if the future is to be judged by the past, the recent outbreak does not augur well for organized labor.

THE concept of petrologic provinces has proved fruitful, and as Mr. Thomas T. Read shows in this issue, it may be carried over usefully into metallurgy. It is easy to point out that the absence of copper and wide presence of lead has shaped the development of smelting in Colorado as the reverse has operated in Montana. Ease of transportation and many industrial factors, it is true, interfere with any strict delimitation of a metallurgic province, but as a broad underlying concept the idea is worth consideration. Mr. Read has chosen for discussion of its application one of the most important and most active metallurgical regions in the World, our own Southwest, and his comparisons of practice at the smelters of a whole region will, we are sure, prove more useful than the same space devoted to routine description of plants.

COINCIDENT with our publication this week of the details of the Howe process as developed at the Gwalia Consolidated mine, comes the announcement from London that further operations are to be suspended. The figures we print are based upon experiments made in June and come to us direct from Australia by mail. According to reports from London, cabled results of later tests were so unfavorable as to force abandonment of operations. It is said that fuel consumption ran up to 62.7 per cent, and that the extraction was but 36.4 as against 85 per cent reported in July. It is difficult to understand this discrepancy and particularly to believe in the high fuel consumption. It seems possible that some error has occurred in transmission of the figures, and we shall await confirmation with interest.

GOLD output in British Guiana is showing an encouraging increase, the exports between January 1 and August 28 having been 50,653 ounces, as compared with 28,860 in the same period last year. Most of this increase is due to the recent discovery of rich placer ground in the Cuyuni district.

IT is easy to formulate a theory of ore genesis, but difficult to determine which of several theories is correct. In the articles on the Coeur d'Alene ore deposits, of which we print the second and final installment this week, Mr. Hershey presents strong evidence in favor of sedigenetic origin. He does not claim that it has been demonstrated to be the solution of the problems of the field, but he does claim, and we believe with reason, that sufficient evidence in its favor has been massed to warrant suspense of judgment as between this and the magmatic hypothesis. The mere fact that such diverse conclusions have been reached by Mr. Hershey and Mr. F. L. Ransome, indicates how far we still are from possessing positive criteria in the study of ore deposits.

DESPITE announcement of the vice-president, Mr. Hayes, of the United Mine Workers of America, that the striking Colorado miners would "conduct their campaign upon a high plane," Robert Lee, one of the marshals was almost immediately murdered. With 'Mother' Jones as the mouthpiece of the organization and the beginning of the campaign inaugurated with bloodshed, it would seem that a perverted conception of 'high plane' obtains in the mind of someone connected with the strike. Agitation of the 'Mother' Jones brand and bloodshed will do more toward spelling failure for the cause of labor than all elements for the good combined can counteract. We regret this greatly, since, notwithstanding a few slips, the United Mine Workers has had good leadership and has generally stood in an entirely different category from the I. W. W. or the Western Federation of Miners, for example.

METALLURGISTS, whether connected with the iron and steel industry or not, will find much of interest in the program for the autumn meeting of the American Institute of Mining Engineers, now being arranged for October 16 and 17 by the Iron and Steel Committee. The first session will be devoted mainly to blast-furnace gas cleaning, the slagging producer, and the generation of heat from waste gases. At the second session will be discussed problems of briquetting and the use of powdered coal for fuel, a movement deserving close attention from engineers in many lines of practice. The meetings on the second day will be devoted to discussions of technical phases of steel production, though a paper by Messrs. G. H. Clevenger and B. Ray on 'The Influence of Copper upon the Physical Properties of Steel' is likely to be of general interest. The meeting will be held at Institute headquarters in New York and is to close with a dinner on the evening of October 17. To this, as well as to the sessions, special invitations have been sent to members of the American Society for Testing Materials, the American Iron and Steel Institute, American Society of Mechanical Engineers, American Society of

Civil Engineers, American Society of Electrical Engineers, and the American Foundrymen's Association. The Iron and Steel Committee has already won prestige of success and is setting a high standard for the other committees of the Institute. We understand that the new Committee on Mining Law is to have charge of the program at the February meeting and that other committees are in turn to have similar opportunities. This careful planning of the programs of the Institute meetings, focusing each on some group of subjects, is proving extremely effective in increasing the interest in the technical sessions.

Launching a Republic

Present political and economic conditions in China are in many ways of interest and importance to Americans, and the efforts to develop a republican form and method of government in that country presents many interesting analogies to the problems which beset the population of the thirteen states during the period of stress which followed the Revolutionary war. In China, after centuries of government outwardly despotic, but in many ways essentially democratic, the beginnings of national unity have exhibited themselves in a demand for a republican form of government, and Yuan Shih-kai, a strong military leader and far-sighted man of affairs, has been entrusted with the presidency of eighteen provinces, containing a population variously estimated, but certainly not less than 350,000,000. There, as with us in 1780, the problems are essentially tripartite: the necessity for arriving at a working arrangement which will permit the national government to exercise its necessary functions, without unduly encroaching upon the rights of the states or provinces which had previously been in large degree autonomous; the development in the people, concerning republican institutions, of a group of ethical and practical ideas for which there is no word in English, but which the Germans call *sittlichkeit*; and finally, the providing for the refunding of a large national debt and the development of trade, commerce, and natural resources as the basis of a lasting national prosperity.

It will be useful, in obtaining a proper perspective, briefly to recall the status of affairs in this country in 1784. At that time the states had just emerged from a war which had cost $140,000,000 and had left them burdened with a national debt of $40,000,000; truly a staggering sum to a population of less than 3,000,000, whose average scale of living was so near the border of necessity that well-to-do families enjoyed less of luxury than the ordinary workman of today. Party feeling ran so strong that it was seriously proposed to assassinate Alexander Hamilton because he advocated allowing to Tories the peaceable enjoyment of their lives and property, and the individual states were so jealously concerned with safeguarding their individual rights that they lent but scant support to the central government. The outlook was indeed a gloomy one, and prophecies of speedy disaster were rife. Nevertheless, the United States of America has never ceased to prosper and has now taken a place among the leading powers of the world.

Present problems in China differ somewhat from those which first beset us. 'States rights,' while they must be considered, form no such exigent matter as faced our statesmen in 1870. The development of a republican habit of mind is more of a task than it was among the sturdy Scotch-Irish, Covenanters, Huguenots, and Dutch who were the first ingredients of the melting-pot here. Well informed observers have estimated that not more than 2½ per cent of the population of China took any part in the recent revolution, and a large part of the populace is perhaps still ignorant that it has transpired. Universal suffrage is out of the question under such conditions, for citizens who are unaware of what is happening in the internal and external relations of their country cannot vote intelligently concerning them. The importance of this can easily be overestimated, however, for where population becomes dense and the political units large, it becomes almost impossible to keep the general public well informed of what is happening in their government. It might with equal accuracy be pointed out that a very small proportion of the population of New York City has any idea of the sums annually derived by taxation, for what they are expended, whether these expenditures are wise or unwise, and what are the real forces which actuate the movements of their machine of civic government. Officials in China have been and probably will be corrupt, but it is doubtful whether anything so vicious will ever be uncovered in that country as the relation which recently existed between the police and organized vice in New York. These problems are neither Oriental nor Occidental; they are problems of human nature. It is safe to venture the prophecy that for some time government in China must remain in the hands of a comparatively few strong men, but that with the enlightening influence of the public press and the catalytic action of the returned students, who have obtained an international viewpoint and sense of balance through study in Western universities, the nation will steadily advance in the development of a republican form of government. So far as practical results are concerned, a republic seems to offer comparatively little advantage over a monarchy, but it is evidently in line with the evolution of institutions, just as the eohippus was in line for the development of the horse, while the trilobite was in line for the development of nothing useful.

Finance is a critical problem in China. The national debt is now approximately $900,000,000. This is less than $3 per capita, as compared with our own debt of $15 per capita in 1784; but the circumstances in the two cases present fundamental differences. In the one case a few people were scattered about the borders of a vast area of virgin natural resources, awaiting only well directed labor to produce great wealth. In China a dense population inhabits a region of which the agricultural resources are already intensively developed. Vast resources of coal and iron, the fundamental bases of trade, still await development, but the rela-

tive possible expansion in China is obviously much less than was the case in our own early history. The huge size of its economic units makes its problems infinitely more critical; mishaps in handling marbles are not serious, while cannon balls may work havoc. Continual internal unrest in China, such as was recently exhibited as a by-product of the too-advanced ideas of the southern 'republicans' (the *Kuo-ming-tang*) is likely to prove fatal. The fixed expenses of the government are high, and if the proceeds of provincial taxation are not forthcoming and the funds of the government are perforce devoted to the suppressing of rebellion, the end is not far to foresee. Recent reports, of perhaps doubtful authenticity, state that present receipts are less than one-third of expenditures. In such a situation it is urgently necessary to restore quiet and order, even at some sacrifice of idealism, in order that a catastrophe may be averted. Lord Cromer has pointed out that when a nation combines destruction of internal income with the incurring of foreign debt the outcome is inevitable. If China wishes to avoid Egyptianization, it is urgently necessary for her to place the statesman and man of affairs above the political agitator. Fortunately, both the characteristics of her people and the evidence of recent events indicate that this will be done.

President Huerta's Message

The recent message of President Huerta to the Mexican Congress at the opening of the second period of sessions on September 16, has a tone of general hopefulness on the part of the executive for a speedy solution of the internal difficulties of the country. From a great many standpoints the government is to be congratulated on the progress that has been made during its brief administration and under the most trying circumstances; and whatever may be thought of the circumstances under which the provisional government was established, the message carries the impress of a strong man making real progress against amazing difficulties.

International relations are but briefly discussed, the message being devoted almost entirely to a report of the administration and the hopes and purposes of the government. In referring to the recent strained diplomatic relations with the United States, the President says: "I have only to state that the government has well grounded hopes that an early solution will be found for the difference that just now holds in suspense the relations of good and long standing friendship destined to bind us for an indefinite future with our powerful and civilized neighbor." In the major portion of the message dealing with the affairs of the government, it is gratifying to note the marked progress that is being made despite the handicap of disorder under which the administration is laboring. The financial statement shows the revenue for the past fiscal year amounted to ₱120,500,000, which is greater than any revenue collected under the Diaz régime. Last year's revenue was ₱15,300,000 in excess of that of 1911-12, which is accounted for by ₱7,600,000 being derived from new taxes and ₱7,700,000 as an increased yield from the existing taxes. The expenditures for the period under review have not been fully reported, owing to a large extent to lack of facilities for communication. The disbursements for the first eight months of the year amounted to ₱65,100,000, which, if the same rate obtained for the rest of the year, would amount to ₱97,650,000 for the year, and would afford a surplus of ₱22,850,000. However, as pointed out in the President's message of last April, no hopes for such a balance are entertained and a deficit is expected.

The judicial reforms which are recommended provide for the establishment of conciliatory courts (*juzgados de paz*) whose jurisdiction and methods of procedure will be such as to realize the long-standing desideratum of affording cheap and efficient justice to the poor. Such courts properly regulated will fill a long felt want in Mexico's department of justice, and it is hoped that this recommendation will receive congressional support. In dealing with the department of Fomento, the efforts which are being made to find a satisfactory solution of the agrarian question are to be noted as bearing fruit. During the first half of the year 46,485 hectares of national land were converted into private property. The agrarian question is generally conceded to have a most important bearing on Mexico's future, and has been the cause of many uprisings and revolutions in the past, of which the Zapatista warfare which has kept the states of Guerrero, Pueblo, Michoacan, Morelos, and Mexi in a state of unrest for the past two years, is an example. At the present time lands are being surveyed in San Luis Potosi, Michoacan, Veracruz, Tabasco, Chiapas, Lower California, and in the Federal District with the object of making it available for small farmers, a movement which it is believed will do much toward eradicating existing class feeling and will have a powerful influence toward pacification. The government realizes that the pacification of the country is urgently necessary for the normalization of public services and the re-establishment of political, social, and economic equilibrium and the conduct of a broad program of reforms. It is to be hoped that the Mexican people will awaken to the task before them of bringing about that union which the Republic demands and which power of accomplishment lies wholly within the people themselves. As the President points out in his message, it is indispensable that all Mexicans without distinction or political or religious creeds, stand shoulder to shoulder for the laudable purpose of maintaining intact the inheritance of the race and the prestige and integrity of the nation. While the President intimates that American men-of-war will not be welcome in Mexican waters after October 25, we trust that there will be no occasion for keeping war vessels in Mexican ports after that date, although such good fortune is hardly anticipated. No doubt the matter will be adjusted satisfactorily. He would be an over-bold prophet who should attempt to say what the month may bring forth in Mexico, but at least there are evidences of distinct progress, and we are warranted in maintaining a hopeful as well as friendly attitude.

Copper Smelting Practice in the Southwest

By Thomas T. Read

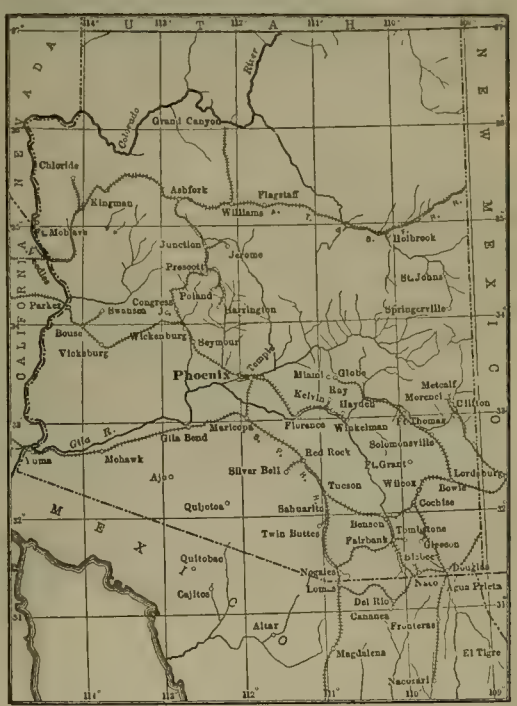
A concept which has proved useful to geologists is that of the existence of petrographic provinces, or areas in which characteristic and often related types of rocks occur and in which characteristic minerals and mineral associations can be discerned. It therefore follows that metallurgical provinces can also be distinguished, since the choice of metallurgical methods employed in the treatment of metallic ores is often decided by the characteristic minerals present in that ore. The states of Arizona and New Mexico, together with the adjacent parts of Mexico, may thus be considered as roughly constituting such a metallurgical province, especially if the inquiry is limited to the ores of copper. In this area, in 1912, approximately one-third of the total copper output of the United States was produced, chiefly from ores that exhibit many characteristics in common. It is natural, therefore, that the metallurgical methods employed should also exhibit common characteristics. It is not my purpose to attempt to present here any profound research into the fundamental relations between the climatic, topographic, geologic, and economic conditions here prevailing, and their effects, as exhibited in past and current practice, but rather to indicate in a somewhat sketchy fashion only a few of their more salient features. It will be impossible because of the limits of space to enter into any discussion of the history of the area under discussion, and since this has recently been admirably done by James Douglas*, than whom no one could speak with more authority, there is indeed no necessity to make the attempt. These remarks are, therefore, based upon present practice as it has crystallized in the light of years of experience.

Situation of the District

Bounded by the Rocky Mountains on the east, and the Sierra Nevada on the west, the region under discussion may be regarded as in part a southward extension of the Colorado plateau and in part the northern portion of the Mexican plateau. The Colorado river may indeed be considered to form its northern and western boundary as it threads through its profound cañons in its course from its headwaters in the Rocky Mountains to the Gulf of California. Though bordered by such a mighty river, the entire region is arid, and in some parts a true desert. It will be remembered that the prevailing westerly winds from the Pacific Ocean exhibit their maximum force, with its resulting damp climate, from Juneau south to San Francisco. South of San Francisco the coast sweeps away eastward, while the trade winds swirl away to the south and finally west. As a result, the climate of that part of the United States lying south of 40°N. latitude and between the Sierra Nevada and the eastern front of the Rocky Mountains is almost entirely arid. This peculiarity not only affects the character of the ore deposits, as altered by subaerial agencies, but by its effect in such important economic questions as food, water, and timber supply, and character of population serves to determine in a marked degree many of the salient features of the mineral industry. In its flora and fauna, including in the latter its human population, this region differs in many respects from every other part of the United States, with the exception of the adjoining parts of California.

Copper Deposits

The copper deposits found in this region are, as might be expected, characterized by outcrops of oxide and carbonate minerals, Arizona being famous



MAP OF ARIZONA.

for its specimens of malachite and azurite. At varying, but usually considerable depths, the oxidized minerals give way to secondary and even primary sulphides. The orebodies are of such multiformity and occur in such a variety of enclosing rocks that no attempts at generalization would be useful. These orebodies are commonly regarded as marked examples of the concept that copper orebodies are typically marked by a surface zone of oxidation, a succeeding zone of secondary enrichment, and a bottom zone of primary ore. This conception, at first extremely valuable, is beginning to outlive its usefulness and remains to hamper free thought. In a recent paper on the Bisbee deposits, A. C. Notman employs the term 'underground gossan'; surely a most confusing name for an obscure concept. As a matter of fact oxide minerals occur both above and below the sulphides. Thus, at the Chino mine, at

*'The Copper Queen Mines and Works,' *Trans.* Inst. Min. and Met., March 1913.

Santa Rita, in New Mexico, the oxide ore in places extends to 1100 ft. in depth, while sulphides occur close to the surface and overlying the oxides.

Where the ores are rich enough to stand the cost, they are mined by methods appropriate to the size and character of the deposit and smelted directly.

OLD DOMINION SMELTER.

In the early work so small an amount of sulphide was available that the oxides were smelted to yield black copper. In practically every district enough sulphide ore is now available to allow smelting with the formation of matte, and in many cases a certain amount of sulphide has to be roasted, though in others the charge balance, for blast-furnace smelting, is somewhat short of sulphur. The tendency of present practice is toward concentration of the low-grade sulphides and leaching of the oxidized ore. More than a half dozen large concentrating plants are already at work, but, with one exception, the leaching work has as yet not progressed beyond the experimental stage. Most significant in its probable great importance is the experimental work with the flotation process which is being carried on at the Inspiration mine. If the 600-ton plant now in course of construction proves as successful as the experiments made with a 50-ton plant, it is unquestionable that profound changes in present practice in this district are to be expected.

Smelting Plants of the District

There are now in operation in the district under review eleven important smelting plants, and preliminary plans for the construction of a twelfth are well advanced. The El Paso smelting plant of the American Smelting & Refining Co. is included in this list, since it draws its supply of copper ore chiefly from this area, though situated beyond its margin. As typical examples of the range of practice, the Old Dominion smelter at Globe and the A. S. & R. smelter at Hayden may be cited. The ore supply of the former is lump ore, which is smelted in blast-furnaces. At the Hayden plant all the ore is subjected to preliminary wet concentration, the resulting concentrate being roasted and smelted in oil-fired reverberatory furnaces. Present conditions all tend toward an increase of reverberatory smelting. The amount of ore of high enough grade to permit direct smelting is limited, while, on the other hand, at the Chino 90,000,000 tons of concentrating ore has been developed, at the Ray 84,000,000 tons, at Inspiration 45,000,000, and at Miami 21,000,000. It is evident, therefore, that future tendencies will be toward an increase of reverberatory smelting. L. D. Ricketts has given the cost of reverberatory smelting at Cananea during the period from February to July 1911, as $2.22 per ton, from which must be deducted $0.82 as a credit for the value of the steam generated by the heat recovered in the waste-heat boilers, making the net smelting cost $1.40 per ton smelted. Of the total amount thus smelted, one-third was flue-dust, and the apparent cost of blast-furnace smelting must be increased by an amount equivalent to the cost of smelting in the reverberatory that excess of flue-dust produced in blast-furnace smelting as compared with reverberatory smelting. The average milling cost at the Chino last year was 58½c. per ton, so that it is evident that the field of milling and reverberatory smelting is likely to continue to make inroads into that of direct smelting. With so much as an introduction, I shall briefly describe each of the principal smelters in this diserict, without going into detail except as to such features as may be peculiar to that plant.

The El Paso Smelter

At El Paso the American Smelting & Refining Co. has recently added copper smelting equipment to a plant which has for years smelted lead ores. Two blast-furnaces, 40 by 144 in., smelt lump custom copper ore, derived from various parts of Arizona and New Mexico, yielding a matte of about 45% copper which is blown to blister in two Pierce-Smith converters; a newer 12-ft. Great Falls converter not yet having been put into service at the time of my visit. The main matte supply for the converter is derived from two 19 by 104-ft. reverberatory furnaces. These are oil-fired, but as this method of firing is general practice throughout the area it will not again be referred to except to give details of practice. Most of the oil used for firing is obtained from the Mexican fields, though Texas oil is also available, and has the advantage of not requiring as much preheating, as it is lighter in specific gravity. The reverberatory furnaces yield a 40% matte, the matte-fall amounting to about 30% of the charge, each furnace handling about 300 tons per day. The capacity is somewhat in excess of this, but was limited at the time of my visit by the capacity of the roasting plant. This consists of three 4-hearth Wedge furnaces, 22½ ft. outside diameter, and two more are in course of erection. These furnaces are designed to handle 100 tons each per day, but are being operated at a capacity of 130 to 150 tons each per day. It was originally expected that the average sulphur content of the Chino concentrate would not be so high as to

require much sulphur elimination, and that roasting of only part of the total tonnage would be required. In actual experience it was found that the sulphur content ranged between 12 and 22%, according to the part of the ore deposit from which the mill feed is obtained; the necessity of directing the steam-shovels so as to carry on development work in the most efficient manner, making it impracticable to control the mill feed. Running a Wedge furnace at so much in excess of its intended capacity makes it impossible to completely dry the concentrate upon the top hearth. It therefore passes through the slot upon the third hearth in a somewhat sticky state, and in order to cause it to pass freely it was necessary to remove the distributer plate. This causes the concentrate to pile up on the third hearth, and from time to time coarse fragments roll between the central cylinder and the hearth ring, much to the disadvantage of the latter. Various small alterations have been made to minimize this and other minor troubles, but it is on the whole remarkable that a roasting furnace can be pushed so far beyond its designed capacity with comparatively little alteration beyond the use of an additional burner on the second hearth. This plant is under the direction of Kuno Doerr, general manager; J. J. Ormsbee, superintendent; H. F. Easter, assistant superintendent; and A. F. McCormack, assistant superintendent of the copper department.

BEDDING SYSTEM FOR COARSE ORE, CANANEA CONSOLIDATED COPPER CO.

Arizona Copper Smelter

The next smelting plant, proceeding to the west, is that of the Arizona Copper Co. at Clifton, Arizona. This is at the end of a rather long branch railway line, owned by the Company, which connects with the Union Pacific at Lordsburg, New Mexico. This is an old plant, shortly to be abandoned, which excites interest chiefly by the ingenuity which has been expended in compressing it into a narrow and inconvenient site at the junction of Chase creek and the San Francisco river, the boilers for steam supply being scattered about in niches between other equipment. It is also unique as to its chimney, which consists of a shaft, or winze, to the top of the nearby mountain. The experiment is one not likely to be repeated, since such a chimney defies attempts to repair or enlarge it. A new plant has been designed by Repath & McGregor, under the direction of L. D. Ricketts, consulting engineer to the Company, and is already partly constructed, the site being farther down the San Francisco river, where ample dump room is available. The reverberatory furnaces will be 22 by 100 ft., space being provided for three such and for eight 21½-ft. Herreshoff roasters. This plant is similar in its design to the new plant of the Calumet & Arizona, which will be described more fully later.

Leaching With Sulphuric Acid

An especially interesting feature of the work at the old plant is the leaching of oxidized copper ore with sulphuric acid. The acid, of 52°B. specific gravity, is made at the plant from pyrite obtained from one of the company's mines. The jig tailing from milling operations, containing 2 to 2½% copper, 0.4% S, 60% SiO_2, and 16% Al_2O_3, is charged into vats and leached for 12 hours, the solutions being so managed that the first strong solution contains very little free acid, and, after decanting, its copper content is precipitated by passing it through a trommel filled with scraps of wrought iron and steel. The precipitated solution then goes to waste, and the wash water used in the vats is strengthened by the addition of acid to yield fresh leaching solution. This method can only be used on ore which is

high as SiO_2, otherwise the loss of acid through the formation of Al_2SO_4 and $FeSO_4$ becomes prohibitive. The acid consumed in leaching is given as 2½ lb. per pound copper recovered. Allowing for the cost of the iron used for precipitation and labor there can be no great profit on the operation except as an adjunct to the wet concentration of ores of suitable composition. This Company is under the direction of Norman Carmichael.

The Shannon Plant

Just across the river from the new Arizona Copper plant is the mill and smelter of the Shannon Copper Co. This consists of two blast-furnaces 42 in. by 15 ft. and one 44 in. by 30 ft., the latter handling about 700 tons of charge per day. These furnaces are provided with cast steel crucibles, which have given trouble by cracking. Pyrite is brought from Gleason, Arizona, to yield the sulphur required for the formation of matte. About 500 tons per day of the ore-supply contains no sulphides and is smelted directly; the remainder, 300 tons per day, is concentrated 10 into 1. The fine concentrate is then dewatered and mixed with flue-dust before charging into the blast-furnaces. Two small stands of acid-lined converters are sufficient to handle all the matte produced. This plant is under the management of J. O. Bennie, who deserves the greatest credit for the skill with which he has brought into shape a rather unsatisfactory plant and a mine which is on the border line of profit. Mr. Bennie has carried on an extensive series of leaching experiments; the general method of attack being roasting in specially constructed heaps, the progress of the operation being so controlled as to completely convert the copper into the sulphate, and to avoid the formation of ferric sulphate, as this consumes iron in the subsequent precipitation of the copper. No details of results obtained have been released for publication, but the method seems to offer much of promise. The experimental work is exceedingly tedious, as the time required to build and burn the heaps is great.

The Detroit Smelter

At Morenci, a few miles to the west of Clifton, but at a considerably higher elevation, is the smelting plant of the Detroit Copper Mining Co. This presents a number of features of interest; for example, the smelting of concentrate in blast-furnaces. All the mine ore is milled and the only lump ore smelted is that produced by lessees. Smelting is now done in a 42 in. by 22-ft. blast-furnace, which is driven slowly, smelting 350 tons per day. The concentrate contains 15 to 17% copper and 15% SiO_2; about 50 tons per day of limestone is used as flux. The slag contains 7.2% Al_2O_3 and 2% MgO, and the matte, of which 60 to 70 tons per day is produced, contains 42% copper. It is thus seen that a high degree of desulphurization must be maintained. The tonnage to be handled is too small to justify building reverberatory furnaces. It is planned to build a 33-ft. furnace which will smelt even more slowly, the idea being not to increase the desulphurization, but to cut down the dust losses. It would seem, on the face of the matter, that this end might be better obtained by first sintering the concentrate upon Dwight & Lloyd machines, but careful study of the local problems was made by the management, and it is safe to assume that the methods employed have only been adopted after due consideration. Converting is now done in acid-lined shells, but a Great Falls converter will perhaps be built, largely for the purpose of decreasing the amount of seconds to be rehandled. Another interesting feature of practice here is the use of Crossley and American Crossley gas engines for power supply. The gas is generated from bituminous coal, obtained from Dawson, New Mexico, in a Loomis generator. This is at the mine and the gas is brought to the smelter in pipes which sometimes give trouble in cold weather, due to freezing. The smelter is provided with round steel bins, which were built some years ago, and must be among the first bins of this type ever built. A. T. Thomson is manager of this plant, and E. W. Honeyman is superintendent.

The Old Dominion

The Old Dominion smelter, at Globe, is at the end of a 125-mile branch of the Southern Pacific, the Arizona Eastern, which connects with the main line at Bowie. At this smelting plant there are six blast-furnaces, of which three or four are usually in use. All, except one, are 48 in. by 16½ ft., the exception being 19¼ ft. long. An average daily tonnage of 325 per furnace is smelted. The smelting column is about 12 ft. high and 22 oz. blast pressure is used, with a coke percentage of 12.6. These features are due to the shortage of sulphur on the smelting charge, it being necessary to bring sulphide ore from Bisbee to make up the deficiency. The flue-dust made amounts to about 8½% of the tonnage smelted; this is drawn from the chambers and shipped to Douglas for smelting in the reverberatory furnaces. The matte averages 44% Cu and is handled by an 8-ft. Great Falls converter. This type of converter has become standard in the district, as its form, a vertical cylinder, offers obvious mechanical advantages over the horizontal cylinder of the Pierce-Smith converter. Since the basic lining is expected to maintain itself over a long period it should be of such a shape as to offer the maximum of strength with the minimum of exposed surface. Part of the tonnage smelted at this plant is lump ore, and part concentrate; about 500 tons of ore per day being concentrated 4 into 1. The relative proportion of concentrate to lump ore in the furnace is 1 to 4. P. G. Beckett is manager and L. O. Howard smelter superintendent.

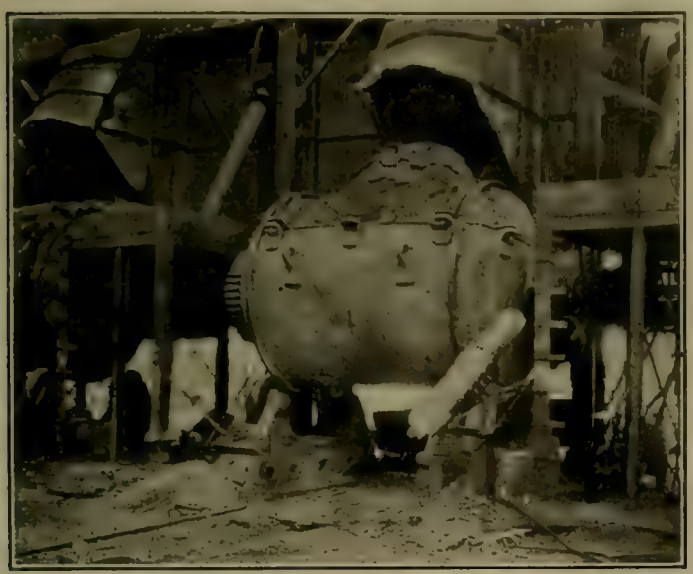
The Miami District

A short distance to the west the Miami is milling all its ore and shipping its concentrate over 200 miles, to Cananea. The Miami ore is also short of sulphur and the Old Dominion company, which has been involved in litigation for many years, apparently does not care to undertake the construction of a reverberatory plant for the handling of custom ore. As within a comparatively short time the Inspiration, which adjoins the Miami, expects to be producing concentrate from an 8000-ton mill, the International

Smelting & Refining Co. will shortly undertake the construction of a new smelter at Burch, halfway between Globe and Miami to consist of roasting and reverberatory smelting equipment.

The Hayden Plant

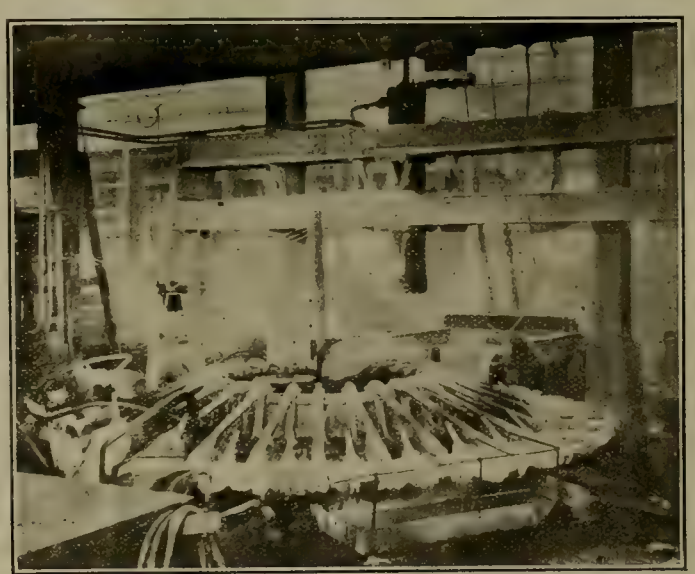
About 20 miles directly south, but across a range of mountains, is the Hayden smelter of the A. S. & R. Co. This was recently built to handle the concentrate from the Ray Consolidated Copper Co., which it directly adjoins. The wet concentrate brought in railway cars, is allowed to dry as much as possible, then is sampled, dropped into bins, and when wanted for smelting is drawn out upon belts, which discharge into the McDougall roasters. Of these, five are 24-ft. and have 5 hearths, and three are 19-ft. and are 6-hearth furnaces. The concentrate contains 24% sulphur, and it is necessary to burn a little oil from time to time, on account of the high moisture. Each McDougall handles about 90 tons, the top of one 5-hearth roaster being used for drying. The reverberatory furnaces are 19 by 112 ft., and smelt about 350 tons per day each, including seconds, with a consumption of 0.8 to 0.9 bbl. oil per ton smelted. The steam recovered in the waste-heat boilers (Stirling) goes to the main power-plant, and suffices to meet all the power requirements of the smelter with a substantial success. The matte-fall amounts to about 25 to 40% matte. This is blown to blister in either one of two Pierce-Smith converters or in one 12-ft. Great Falls type converter. Slime concentrate is used for fettling the furnace. The blister is poured into an oil-fired receiving vessel in order to keep it hot while pouring the anodes. This smelter would naturally be the one for handling the Miami and Inspiration concentrate, but in order to get over the intervening short distance, several hundred miles of railway haul would be necessary. A short line connecting Winkelman with a point on the line from Bowie to Globe would form a short and convenient connection, but as the line would have to traverse the site reserved for a dam in a future government reclamation project there is but little likelihood that it will ever be built. J. B. Haggie is superintendent of this plant.



CONVERTER STAND, CALUMET & ARIZONA SMELTER.

Calumet & Arizona Smelter

At Douglas, which is on the border line between the United States and Mexico, there are two smelting plants. The new plant of the Calumet & Arizona, which was designed by Repath & McGregor under the direction of J. C. Greenway and L. D. Ricketts, embodies all the important features of the New Arizona Copper Co. smelter and also that of the United Verde, at Jerome, therefore I shall describe it at some length. The blast-furnaces, of which there are two, are 48 in. by 40 ft. and are designed for the maximum convenience in charging and tapping. The ore from the beds is drawn out upon a series of belts, which in turn discharge upon a main belt which elevates the ore, fuel, and flux to the bins above the blast-furnaces. Each furnace is provided with four charging cars, each 20 ft. long, which rest upon track scales beneath charging hoppers, which are filled by belts provided with distributers, running between the pairs of hoppers. When the charge-car is filled, it only requires to be moved a short distance forward in order to discharge directly into the furnaces. The estimated capacity of these furnaces is 800 tons each per day. The settlers are oval in shape, the matte being tapped directly into pots set in the main crane aisle, the slag being drawn off into large pots



AUTOMATIC COPPER INGOT MOLD, COPPER QUEEN SMELTER.

and hauled by an electric locomotive to the slag dump. The reverberatory furnaces, of which there are four, with space for a fifth, are 19 by 100 ft., and present no special features beyond the convenience of their arrangement with respect to the rest of the plant. The calcine is brought directly over the charge hoppers in cars from the roaster. The converter slag is poured by the crane directly in at the feed end, and fettling and fluxing material, brought up by the same belt which elevates the lump ore, is drawn about as desired in small cars. Of converters, six stands of 12-ft. Great Falls type are provided.

Arrangement of Plant

The converter flue is hung directly upon the frame of the building and a hopper for the silicious addition is placed directly above, delivering the silicious material directly through a chute into the converter, without its being necessary to move the shell from its normal blowing position. These bins are filled by a conveyor, thus relieving the crane of much work, so that one is able to serve the whole main aisle. Two casting machines of the Anaconda type will be provided, one at each end of the main aisle. In order to eliminate labor in breaking up skulls, a heavy steel plate with 8-in. holes is placed beneath a miniature pile-driver; as fast as the material is sufficiently reduced in size it falls through the plate into a hopper below. For roasting concentrate, twelve 21½-ft. Herreshoff air-cooled roasters are provided. These have six hearths and the roof is also used for preliminary drying. These as well as the furnaces are provided with dust flues hung in a steel frame, and with bottoms made from hollow tile. As this tile is manufactured at El Paso, steel plates will be substituted for it at Jerome, on account of the relative freight cost. The gases are distributed throughout the settling chamber by a row of flat bands, hung near the entrance; by sliding these the gases can be uniformly distributed over the whole cross-section. At the middle of the dust chamber a 20-ft. section is hung with No. 10 wires suspended from the roof. The plant has been designed to secure a maximum of capacity with a minimum of labor and equipment, thereby attaining low operating costs. The success of such an arrangement is largely dependent upon an accurate foreknowledge of the conditions to be met, and the whole forms an excellent example of advanced modern practice. J. C. Greenway is manager.

Copper Queen Smelter

The other plant at Douglas is that of the Copper Queen company, built about ten years ago, and exhibiting characteristic differences from the plant just described. The most marked of these is in the bedding system employed. Long stalls, 21 car lengths long and 50 ft. wide are provided, with tracks upon the bottom for reclaiming, and tracks at a higher elevation on each side. Converter slag is placed on the bottom, lump ore is distributed over the top, and a small amount of concentrate is intermixed. About two days after a bed is completed, reclaiming of it is begun, using small steam-shovels for the purpose. The total storage capacity is 100,000 tons. The cost of reclaiming is given as 3c. per ton, 9 days being required to exhaust a bed. This ore is smelted in ten blast-furnaces, five of which are 20 ft. long and the others 18. The larger furnaces smelt about 360 tons per day each, using 30 oz. blast pressure, and making a 40% matte. The smelting charge is rather high in alumina, yielding a somewhat viscous slag.

The flue-dust and roasted concentrate from the Nacozari mines is smelted in two reverberatory furnaces, 19 by 95 ft., which handle about 300 tons per day each, using 0.86 bbl. of California crude oil per ton smelted. This plant is unusual in that Erie boilers, instead of the usual Stirling, are used to recover the waste heat of the reverberatories. As the result of extended experience the mechanical engineer of the plant reports that these boilers are of almost equal efficiency, lower first cost, and are easier to clean. The usual difficulty experienced with the Erie boiler is that it primes badly when it is forced, and a waste-heat boiler usually works under a heavy overload. The draft pressure on one reverberatory is 0.5 in. and on the other 0.3 in., the difference being due to a fuel economizer placed after the waste-heat boiler in the second. Better results are obtained with a higher draft pressure, but may be due in part at least to the fact that this furnace has been in operation for a longer period. It was necessary to raise the roof of these furnaces in order to give more combustion space, and it may be expected therefore that the 22-ft. reverberatory at the New Arizona Copper Co. plant will give somewhat better results than a narrower furnace. The necessity for ample space to ensure the proper combustion of a liquid fuel has been discussed at some length in recent issues of the *Mining and Scientific Press* and need not be further referred to here. This plant is under the general direction of Walter Douglas. Mr. French is manager, and Frank Rutherford superintendent.

Practice at Cananea

The smelting plant at Cananea, a short distance south of the Mexican border, may be regarded as the type of the district, since it is here, under the direction of L. D. Ricketts, that the methods and equipment have been developed which are embodied in the newer plants now under construction or recently completed. The lump ore is smelted in eight blast-furnaces, 48 by 210 in., with a height of charge above the tuyeres of 7 ft. and using 26 oz. blast pressure. Each furnace smelts about 300 tons per day, using 9% of coke, and yield flue-dust amounting to about 10% of the charge. The material charged to these furnaces consists of lump ore, some custom ore, converter slag, and about two-thirds of the total amount of concentrate made in the Cananea mills, 600 tons per day in all. The charge is delivered into bins placed above the charge floor, and is run directly into the furnaces through chutes. The system of bedding for mixing the charge has been described in detail by M. J. Elsing, and will not be further referred to here.

The Cananea concentrate carries 30 to 35% sulphur and is roasted in 6-hearth 18-ft. McDougall furnaces, 10 being provided and 6 in use. The sul-

phur content is reduced to 6 to 7%, each roaster handling about 40 tons per day. The calcine and about 75 tons per day of raw Miami concentrate are smelted in two 19 by 100-ft. reverberatory furnaces which handle 260 to 275 tons per day each. The fuel used is California crude oil, less than 0.8 bbl. per ton smelted being required, having been reduced to that figure from 0.9 bbl. The oil is heated by a steam coil in a tank and is injected by air at 13 lb. pressure, the former burners which used both air and steam for injection having been discarded. Air for combustion is admitted through a checkerwork of brick above the burners, this arrangement producing a more even distribution of heat throughout the furnace. The Miami concentrate, still wet, is dropped against the walls to serve as fettling, and is better for this purpose than silicious ore, which is likely to produce 'floaters.' This concentrate only carries about 21% S in its raw state.

Miami Concentrate

The remainder of the Miami concentrate, which amounts to 125 tons per day in all, is blown into the converters by use of an ingenious blow-pipe. Three 12-ft. Great Falls converters are in use, and three more are under construction. The matte to be handled amounts to 400 to 500 tons per day, yielding about 150 tons of blister copper. The concentrate is first dried and in the course of the blow a certain amount of it is blown through the tuyeres, one at a time, in order to prevent local chilling. In this way 50 tons per day of concentrate is smelted, its silica content serving to displace a corresponding amount of silicious material which would otherwise require to be introduced through the mouth. The two reverberatories are provided with eight waste-heat boilers, three being 250 hp. each, two 225 hp., and three 200 hp. These yield about 1000 hp., the remainder of the power being furnished by a battery of oil-fired boilers. With admirable foresight the tailing from the milling plant has been impounded behind sand dams, looking forward to a time when it will be possible to recover a further part of its copper content.

At Jerome is the smelting plant of the United Verde. The old plant is just in process of being abandoned and a new plant is under construction. This will not differ materially from the new Calumet & Arizona plant, except that Wedge furnaces will be used for roasting. At Humboldt is the smelting plant of the Consolidated Arizona. This consists of blast and reverberatory furnaces, only part of the equipment now in use. I have not seen this plant, the management having declined to extend that courtesy. An important project which has not yet reached the construction stage is the Ajo or New Cornelia property, which has been acquired by the Calumet & Arizona, after extensive drilling operations had disclosed the existence of large reserves of oxidized ore. Plans for working have not yet been fully matured, but it has been proposed to leach the ore with sulphuric acid. The resulting copper sulphate solution will be precipitated by the metallic iron. The manufacture of sulphuric acid is rather expensive, however, and the consumption of iron so high that even with cheap iron the process is likely to be somewhat expensive. The process is being studied with care.

Summary

The range of ore to be handled in this district may be indicated on the one hand by the Cananea blast-furnace practice, with the elimination of 70% of the sulphur in the charge and the production of a 33% matte, and the Miami concentrate, which contains about 35% copper and 21% sulphur. The tendency toward increasing use of reverberatory smelting is not only due to the increasing amount of fine concentrate to be handled, but also because many of the lower-grade deposits are too low in sulphur for the formation of a satisfactory matte. The net cost of reverberatory smelting has been lowered to a point where, in many cases, it is better at once to smelt in reverberatory furnaces, rather than to attempt to handle much concentrate in the blast-furnaces, with the inevitable rehandling of a considerable part of it as flue-dust. For roasting, both the water-cooled Wedge furnace and the air-cooled Herreshoff are coming into use, as more satisfactory from a mechanical standpoint than the ordinary McDougall. The Great Falls type of converter has become standard practice, the longer life of the basic lining leading to lower costs, especially through the greatly decreased handling of seconds. Thus at Cananea it is hoped that much of the converter slag can be poured directly into the settlers of the blast-furnace, instead of requiring smelting. Sweeping changes in present practice are likely to result from the experimental work now being done on the use of flotation for the recovery of concentrate and of leaching processes for the recovery of copper. But through the similarity of general conditions which govern smelting operations in the territory which has been described, it is likely that smelting practice in the area will continue to exhibit certain characteristic common features.

The suggestion was made recently to the Queensland Minister of Mines, Mr. Appel, that the Government should advance $290,000 for the purpose of sinking a large shaft on the Charters Towers goldfield to test the ground to a depth of 4000 ft. The minister replied that the Government did not consider the scheme feasible, for the present at any rate. Mr. Appel, however, stated that the Brilliant Block Co. had made an application for a loan of $12,000 to carry out the exploratory work mentioned as desirable before the shaft was sunk. The Government had previously advanced $14,400 for this work, to be undertaken by the Brilliant Block and Brilliant Deeps jointly, and the amount had been so useful that it was desired to continue the arrangement, the sum of $12,000 being required for its completion. The July metal production of the field was valued at $115,000.

The Lena Goldfields, Ltd., in Siberia, during the season from October 1, 1912, to July 10, 1913, mined and hoisted 549,384 cu. yd. of gravel, washed 456,218 cu. yd., and recovered gold worth $3,216,000. The Orsk Goldfields, Ltd., in July dredged 116,080 cu. yd., yielding $49,000.

Dredging in Victoria in 1912

*There were 138 leases covering an area of 14,797 acres of land, in seven different districts of this state in Australia, during the year, and 94 plants were working and 12 in course of building or reconstruction.

Scale of Operations

Fifty-five bucket-dredges, working an aggregate period of 2104 weeks, raised 16,777,591 cu. yd. of material, yielding 59,445 oz. of gold, or 1.7 gr. per cubic yard; 3¾ tons of tin, valued at $2400, was also recovered. The area treated was 589 acres, and the quantity of gold saved per acre was 100.9 oz. The dredges, which treated most of the material, recovered 1233 oz. in 52 weeks from 20½ acres of ground, averaging 1.2 gr. of gold per cubic yard of material treated. The average weekly return of gold per plant was 28.2 oz., the number of men employed was 765, and the weekly expenses in wages, fuel, water, maintenance, and repairs per plant averaged about $360, equivalent to, say, 19 oz. of gold. One bucket-dredge treated over 15,000 cu. yd. of material per week. Another handled more than 14,000 cu. yd. per week; and three others treated over 13,000 cu. yd. weekly.

This system shows a decrease of gold won during the year of 53 oz. as compared with the previous year, and a decrease in dividends of $76,000. Sixteen companies paid dividends ranging from $480 to $28,800, from ground yielding 1.2 to 4 gr. per cubic yard of material treated; but it is to be noted that a good many companies working their plants are practically paying for them out of the gold recovered, dividends thereby being reduced. The amount expended by the dredging companies in wages, fuel, and maintenance during 1912 was $768,000, and the dividends paid $14,400. The initial cost of these plants was $1,400,000. The sizes of buckets varies from 3 to 6.5 cu. ft., and from 10 to 16 are discharged per minute.

Hydraulic Sluicing Plants

Twenty-six pump hydraulic-sluicing plants, during an aggregate working time of 386½ weeks, handled 2,445,009 cu. yd. of material, yielding 11,147 oz. of gold, or 2.2 gr. per cubic yard. Twelve and one-half tons of tin, valued at $7700, was also won. The area worked was 69.8 acres, the quantity of gold won per acre being 159.7 oz. The plant with the highest yield of gold obtained 1226 oz., from 6½ acres of ground, containing 167,794 cu. yd. of material, or an average of 3.5 gr. per cubic yard. The average weekly yield of gold per plant was 29.1 oz., and the number of men employed was 407. The average weekly expenditure in wages, fuel, water, and repairs, per plant, while sluicing, shifting, and repairing, was $430, equal to about 22.6 oz. of gold. One pump sluice plant operated on over 15,000 cu. yd. of material per week, another plant of the same type treated over 14,000 cu. yd. per week, two others each treated over 7000 cu. yd., and three others each did over 6000 cu. yd. in the same period. As compared with the previous year, a decrease of 5880 oz. of gold is shown by this type of dredge during 1912, also a decrease of $7200 in dividends. The dividends paid by the companies varied from $770 to $3400, obtained from ground worth 2.9 to 5.5 gr. per cubic yard of overburden and wash-dirt treated. An increase of 10.65 tons in the tin yield is shown. The wages, fuel, water, and maintenance accounts total $240,000, and the dividends paid were $7700. The initial cost of these plants was $326,000.

Twelve jet elevators, working an aggregate time of 147 weeks, handled 407,265 cu. yd., yielding 2620 oz. or 3 gr. of gold per cubic yard of material treated. The area worked was 13.7 acres, the quantity of gold won per acre being 191.3 oz. These plants employed 70 men, and were valued at $31,200. Other plants of this description were in operation during the year, whereby 793 oz. of gold was recovered, but other information is not available.

Summary of Placer Mining During 1912

The total quantity of material treated during the year, under dredge mining and hydraulic sluicing by gravitation, was 19,722,227 cu. yd., as against 20,144,347 cu. yd. in 1911, and the amount of gold won was 73,781 oz. as against 81,593 oz. in 1911. The yield of gold per cubic yard of material treated was 1.8 as against 1.94 gr. for the previous year. The total area treated was 675.7 acres, the ground varying from 8 to 59 ft. in depth, and the number of men employed was 1293. This area may be classified thus: agricultural, 20 acres; pastoral, 159 acres; river and creek beds and old worked ground, 497 acres. Under this heading the dividends paid were $153,000. The wages and other expenses amounted to $1,066,000, and the initial cost of the plants was $1,872,000. The quantity of tin won during the year was 20.6 tons, valued at $12,000.

Since 1900, placer mining has treated 185,254,860 cu. yd., yielding 856,256 oz. gold, an average of 2.2 gr. per cubic yard. Other returns bring this total to 951,944 oz., and 355.5 tons of tin.

*Abstract from the annual report of the government on dredge mining and hydraulic sluicing.

The iron and steel output of Italy for the past year has been somewhat disappointing, although a general increase is to be noted. The iron is produced almost entirely from the ore from the Elba mines, the importation of foreign ores amounting to only 30,000 tons. While the national production is increasing, the importations of crude iron are also on the increase. In 1912 there was 267,000 tons imported. The country produces a million tons of iron and steel, and imports 300,000 tons of girders, sheet iron, etc., in addition to 400,000 tons of scrap iron for the Martin steel furnaces.

Extensive asbestos deposits are being worked on the eastern slope of the Urals. The production of the region has doubled during the past five years. The production for 1912 amounted to 1,007,697 poods, and the total production for the past ten years, 6,365,004 poods, or approximately 106,000 long tons.

Origin of Lead, Zinc, and Silver in the Cœur d'Alene—II

By Oscar H. Hershey

The Belt sediments, in northern Idaho and western Montana, have been invaded by a number of small stocks of monzonite, syenite, granodiorite, and closely related rocks. Those in the Coeur d'Alene district are presumed to be arms of a deep-lying north extension of the great quartz-monzonite batholith of central Idaho. About some of these arms there are definite zones of contact metamorphism.

Prichard Type of Ore Deposits

The Prichard type of ore deposits invades these zones, in a few cases to the very contact. The mineralogical character of the deposits is like that of the ordinary Prichard plus contact metamorphic silicates. The best example of these contact metamorphic ore deposits is at the Granite mine on the border of the Gem monzonite area. Mr. Ransome says[14] that "the association of the ore minerals with the metamorphic silicates is so close that the conclusion of their contemporaneous genesis is unquestionable. * * * The foregoing characteristics indicate that the ore of the Granite mine was deposited shortly after the intrusion of the monzonite and is a phase of contact metamorphism." In proceeding eastward away from the Gem monzonite there is a gradual fading of the evidences of metamorphism. Garnet and green biotite are intergrown with the sulphides in the Gem vein. Green biotite and an asbestiform mineral occur with the sulphides in the Hercules orebody. The ores of the Granite and Sixteen-to-One mines, in the contact zone, are rich in sphalerite. This mineral decreases, in the Canyon Creek mines, away from the monzonite area and upward in the veins. Magnetite and pyrrhotite are present near the contact, but seemingly decrease and finally disappear entirely away from the monzonite.

Wardner Type of Ore

After leaving Canyon Creek district, by selection without reference to distance from the monzonite at Gem, a mineralogical gradation may be found to what has been denominated the 'Wardner type' of ore. I suppose this refers to an ore that consists of quartzite fragments, siderite, galena, a little vein quartz, and practically no pyrite and sphalerite—the 'Bunker Hill type' of my classification. The magmatic hypothesis presumes that the ore minerals in the contact metamorphic deposits were derived from the monzonite and that as there is an apparent mineralogical gradation between all the ore deposits of the Coeur d'Alene district, it is reasonable to presume that they have all been derived from the same source and by the same process, their differences being largely a function of distance from the monzonite contact. It is supposed that when the solutions issued from the monzonite, zinc sulphide was at first deposited in equal or even greater quantities than lead sulphide. Siderite was driven to a considerable distance from the contact. Thus the Prichard type must owe its characteristics to proximity to the monzonite. It is held that because ores in which pyrrhotite and sphalerite are comparatively abundant occur in the Pine Creek prospects, the top of the batholith may not be very deeply buried in that region. The fact that the Prichard type is confined to the Prichard formation may be explained, under this hypothesis, as due to the Prichard being stratigraphically the lowest formation in the mining districts, and it would hence be most likely to receive the deposits nearest to the monzonite. The fact that the monzonite is intruded into rocks as high as the Wallace raises no difficulty, for there are no contact ore deposits higher than the lower Burke so far as I know. It may, therefore, be purely a coincidence that the Prichard type is confined to the Prichard rocks.

Relation of Batholith to Ore Deposits

The magma at first, it is supposed, had very small quantities (per ton) of lead and zinc, and hence it is not surprising to find the arms of the batholith which reach the present surface practically barren of these metals. The millions of tons of lead and zinc in the district were apparently not supplied by these arms. As the upper portions of the batholith cooled and crystallized, it is presumed that there was a concentration of the heavy metals in the remaining portion. Finally, the process of crystallization expelled from the deep-seated portions of the magma solutions relatively rich in zinc and lead. They rose through the thick shell of solidified monzonite, either in fissures or through the minute pores of the rock. In either case they would hardly have left no traces in the monzonite. So far as I know, no such traces are known in the exposed monzonite. It is, therefore, presumed that the solutions entered the sediments from the monzonite at points deeply buried beneath the present surface. Unfortunately, the mines may never penetrate to where the mineral deposits in the sediments may be presumed to connect with some sort of mineralization in the igneous rock, so the magmatic hypothesis is under the disadvantage that it may never be capable of positive proof in the field.

Contact Deposits

The contact metamorphic ore deposits are incontrovertible proof that some zinc and lead were deposited from solution in connection with the monzonite intrusion, but they are not even strong evidence that the metals came from the magma. Practically all those known to me occur near the top of the Prichard formation, suggesting that the magmatic gases or waters, or vapors heated by proximity to the eruptive rock, leached them from diffused mineralization at this horizon. At a certain mine in western Montana, typical contact ores have been deposited in connection with a nearly vertical fissure

[14]Professional Paper 62, U. S. Geol. Surv., p. 185.

cutting Prichard strata dipping about 30°. Bands that are predominantly slate alternate with bands that are predominantly quartzitic. The horizon is near the top of the Prichard formation. The minerals present are chlorite, garnet, actinolite, pyrrhotite, chalcopyrite, galena, sphalerite, pyrite, quartz, and calcite. The shoots of ore apparently pitch in the direction of the dip of the strata. That portion of the vein that lies deepest stratigraphically, has shoots that are mainly zinc ore. Higher stratigraphically are shoots that contain much lead ore and proportionately less zinc. There is no evident explanation for this in the apparent character of the wall rock, in the associated metamorphic minerals and in the relative altitudes. I have considered it evidence that zinc greatly predominates in the supposed diffused deposits at lower stratigraphic horizons and the lead content increases higher; but perhaps I have made unwarranted use of this case, particularly as the exact situation of the eruptive is not known.

The Granite Mine

At the Granite mine, the ore occurs in irregular masses which are practically confined to the Prichard sediments. The adjacent monzonite is barren in appearance and contains small aplitic and pegmatitic dikes which, so far as I could see in a surface examination, are absolutely barren. "The commonly accepted theory of the origin of aplite is that it represents the acidic remainder in a granite or quartz diorite magma after the more basic elements have crystallized. The aplite is forced up from below and fills previously formed cracks, which are perhaps the result of cooling, in the main mass of the granitoid rock."[15] It seems to me that there is here evidence that long after the Gem monzonite arm had crystallized, at least in its upper portion, the emanations from the deep-seated portions of the magma did not bear notable amounts of lead and zinc. At the Granite mine, I have seen small pockets of sphalerite in the monzonite near the border; I am not certain whether they occur as inclusions or have been deposited later than the igneous rock. Streaks, several inches thick, of nearly solid galena lie against a wall of monzonite. I strongly suspect that the ore deposits were in existence in some form before the intrusion.

There is reason to consider it possible that in time conclusive proof may be secured that a large part of the lead and zinc mineralization in the Coeur d'Alene district antedated the monzonite intrusion. The exact relation between the fault systems and the intrusion has not been worked out. Immediately west of the southern portion of the Gem area there is a badly faulted area containing some comparatively old faults. Unfortunately, its relation to the monzonite is obscured by a great fault, the Dobson Pass, at the contact. The east side of the Gem area seems more promising. When this has been thoroughly studied it may be found that much of the ore is genetically connected with faults that are older than monzonite. This surmise is warranted by the outlines of the various monzonite areas. I am inclined to the opinion now that in my Wardner paper I put the monzonite intrusion too far back. I thought I saw evidence of it in certain possible contact deposits, and in the disseminated zinc-lead mineralization, making it older than the second system of faults. These deposits, however, may be due to an earlier intrusion or to some other cause. About all that is positively known as to the age of the monzonite is that it antedated the ninth system faulting.

The Wardner district contains, perhaps, the strongest evidence in support of the magmatic hypothesis. When the four principal stages of lead deposition (the disseminated zinc-lead mineralization and the Blue Bird, Jersey, and Bunker Hill stages), are considered, it will be seen that there has been a tendency to a gradual elimination of the zinc and iron sulphides. A similar mineralogical change in the Canyon Creek mines has been attributed by Mr. Ransome to the effect of increasing distance from the monzonite and by me as brought about by increasing distance from the presumed source of the minerals in diffused mineralization in the Prichard formation. In the Wardner district, however, it is a function of time, not of depth. Under the magmatic hypothesis it might be explained as the result of a receding source, the solutions in each stage starting at a much greater depth as the result of the progressive solidification of the magma. Unfortunately, the same effect in so far as it is influenced by heat and pressure might be secured by the progressive decrease of depth due to lowering of the surface of the country by erosion, so that it furnishes no real support to the magmatic hypothesis. Besides, there were temporary returns to the zincy status. The very latest ore mineralization in the district has nearly as much zinc as lead. The silver ratio increased to the Jersey stage, but in the Bunker Hill type dropped to normal, namely, a little less than half an ounce for each per cent lead.

Mississippi Basin v. Coeur d'Alene Deposits

I want to call attention to a curious contrast in one particular between the lead and zinc deposits of the Mississippi Basin districts and those of the Coeur d'Alene. In the former districts zinc tends to predominate at lower levels, which is explained as due to the fact that downward-moving waters, owing to the principle that zinc has a less strong affinity for sulphur than has lead, may concentrate the galena at high levels and the sphalerite at lower levels. In the Coeur d'Alene, on the contrary, a similar tendency for zinc sulphide to predominate at lower levels is attributed to the action of ascending waters. In the Mississippi Valley districts, the lead and zinc traveled largely as sulphates and were precipitated by the agency of organic matter. The same principle, applied to the supposed diffused mineralization in the carbonaceous Prichard slate, would lead one to expect lead to predominate over zinc. However, through the law of mass action, if zinc salts greatly predominated in the Prichard waterbody, more zinc than lead might have been deposited. In the case of the ore-making solutions it is not so

[15] Weed, W. H., 'Geology and Ore Deposits of the Butte District, Montana,' Prof. Paper 74, U. S. Geol. Surv., p. 39, 1912.

easy to get around this difficulty. The solutions appear to have started in the Prichard formation (or near the monzonite) comparatively rich in zinc. For a time they lost zinc faster than lead. Because of its stronger affinity for sulphur and less solubility, lead sulphide should have been precipitated first and should be more abundant at lower levels. If the mineralogical character of the Prichard type be attributed solely to the precipitating effect of the slaty rock, the carbon marks the only important mineralogical difference between this rock and the higher rocks, and this carbon should have made galena more abundant at lower levels than higher. My impression is that the explanation will lie along the lines that the minerals in the Coeur d'Alene were carried as sulphides dissolved in hot water under pressure and precipitated by decrease of heat and pressure. I have not been able to find any chemical law which will permit zinc sulphide to be precipitated in preference to lead sulphide, nor have I found any very definite statement as to the behavior of dissolved sulphides under considerable heat and pressure.

Copper and Gold Minerals

If there are any mineral deposits in the Coeur d'Alene district that derive their metals from the monzonite magma, they are more likely to be the copper and gold than the lead and zinc deposits. In central Idaho, where erosion has cut deep into the quartz-monzonite batholith, some idea of what minerals may be traced to the deep-seated portions of the batholith may be obtained. The Geologic Map of North America[16] shows a broad expanse of 'post-Cambrian intrusives' in central Idaho. A large part of this area is quartz-monzonite. Turning to plate VII, in Bulletin 507, U. S. Geol. Surv.,[17] it will be found that this area is studded with districts in which gold is predominant, a few with silver predominant, and none with lead predominant. From this it seems proper to infer that gold would be, by value, an important constituent of any mineral deposit derived from the deep-seated portions of the batholith. The silver-lead deposits of the Wood River region, near Hailey, in Blaine county, Idaho, are cited as supporting the magmatic origin of the Coeur d'Alene deposits, because they occur in sediments on the flanks of the great central Idaho granitic area, because these sediments are intruded by granite or quartz-monzonite masses, because siderite is abundant, and because of metasomatism in the ore deposits and its weakness in the country rock. I have not seen the Wood River deposits, but I see nothing in the descriptions that precludes the probability that the lead was derived from the sediments.

The copper deposits at Butte, Montana, occur in the Boulder batholith of quartz-monzonite. "Similar batholiths of granite occur elsewhere in the Montana ranges and are all probably connected with a deep-seated parent mass that underlies the entire region between the Front range and the Idaho plains."[18] This, by inference, connects the mass at Butte with the monzonite in the Coeur d'Alene region. Pyrite "occurs as a primary constituent of the Butte quartz monzonite and in pegmatitic facies of the aplite." In massive veinlets it carries some copper and "is supposed to be the mother copper mineral of the district." Mr. Weed also states that "chalcopyrite is a primary mineral in the Butte quartz monzonite, a study of thin sections and of polished specimens showing that it is intergrown with the rock minerals in the perfectly fresh rock." The earliest copper veins are a mass of pyrite and quartz carrying less than 1% of copper. "Though the evidence is not conclusive, it is believed to indicate that the copper and other metals of the quartz-pyrite veins are derived from magmatic emanations coming from a deep-seated mass of igneous magma." I am not disposed to criticize that conclusion. The gold in the Butte copper ore averages low, but is much greater than in the Coeur d'Alene lead ore.

Occurrence of Gold in the Coeur d'Alene

In the latter district, gold veins occur mainly in two groups, both of which are rather low in the Prichard formation, suggesting that minute quantities of gold may have been disseminated in the lower Prichard strata, but I am inclined to connect them with the monzonite intrusion. Nearly all the gold-quartz veins in the Murray district that have been described[19] are bed veins and lie at rather low dips. They contain small quantities of pyrite, chalcopyrite, galena, sphalerite, and free gold. They may all be connected with the so-called 'Mother vein.' This is a large low-grade base vein traversing the district in a northwest direction and extending, if I may believe prospectors, six or seven miles. It stands nearly vertical and cuts the bedding of the Prichard rocks. Where seen by me it is 15 to 30 ft. wide, largely composed of quartz, heavy with pyrite. In places considerable chalcopyrite and galena appear with the pyrite. The entire vein is said to carry appreciable but small amounts of gold. This great vein may well extend down to the supposed underlying monzonite. The presence of scheelite in one of the gold quartz veins may be another indication of derivation from a magma, for tungsten deposits are almost invariably found in or near a granitic batholith. As Mr. Ransome points out, "although the gold-quartz veins all carry a little galena, yet the striking feature about them is not their similarity to the lead-silver deposits, but their rather marked difference in structure and in mineralogical character. No deposit has been found, so far as known, which suggests any transition between gold-quartz veins of the Murray type and lead-silver deposits such as those of the Barton and Paragon mines in the same (Prichard) formation." A typical Prichard type vein, the Terrible Edith, occurs near the principal old gold-quartz mine, but a little higher, altitudinally and stratigraphically. The foreman says that the ore on the middle level contained $2 gold

[16]Prof. Paper 71, U. S. Geol. Surv., plate 1, 1911.

[17]Hill, J. M., 'The Mining Districts of the Western United States,' 1912.

[18]Weed, W. H., 'Geology and Ore Deposits of the Butte District, Montana,' Prof. Paper 74, U. S. Geol. Surv., p. 28, 1912.

[19]Prof. Paper 62, U. S. Geol. Surv., pp. 141-149.

per ton, as paid for by smelting companies. This indicates that the Terrible Edith solutions came into contact with a gold-quartz vein and that the Prichard type of lead-zinc deposits is younger than the Murray gold veins. I have no intention of committing myself to the idea of a magmatic origin for the gold, but I submit that the gold veins are of the type that would be expected if derived from the deep-seated portions of the great quartz-monzonite batholith, and the lead and zinc veins are not.

The copper veins in the Coeur d'Alene are of two types. In one, the primary mineralization was pyrite and chalcopyrite impregnating certain porous bands of quartzite. These veins are parallel to the bedding. The other type consists of quartz veins with occasional pockets of chalcopyrite. There is usually some pyrite and in some veins considerable galena. These veins cut the bedding. They appear to be more independent of the formations than are the lead veins properly so called, and as numerous in Wallace areas as in Prichard. They are also more independent of the excessive disturbance of the rocks. From this fact, and their mineralogical composition, they appear to me more likely to be genetically connected with monzonite that may be presumed to underlie the entire district than are the lead-zinc veins. The galena present in some of the copper veins may have come from the magma or may have been leached from the sediments by the ascending solutions. Even the copper-impregnated bands may have derived their minerals from solutions emanating from the magma. Some of the copper veins have little gold, while others contain $2 to $3 per ton. The silver content varies from nearly nothing up to 10 to 15 oz. per ton.

Silver-Bearing Lead Ore

In the lead mines of the Coeur d'Alene, when the silver ratio exceeds 0.5 oz. to each per cent lead, the excess is nearly always due to the presence of argentiferous tetrahedrite. This mineral appears to be distributed somewhat independent of the lead and occurs, with chalcopyrite and small quantities of sphalerite, in bodies of siderite and pyrite that contain no lead. Without committing myself to the theory, I say that this argentiferous tetrahedrite may have been derived from the monzonite magma.

In a territory about one and one-half by two miles, in the range east of the Steptoe Valley smelter at McGill, White Pine county, Nevada, there is a group of small lead mines that have produced some shipping ore. At the time of my visit in 1905, I estimated that there was about 12 tons of shipping ore in sight, but the character of the deposits is such that no large reserves would be carried. Small pockets (up to 1000 lb. weight) of rather coarse-grained galena are irregularly distributed through Lower Cambrian limestone, without any apparent connection with deep-extending fissures, though they are largely associated with secondary calcite in veins and irregular bodies. This is the only district in eastern Nevada that I have visited in which lead ore occurs under the conditions common to the great lead districts of the Mississippi Valley. I was told that the ore contains almost no silver or gold.

In Clifton district, in Tooele county, Utah, besides the typical contact metamorphic copper-gold deposits and a lead and silver-bearing deposit probably due to a small vein coming up through granite and spreading out into a flat-lying lenticular mass in the limestone, there are, in the granite area, a score of parallel fissure veins of calcite, quartz, and altered granite carrying galena said to be fairly rich in silver. In granodiorite in the Cortez district, Eureka county, Nevada, there are small veins of white quartz carrying coarse blende, galena, and pyrite and said to be chiefly silver ore. In these two cases, unless one assumes a downward circulation for the solutions, there seems no escape from the conclusion that the veins derived some lead from the eruptive rock. It is to be noted, however, that in veins of this class, the lead content is relatively low and the precious metal ratio high. There are many lead-bearing veins and chimneys in the limestones of eastern Nevada that may have had a deep-seated origin and they almost invariably have a high silver and often high gold ratio. H. F. Bain, among others, has called attention[20] to the fact that the igneogenetic type of ore deposits is characterized by the presence of considerable gold and silver, while these metals are likely to be absent or unimportant in the sedigenetic type. In the practical absence of gold (the Terrible Edith excepted) and the low silver ratio where not complicated by the presence of tetrahedrite, the lead and zinc deposits of the Coeur d'Alene are more like the McGill than the Clifton and Cortez types as described above, more like the Missouri and Wisconsin ores than like the majority of lead and zinc-bearing veins of the western half of the United States. It is another count in the indictment against the magmatic hypothesis.

Elko County, Nevada

In 1905, I made a reconnaissance of the Bullion silver mining camp of Elko county, Nevada, where a small batholith of granodiorite has been intruded into the Paleozoic sediments. The contact appears to dip eastward, under the limestones, at a high angle. The mineral belt extends from the contact to about one-half mile east. I gained the impression that near the contact, deposits of iron ore and of copper sulphide ore were formed by contact metamorphic action, that at a distance from the contact these deposits pass into larger deposits in which lead-silver minerals are mixed with the copper and finally along the extreme eastern border of the belt, galena rich in silver occurs alone in thin seams in the limestone. From this I inferred that the solutions may have issued from the magma prepared to deposit iron and copper minerals and that as they rose through the limestone they derived lead from it and deposited it higher. As W. H. Emmons has since studied the district[21] and not noted such a relation my inference may not be warranted.

At the Keystone mine, 15 miles south of Cortez, Eureka county, Nevada, sulphides of copper, lead,

[20] 'Types of Ore Deposits,' p. 102.

[21] Emmons, W. H., 'A Reconnaissance of Some Mining Camps in Elko, Lander, and Eureka Counties, Nevada,' Bull. 408, U. S. Geol. Surv., pp. 89-95, 1910.

zinc, and iron occur with contact metamorphic silicates in a point of limestone projecting into a granitic mass, and at a short distance from the contact, one of these deposits approaches the form of an ordinary vein, with a proportionate increase in the lead content. At Spruce mountain, in Elko county, Nevada, lead occurs with copper in contact deposits that appear to have been somewhat modified by secondary vein action. At the Mount Hope zinc mine, in Eureka county, Nevada, a dark zincblende, accompanied by a little galena and chalcopyrite, is mixed with contact metamorphic silicates produced by the intrusion of a rhyolitic rock into the Nevada limestone. There may be many other places in Nevada where lead and zinc sulphides are apparent primary constituents of contact metamorphic deposits, but I believe it is true that they are relatively limited in extent, have some copper sulphide and appreciable quantities of gold and silver.

Occurrence of Lead in Arizona

In Arizona, lead is usually absent from the primary mineralization of the contact metamorphic copper deposits. In a district visited by me, galena occurs with quartz or fluorite in fractures in the primary copper ore and clearly represents a later stage of mineralization. At Butte, Montana, Mr. Weed says galena "seems not to be present in the old copper veins, but to be confined to the later fault veins." Lead certainly, and zinc possibly, must be placed in a different category from copper and iron. The fact that iron, copper, gold, and silver deposits may often, with fair reason, be attributed to a magmatic source must not be held as support to the magmatic hypothesis as applied to the great lead and zinc deposits of western America. The latter must be clearly established by local field evidence. It is not sufficient to show that eruptive rocks occur in proximity to the ores and that some of the deposits have contact metamorphic characters. Thus, in the Park City district,[22] while it has been shown that there is an apparent genetic connection between the ore deposits and certain dioritic intrusives, actual tracing of the lead mineral into the diorite is needed to bring conviction. In the absence of that, one is justified in placing on one side the known existence of great lead concentrations by the sedigenetic process in the Mississippi Valley, and on the other the absence of any equally strong evidence of the formation anywhere of a great lead deposit, low in silver and gold, by the igneogenetic process. What would happen if the Missouri and Wisconsin lead-zinc districts were buried under 5000 ft. of sediment and intruded by a granitic magma? There would be reconcentration of the minerals and the formation of typical lead and zinc contact deposits.

Conclusion

In conclusion, I submit that, so far as the origin of the lead and zinc deposits that are being mined in the Coeur d'Alene district is concerned, the modified sedigenetic hypothesis is a rational one, that there is much field evidence tending to establish it, and that the chief objection that can be brought against it is the fact that the supposed diffused deposits in the sediments have not been found. The last is purely negative evidence that may exist only because the proper search for these deposits has not been made. The magmatic hypothesis, on the contrary, is not supported by any field evidence that cannot be otherwise satisfactorily explained, and it is negatived by a study of other mineral deposits in the Coeur d'Alene district, in the region of the great Idaho quartz-monzonite intrusion and in the western United States in general.

[22]Boutwell, J. M., 'Geology and Ore Deposits of the Park City District, Utah,' Prof. Paper 77, U. S. Geol. Surv., 1912.

Osmium-Platinum: A New Alloy

By F. Zimmermann

*Of the several metals of the platinum group, platinum, palladium, iridium, and rhodium have been most generally employed in the industrial arts, either alone or in combination as bivalent alloys. Of the latter, iridium-platinum is the best known, but the growing scarcity of iridium has led to the search for other combinations of the metals of this group yielding alloys possessing physical and chemical properties of equal if not greater value. The rarer metals of the platinum group are not easily obtained in great purity, and because of this fact but little success has heretofore been obtained when combining them as bivalent alloys. Furthermore, the strong affinity of osmium for oxygen has increase the difficulty of making alloys of it with other metals in definite proportions. After many experiments by the author, highly refined platinum and osmium have been successfully combined in widely varying proportions yielding alloys of commercial value. While the two metals may be combined in almost any proportion, alloys containing from 1 to 10% of osmium and 99 to 90% of platinum are chiefly used.

Great purity of the components is essential, as the presence of small percentages of other elements appears to be very detrimental to the properties of the resulting alloy. According to the chemical and physical behavior, it seems that one part of osmium in an alloy with platinum will take the place of two and one-half times its weight of iridium. The osmium-platinum alloy is very acid-resisting, and for this reason may be of great service in the electrochemical industry. Its electrical resistance is considerably higher than that of an iridium-platinum alloy of the same percentage composition. The alloy further possesses great hardness and tensile strength. Wires of the finest size are drawn with comparative ease.

*Preliminary paper presented at the Denver meeting of the American Electrochemical Society.

The production of gypsum in 1912 was the greatest in the history of the industry, according to the U. S. Geological Survey; the amount of gypsum consumed being 2,500,757 short tons. The value of gypsum and gypsum products was $6,563,908, an increase of $101,873 over 1911. In 1880 only 90,000 tons of gypsum was produced; in 1900 the production was 590,000 tons.

Mining Iron Ore in Cuba

The iron ore deposits of the Mayari division of the Spanish American Iron Co. occur on an irregular plateau about 15 miles long and 4 miles wide, and at an elevation of 1700 to 2200 ft., on the north coast of Cuba, almost directly north of Santiago de Cuba. These deposits, together with those owned by the same company at Daiquiri, on the south coast, have been described in some detail by James E. Little, in the *Transactions* of the American Institute of Mining Engineers, Vol. XLII, p. 152, to which reference should be made for further details. The mining of these ores constituted an interesting problem, as they occur in a surface-mantle varying in thickness from a mere film to over 120 ft.; the average thickness being 18 to 20 ft. The underlying bedrock is uneven and the ore lies in pockets, and the problem in mining was to secure some type of machine that would remove all the ore down to bedrock. Another point of importance is that the top layers of ore differ in composition from the bottom levels, as nickel is present in increasing amounts with depth; the average nickel content being 0.8%. To insure an even grade of ore it is therefore desirable that the ore shall not be removed in horizontal layers, as with a steam-shovel, but in inclined slices, if possible. It was, therefore, necessary to secure some type of machine that would set on the ground-level and allow its buckets to penetrate into all the hollows of the bedrock, leaving, after the work is completed, an uneven bottom unsuited to the maintenance of tracks. The problem was solved by the use of drag-line excavators which rest on the original surface and back away from the excavation as completed. These excavators load the ore in 50-cu. yd. standard-gage gondola cars, running on tracks laid upon the original surface, as shown in the accompanying illustration. In this way all the ore is removed down to bedrock, and the upper and lower layers are thoroughly mixed in mining. The Company now owns and operates three Lidgerwood-Crawford class B drag-line excavators, each of which digs about 1000 cu. yd. in 10 hours, the output depending on the ability of the organization to 'spot' cars for loading. The excavators have 50-ft. booms and 1½-cu. yd buckets. They are operated by steam-power, the boilers consuming coal mined on other properties owned by the Spanish American Iron Co. Only two men are required for each machine, an operator and a fireman. Only a few men are required for handling track, and the method shows great economy as compared with the steam-shovels ordinarily used for mining surface deposits of iron ore. The loaded cars are lowered down inclines, 6800 and 1950 ft. long respectively, two cars at a time, and sent to Felton, on Nipe bay, and then loaded into sea-going steamers for shipment to the Sparrows Point works of the Maryland Steel Company.

LOADING IRON ORE WITH DRAG-LINE EXCAVATOR, MAYARI, CUBA.

Although the mining industry of Servia has been at a standstill for some time, reports from that country state that Austrian and French capitalists are investigating certain properties and actively engaged in a hunt for investments of merit.

While tin continues to be the source of greatest wealth from British Malaya, the great increase in the rubber business gives promise of surpassing tin mining as a source of revenue.

The Howe Volatilization Process

The main features of this process were described in this journal of March 29, 1913, and further results on a large scale by Ben Howe, at the Gwalia Consolidated mine, Western Australia, should be of interest. This property is one of the big mines in regard to ore deposits in this state, and the lode has been traced for about 3900 ft., and over 100 ft. width averages $9.60 per ton. Hitherto the ore, containing antimony, even in the upper levels, has resisted the best known metallurgical methods to give a reasonable extraction. The mine has produced about $1,200,000 from above the 100-ft. level, and diamond-drilling to 500 ft. has shown $12.48 ore. In consequence of the success achieved with the experimental furnace, a plant capable of treating 30 tons of ore per day was installed at the mine, and early in July the first clean-up from this plant had seemed to show the success of the process on a commercial basis. It was then proposed to erect a 100-ton unit at once, consisting of a No. 8 Krupp ball-mill, rotary roasting furnace, condensing chambers, and gold recovery plant.

Well known metallurgists at Kalgoorlie have concluded that there are immense possibilities ahead of the process for the treatment of refractory, especially antimonial and arsenical ores, and those that will not yield a satisfactory extraction to cyanidation after roasting. In the case of the Gwalia Consolidated, the best results from roasting, sliming, and cyaniding were 75%, while the volatilization process, where the ore is roasted with salt, the recovery is 92%. Another important point is the fact that in the new process there is considerably less expenditure on equipment.

Details of the Process

The details of the process as at present running are quite simple. The ore is crushed dry, in a ball-mill, with 30-mesh screens, 5% of salt being added to the broken ore as it feeds into the mill. The mixture of crushed ore and salt is fed direct into a rotary brick-lined furnace, 27 ft. long by 5 ft. diam., making 2 r.p.m. The raw ore under these conditions roasts in the first 9 ft. of the furnace, and volatilization takes place in the next 18 ft. When the ore gets to the end of the furnace it has lost its gold and goes direct to the tailing dump.

The temperature required in the furnace is somewhat higher than that usually attained in a roasting furnace, and is obtained by gas firing from a wood generator. This generator is worked by pressure, not suction. Air at about 6 to 8 in. water-gauge is blown into the generator from a small Roots blower, and the same blower also supplies hot air for mixing with the gas before burning. The arrangement is simple, and well under control of the man in charge of the furnace. Large furnaces require less attention that smaller ones, and Mr. Howe believes that in the future a furnace about 9 ft. outside diameter by 90 ft. long, treating 100 tons per day, will be a good size. Such furnaces, built of boiler plate, riveted together, would not be very expensive. Fuel consumption at present is about 16% of the ore treated, but this will be considerably reduced with a longer furnace. The regulation of temperature is an important item in the process.

Course of Gases Through the Plant

The gases are hot as they come from the furnace, and carry a good deal of dust, about 5% of the total ore. These gases pass through a dust-

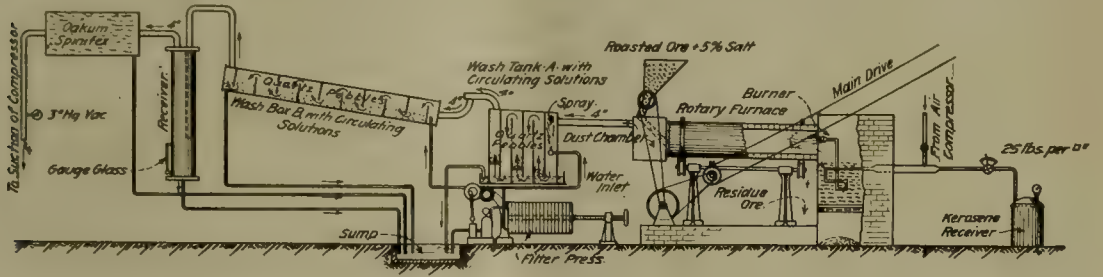


DIAGRAM SHOWING THE ARRANGEMENT OF APPARATUS FOR THE HOWE PROCESS.

chamber, and then into a wooden box, 5 by 5 by 18 ft. The first 6 ft. of this box is brick lined to withstand the heat, and the whole of the top, 18 ft. long, is covered by a perforated tray which is kept full of water. This water runs through the perforations into the box as a constant shower. It is picked up again at the bottom of the box by a centrifugal pump and returned to the upper tray, thus keeping it in constant circulation. It should be mentioned that the perforated tray is divided into two parts, one for the dust portion of the box and the larger one for the gold-collecting portion. Each portion has its own separate pump. The 'dust' pump takes the water from the bottom of the box, as already mentioned, and passes it over two spitzkasten and a wooden table, like an amalgamating table, the former to remove the dust and the latter to cool the water somewhat before returning it to the top perforated tray. The 'gold' pump simply circulates the water from bottom to top continuously, but a small proportion, say 15%, passes through a gravity filter, similar to those used in clarifying cyanide solutions. From these filters the gold is removed as a black sludge, similar to that from zinc-boxes, and is melted in a similar manner.

The shower of water in the gold-collecting area falls on cocoanut-matting filters of special design, and it is through these wet filters that the fumes are made to pass. At present it is passed through one and then another of these coir filters, and so recover about 85% of the gold. During the next

few weeks a third and perhaps even a fourth filter will be tried. As a final filtration the gases pass through a chamber filled with oakum and spinifex, the latter being a tough native grass.

In the case of copper ores, more salt, even up to 10%, is required, but to compensate for this increased cost it is found that 80 to 90% of the copper content is also recovered from the ore by merely passing the gold-collecting solutions over scrap iron.

Mr. Howe states that the total cost, from the mine shaft to recovery of bullion, will not exceed $1.80 per ton. At a recent meeting of the Company in London it is reported that the results of this process have not been up to expectations, although a number of Australian metallurgists regard the process with favor and consider it an important step toward the successful treatment of refractory ores.

The Output of Gold

By J. R. Finlay

*Within the limitations of the question, "What is the probable limit of gold production from discovered deposits under present conditions?" it is certain that production must soon begin to decline. Many of the most important gold mines of the world are already declining. The increased production within the past few years has been due almost entirely to the great deposits of the Witwatersrand in the Transvaal. The ultimate production of this district has been pretty well estimated, and I believe amounts to some five or six thousand million dollars. Operations on this great deposit have been steadily increasing, but have now reached approximately the limit which mining engineers expected them to reach. In other words, the increased production, due to the development of deeper mines, will soon be offset by the exhaustion of the shallower mines. Outside of the Transvaal I do not know of a single important district which is in a position to increase its output substantially. In the United States practically all such districts are either decidedly on the decline or are doing well to hold their own. The production in this country has been about stationary for the past few years, but it would have already declined if the output from the established mines had not been reinforced by some new discoveries and by an increasing production of gold in the form of a by-product from mines of other metals.

Limit of Production

As to the question of how soon such limit will be reached, I am of the opinion that with no further discoveries the production* of gold would immediately begin to decline. That is, it would be at its maximum now. However, gold is widely distributed, and there is a constant discovery of new deposits. How fast such new discoveries can be made is difficult to say. So far as I can make out, most discoveries are in the way of reopening old mines. New important districts have not come forward for a number of years. The latest one was the Goldfield district in Nevada, which was discovered in 1903, and is already much on the decline. Mining engineers who have made it their business to look for gold mines throughout the world for a number of years are beginning to be somewhat discouraged, and declare that it is not a good business. While new properties are being found or old ones reopened, it is quite usual to find that they are held at exorbitant prices, which means that they must be sold to speculators and palmed off on the public for more than they are legitimately worth. Under these circumstances, it appears to me probable that even with such discoveries as are now being made, the maximum production is likely to be reached within a few years. To name a specific figure, I think it probable that this maximum will be reached before 1920.

It remains to discuss what are the probabilities of production being maintained or increased by improved processes. I think that this is precisely the point which is most promising, and at the same time most doubtful to those who expect gold production to be increased. Undoubtedly a great part of the expansion of the gold mining business in the past twenty years is due to a development of the cyanide process. Undoubtedly there is a good field left for the application of improved methods in a great many old and partly exhausted mining districts. The discovery of still better processes for the extraction of gold on new lines is, I suppose, possible, but I do not believe any such method will be found that will have much effect for another generation.

While gold has been sought in the remotest quarters of the world for many years, it must be pointed out that there are still large areas like northern Canada, South America, the interior of Africa, and the interior of Asia, where the difficulties of exploration have been so great as to impede discovery. I should say that it is not only likely but certain that important new discoveries will sooner or later be made in these regions.

The Analyst, September 8.

Coal production of the South Wales fields in 1912 was over 50,000,000 tons, of which 36,000,000 tons was shipped by water, 23,000,000 tons leaving Cardiff. Nearly 3000 ovens in the coalfield produce about 2,000,000 tons per year. A growing number of mines producing bituminous coal convert the small coal into coke; new ovens are constantly being set up, and there is continuous replacement of old ovens by modern plants, most of which are Coppées. The bulk of the output goes into domestic consumption, and local ironworks are the chief consumers. Eleven briquette plants made 1,500,000 tons of this fuel, the briquettes weighing from 6½ to 24½ lb. each.

The Federated Malay States exported, during the first six months of 1913, 23,882 tons of tin, on which the Government collected in duty $3,212,398 (U. S. currency), increases over the first half of 1912 of 522 tons and $443,645. The approximate Singapore value of the exports was $24,616,631, against $21,742,262 last year. Wolfram exports totaled 85 tons and gold exports 5269 oz. during the period.—*Daily Consular Report.*

Discussion

Readers of the MINING AND SCIENTIFIC PRESS are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment. Insertion of any contribution is determined by its probable interest to the readers of this journal.

Miners v. Technical Men

The Editor:

Sir—In your issue of April 26 there appeared a rather caustic article by 'A Commissary' in reply to one by 'A Miner', and as the subject under discussion is one often met with, I venture a reply.

'A Commissary' refers to the men who are largely responsible for the high standard of mining in this country as 'rough-necks'—possibly 'bone-heads' who 'hang out' at some 'joint' looking for an applicant to come along who is willing to buy a bottle of 'booze' to secure a position. With any such condition as this generally prevailing, any mine would fail to be profitable in a short time, and in my years of observation of many mines in the States and British Columbia, such conditions would not be tolerated by the miners themselves, if for no other reason than their personal safety. The general hard feeling that so frequently exists between miners and college men is many times the fault of the latter. In this, I do not include the mature collegiate who has gained practical experience as well as the faculty of recognizing the other man's knowledge, but the young college graduate.

The miner, as a class, will receive most kindly any information or suggestion from any technical man who is mature enough to convince him that he knows the business, but it is really amusing at times to hear the schemes and proposals put forth by the lad who, perhaps, has secured his college degree, and with it more or less technical knowledge (probably from the best authority, but badly scrambled), as he tried to improve on the work of an old experienced head. The miners can scarcely be blamed for being a bit skeptical of a new man, as there are such a number of 'jokes' at large who term themselves 'experts.' There are, of course, exceptions, but the general run of Western miners are intelligent, efficient, sober, and industrious individuals, from whom many of the best educated college men can gain much first-hand information; but the miners' knowledge is usually underestimated, for as a class they are not inclined toward letters, and the air of superiority carried by the immature graduate does not invite the confidence of the miners nor the interchange of much that might be mutually helpful.

Miners *do* kick about board. Most of the complaint, however, is not with the quality of meals supplied, but with the lack of cleanliness and tastefulness in the preparation and serving of the food, and this kick is frequently justifiable. Proper housing and good food well served will do much to make hard-working men content and self-respecting. I believe most miners are doing their best for the company's interest, and certainly the college man can do no more. The difference lies only in the fields of usefulness and opportunity, and the greatest results will be seen just in the proportion that each is willing to acknowledge the wisdom and experience of the other. The college man who learns at the start of his career that he needs to supplement his technical knowledge with years of practical experience and close observation will in the end win man's favor and attain success. There are faults on both sides, but the miner has by far the harder lot, and his physical labors rob him of much of the time and strength that the college man can give to broadening his intellect by study and reading, which should thus enable him to widen his outlook and see the good in everything.

E. LE ROY.

Motherlode, British Columbia, June 26.

'Ore'

The Editor:

Sir—In your issue of September 13, T. A. Rickard, with his usual graciousness, confesses to redundancy, but then we know that Mr. Rickard is not often redundant, and there must be a reason if he becomes so, in order to avoid being misunderstood by the professional men who are his readers, and who, it may be taken as a hypothesis, are familiar with the language of their profession. The other words in our mining vocabulary need no redundant qualifying to make the individual words intelligible. By applying the standard of profit to the word ore, we restrict its meaning in an endeavor to make its use more exact. But why arbitrarily select one word from our vocabulary and treat it in this way, and say that the vast majority of the profession use it incorrectly because they do not agree with the reformers? We use many words in a manner similar to the generally accepted use of the word 'ore,' and the whole class needs qualification to convey an idea of exactness where such is intended to be conveyed.

Take the range of minerals that go to make up the more common ores—such as chalcopyrite, hematite, blende. If we speak of a body of chalcopyrite, does it give any idea of the percentage of copper? Does hematite necessarily imply a fixed percentage of iron, or zincblende a fixed percentage of zinc? The answer, of course, is in the negative, but if the reformers are right about 'ore,' then all these words should be treated in the same way. Then there is the word slag, which in many respects is kin to ore. The word alone conveys no idea of quality or quantity. If the metallurgist gets too much of my copper in his slag, because perhaps he has miscalculated his charge, then my good ore becomes what—waste, or unprofitable ore? I know Mr. Rickard will reply that this fluke on the metallurgist's part does not apply to the particular case.

Now if one considers Mr. Rickard's definition carefully—"ore is metal-bearing rock which at a given time and place can be exploited at a profit"—he is struck by its great flexibility. It can be stretched over nearly any objection that can be raised. That "time and place" business almost ruins all one's arguments—almost! The trouble comes in its application, because as soon as it is stretched to cover cases like adjoining mines working the same ore,

the one at a profit, the other at a loss, it loses its significance and we flounder back in the same bog as before, and have to use 'profitable' and 'unprofitable' to make ourselves understood.

Mr. Rickard has dared me to give a definition of ore—well, to be frank, I didn't expect him to pull a gun on me that way, and my hands go straight over my head. I did that once, Mr. Editor, and I really wish I hadn't, because I am no hand at making definitions. In future I intend to leave that to those with a better knowledge of the English language.

I do not wish to take up too much of your valuable space, as I have expressed my views fully in my book, 'Mine Sampling and Valuing,' which you now have in the press. I must say, however, that I remain unconvinced—and feel very much like one of the past presidents of the Institution of Mining and Metallurgy, a leader in the profession, who, at a round table conference on this subject, when pressed for a definition, replied to another ditto: "Ore is ore—and if you know the mine you know what I mean."

C. L. Herzig.

Tulsa, Oklahoma, September 23.

The Institute and the Society

The Editor:

Sir—The editorial on this topic in your issue of September 6, which has just come, has interested me greatly. Concerning so large a matter as this there is room for many honest differences of opinion, and, knowing the traditional policy of your journal, I am sure you will be willing to accord space for an argument somewhat different from your own. Being a member of both societies, and resident near their headquarters, I have been able to keep somewhat closely in touch with the progress of these negotiations, so that the following personal opinion is based, I believe, upon the essential facts.

The progress of affairs has seemed to me remarkably like the investigation of a new metallurgical process by the staff of a mining company; a preliminary period in which the proposals seem very attractive, an interim of careful investigation and study, and a final careful weighing of the evidence resulting in a decision not to adopt the scheme in its final form. You say "Those directors who felt they could not vote favorably should have made their influence felt earlier." It is not clear how the directors could have known what their vote would be until the evidence was all in, and it is quite conceivable to me that individuals who at first favored the amalgamation might, after months of thought and discussion, come to take the opposite view. I have been told that the vote of the board of directors of the Institute, many of whom are prominent members of the Society, was almost unanimous in deciding not to affiliate with the Society under the terms proposed. You will remember that the original terms of affiliation as drawn up by the council of the Society met with much opposition among its members, and it was only after much discussion and a referendum vote that agreement was reached. It is unquestionable that there must still exist in the Society a minority unfavorable to affiliation. Meanwhile, as I understand it, there had been growing up in the Institute a belief that the creation of a group of "preferred stockholders" within the Institute was likely to lead to serious friction. I have frequently heard cited the experience of the American Institute of Electrical Engineers, which, by a vote of its members, created a class of fellows. Later certain members brought suit in the civil courts, alleging that the creation of such a group was an infringement on the vested rights of the other members. It is true that the court held that, since this action had been taken by a vote of the entire membership, no grounds for such a suit existed, but the incident is illustrative of the amount of feeling such an action is able to evoke in a simple and uncomplicated situation such as existed in the Institute of Electrical Engineers. The Institute of Mining Engineers is just recovering from the strain of reorganization, and there was evidently ground for a belief that the effect of a similar action would, in their case, be at least not less serious. From what I have heard, I am strongly of the opinion that this consideration, more than any other, influenced the decision of this matter.

There are many, who, like yourself, believe it would be better for the profession to have one national society rather than two, but that does not avoid the practical problem as to whether it is feasible to recast the Institute, with a history of forty years of membership 'on the level', into a mold of classes of membership. Many of its members, myself included, feel that it is not. Everyone is familiar with the fact that the metric system was adopted years ago as the legal system of weights and measures in this country, and yet hardly any progress has been made in its introduction into general use. Humanity *en masse* is one of the most difficult substances on which to make radical alterations, and the task may well cause much hesitation.

Finally, it is well to consider whether the two organizations can not render nearly or quite as high a degree of professional service by continuing their separate existence. To my mind, the degree of success which the Society has already attained has largely grown out of the fact that its membership is small and select; with the emphasis on the small. The number of those engaged in the work of the mining profession who are really interested in broad fundamental questions of legislation, political economy, and social progress is few indeed, and they represent almost as great a variety of opinion as their own number. The activities of such a group carried on within a body which is somewhat inert is likely to produce more of ferment than of useful reaction. Gathered together in a small body of men of similar methods of thought, their activities would be highly important and useful. In politics it is a recognized principle of government that it is best to have two legislative bodies; in technology it may well prove that it is best to have two national societies, one inclusive, the other select. The functions of the Institute are primarily technical, but to round out its work it must touch

on the broader phases of public and social questions. The Society is primarily devoted to the broader phases of mining and metallurgy, and has little need to venture into the field of technology, since nearly all its members are, and doubtless will continue to be, members of the larger organization. Each can operate best in its own especial field, just as a carpenter finds use for both a broad-axe and a drawshave.

I can heartily second your recommendation that the outcome of these negotiations be taken with good humor. Why should it be otherwise? Every year differing varieties of political opinion are urged, and but one view prevails at the polls, whereupon everyone proceeds to make the best of it with entire good humor. To me it appears that the Society has accomplished a distinct service in bringing about the reorganization of the Institute, and that it may now proceed to direct its energies toward other useful objects, of which there is no lack.

A Member of Both.

New York, September 12.

Transportation Problems in Bolivia

The Editor:

Sir—In reference to the article by G. W. Wepfer, 'Railroads and Transportation Problems in Bolivia,' in your issue of July 19, the following may be of interest:

Generally speaking, drilling is done by hand, but jackhammer drills, also heavier types, are being rapidly adopted in the important tin mines and in Corocoro (where electric auger drills were not successful). The Peruvian oilfields, in the vicinity of Lake Titicaca, have been abandoned for some years; arrangements are said to have been made to bring up tank cars from Antofagasta, wherever the railroad can reach the consumers. At present both residuum and distillate are brought up in oil-cans. The tax on mineral land varies; for coal, oil, and gold-placer the pertenencia is 200 metres square, and the yearly tax is 2 bolivianos (80c. U. S. cy.); vein mines are 100 metres square, and the yearly tax is 4 bolivianos ($1.60 U. S. currency).

There are no standard-gage railroad lines in Bolivia. With the exception of the Antofagasta-Bolivia line, between Oruro (Bolivia) and Antofagasta (Chile), and the Huanchaca line between Uyuni and Pulocayo, both 30-inch, the gage of existing lines is a metre. The sketch map shows a line in operation between Carana? (probably intended to be Caqueña) and Corocoro, which has been placed on the Antofagasta-Bolivia line (from which point it lies many miles to the northwest); as a matter of fact, Corocoro is on a branch line of the Arica-La Paz railroad, which latter has been open for traffic since last fall. The line between Rio Mulatos and Potosi has been in operation since late last year.

The hotel accommodations in La Paz are decidedly poor and leave much to be desired; they do not compare favorably with those in other large towns on the West Coast.

Lester W. Strauss.

Lima, Peru, August 19.

Common Sense of the Fume Question

The Editor:

Sir—Of all the pro-smelter drivel that it has been my misfortune to read, the contribution of Herbert Lang, in your issue of August 30 is the least endurable.

Entrenched in assumed scientific datum and technical phrases, the object of Mr. Lang is unmistakably to misinform and mislead the ignorant or the casual reader. It is apparent to any other that he is either a flunky or that he is hopelessly unbalanced. I regret that your journal, either carelessly or injudiciously lends itself to the indorsement of literature of this character, which in effect profits nobody, and which can but prove pernicious and disastrous to all concerned in it, or in the commonwealth. The support lent by journalism to corporations engaged in rapacious exploitation of the common resources of the country presents one of the darkest phases of human endeavor. When the effects of what appears to be journalistic conspiracy between the press and such predatory factions as the Pacific railroads and Western smelting associations, eventually converge and collapse, all those working to that climax will reap as they have sown—they or their descendants—while many blameless fellow-beings will be also involved.

Ignoring Mr. Lang's struggles with his scientific analyses of furnace fume, I will only ask you to test the more material parts of his text, in which he permits his animus and his opinions to show in accusing, arraigning, judging, and in condemnation. He is general and broad in his wholesale and summary edictum. Both persons and property interests are considered, but Mr. Lang, like other ardent exploiters of material values, places the latter commodity in the precedence. He evidently reasons that both should be reduced to matte and spelter. In effect, Mr. Lang's mania seems to centre and swirl about the choice epithet 'smoke farmers,' a unique and characteristic product of pro-smelterism, as it is employed and somewhat overworked by lieutenants of the industry. 'Smoke farming' is a choice and peculiar epithet, and it is almost a pity to find it merely a dishonest term in use by liars to stigmatize pioneer settlers and good citizens who are trying to protect their homes, property, and lives against the brutality of organized exploitation and vandalism.

A journal with the resources and advantages of yours cannot, or, at least, need not be ignorant of facts and conditions within its immediate field; and your more intelligent and solicitous readers will judge your work according to its merit, just as any other work is judged in its ultimate development and display. Do you, Mr. Editor, believe that there is such a person as a 'smoke farmer' who blackmails smelting corporations? Do you believe that any smelting corporation or industry in the West submits to extortion, as alleged by Mr. Lang? If you do, and hold opinion with these abused and mulcted corporate industries, with your combined resources and ability, why have you not, or why can you not make an awful example of one of them? You certainly cannot plead that the law is deaf to

corporation prayers in this country, or this state. You certainly have as much shelter and protection by courts and juries as is enjoyed by the miserable desert rancher who assails, according to Hr. Lang, these interests by "tying a sick horse in the 'path' of the smelter smoke, and makes the smelter pay the price of two good ones for killing one." Mr. Lang is doubtless deaf to the heretic blast, blown in the West, that what is not sense must be nonsense; or that it is drivel, which has usually been paid for.

Mr. Editor, do you not know that all efforts to suppress what is widely known to be a destructive nuisance of the worst character have been repeatedly defeated in California? Do you not know that the federal government is defied by the smelter interests? That state government is helpless or inert? That county grand juries and local organizations are the laughing stock and joke with these corporations? The grand jury of Shasta county, a few months ago—than which we have had no more intelligent or honest men of authority—condemned the smelter nuisance as a public nuisance. The district attorney of the county, with notable alacrity, published the statement that they were helpless, or that he was. That seemed to end the matter.

The defense of the smelting people is wonderfully simple, so much so that it looks like a slur upon American intelligence and common sense. Admitting that their smoke can be made harmless by various processes, they say the by-products obtained will not pay the expense. In other words, their reply to the unfortunate public is, that they prefer still to employ agents, attorneys, and flunkies to cover up, befog, and prostitute, while they continue, serenely, to destroy, devastate, and kill.

Mr. Editor, you are requested to print this statement of facts over my signature, assuming no responsibility yourself. You have my permission to comment upon it as acridly as your conscience will permit. In your interpretation of the signs of the times, you must perceive cardinal writing, that what is not right and rational is reactionary and disastrous, and that the process has a rapid tendency westward.

CHARLES L. PAIGE.

Shasta, California, September 1.

The Editor:

Sir—It is quite apropos that Mr. Paige has delivered himself of his very characteristic critique of my article on this subject, since it exhibits to your readers more plainly than I could have done by any amount of writing the peculiar and extravagant animus prevailing among a certain class of our small landed proprietors and their hangers-on. It is easy to see how difficult it must be to settle the local questions of fume damage on any possible basis of give and take where such sentiments prevail. Such people have no conception of such a thing as an honest difference of opinion, and the utter wiping out of a great and flourishing industry affects their opinions not a particle. The same sentiments are heard in courtrooms during the trial of smoke suits, which, so far as I have observed, originate in this manner:

Some pestilent agitator, usually a pettifogging lawyer of small calibre from the county seat, goes among the farmers and organizes a clique to fight smelter smoke. He painfully coaxes a few dollars from their reluctant purses for the preliminary expenses, and arranges to receive his own reward in the form of contingent fees; that is to say, he is to get a proportion, usually one-half, of whatever he can screw out of the smelting company. As it invariably costs the latter a great deal more to defend the case than the plaintiffs to bring it, the greater number of such affairs are settled out of court, by the payment, perhaps of 10 per cent of the amount of damages claimed. It will be understood that the expenses of defending these suits to the company are extremely heavy, notwithstanding which they have thus far led to no conclusive results.

In fact, it seems to me that the money thus spent in feeing lawyers and for other purposes has been entirely wasted. I question if a single dollar of it has been wisely spent. It appeared to me at the first that the only wise and proper expenditures were those incurred in the actual purchase of the land. I believe that if the Mountain Copper Co., which was the first in the field in Shasta county, and on whose shoulders fell the first burdens, would have done better to have laid out the $300,000 since devoted by it to legal and other costs in connection with these suits, in buying the surrounding lands. I may say incidentally, that I gave them this advice during my connection with them some 17 years ago, at a time when that amount of money would have secured possibly the whole area now claimed by orators of Mr. Paige's kind to be a scene of devastation.

As a matter of fact, it happens that the land in question is of small value; certainly the amount spent in litigating thus far would exceed its worth, then and now, many times over; but it would have been a peaceful solution of an unpleasant difficulty. Furthermore, the re-sale of the land with a smoke clause inserted in the deed might have reimbursed the companies for the outlay. It is regrettable that the active fight waged in Shasta county has drawn public attention to the fume question, and has incidentally opened a promising avenue for the exercise of pettifogging talents and chicanery beyond the ordinary. The contest has become nation-wide, and its results are prejudicial not only to a suffering industry, but to the future development of the country.

HERBERT LANG.

Oakland, September 30.

[Mr. Paige's communication presents the other side, which is entitled to, and shall always have, a hearing in the *Mining and Scientific Press*. Where difference of opinion is so wide as that between our correspondent and ourselves, there is no common ground for argument. We respectfully differ from him as to premises and conclusion, but we are glad to print his letter as an expression of a feeling that must be taken into account in attempting to solve the problems of smelter fume.—EDITOR.]

Special Correspondence

NEW YORK

North Star Shares.—Anaconda and Butte-Ballaklava.—Washoe Smelter Shut-down.—Alaska Gold Mines Co.—Dividends.—Interest of National Railways of Mexico Paid.

The collapse of North Star has been the market topic of the week, and the good sense of those who refused to have anything to do with it from the beginning has been amply vindicated. The blame is being placed upon James Heney, the mine foreman, who is alleged to have deceived the superintendent, while supplying private information to Bush street, San Francisco, brokers. It is said that he was convicted several years ago of robbing the Carson mint. That being the case, he was among worthy associates. It is just such affairs as this which serve to totally discredit share dealings on the 'Curb,' as the open-air market in Broad street, in front of the New York Stock Exchange, is called.

Rumors that the litigation between the Anaconda and Butte-Ballaklava was about to be settled were without foundation in fact. What is of more importance is the impending shut-down of the smelter at Anaconda for a week, in order to allow repairs to be made to the flue system. This will cut off about 750,000 lb. of copper per day from smelter output, and at the rate things are going, the copper trade will soon be operating on a deficit instead of surplus stocks. Some people are rude enough to suggest that possibly the metal market is being manipulated in order to produce activity in the price of shares.

Joseph W. Harriman, president of the Harriman National Bank, has been made a director of the Greene Cananea Copper Co., and will be a strong addition to its board. When E. H. Harriman died, the inventory of his estate showed that his holdings of mining shares were mostly of a peculiar variety. It is interesting to notice that this seems to be almost the general rule; and the more important a man is in the industrial and banking world, the more dubious his mining investments are. Mr. Harriman's affiliation with the Greene Cananea shows that he is disposed to be an exception to this rule.

Alaska Gold Mines shares sold in Boston around $24 on September 26, and it is to be regretted that *Mines and Methods* has suspended publication, for what it would have to say ought to be as interesting reading as some of Thomas W. Lawson's outpourings were before they, through familiarity, sunk from being exciting to merely wearisome. It is reported, by the way, that its publication is soon to be resumed in New York, with Sidney Norman as editor. That being the case, we may expect some interesting reading about the Guggenheims. Returning to Alaska Gold Mines, the published prophecies of earnings at the rate of $7 or $8 per share per year are based upon estimates of total costs for mining and milling at 60c. per ton. On this point the average engineer is 'decidedly from Missouri.'

The United States S. R. & M. Co. has declared its regular quarterly dividend of 1½% on the common and 1¾% on the preferred, payable October 15. The Anaconda has also declared its regular quarterly dividend of 1½%, although it is earning at a much higher rate on the present price of copper. Sound policy, of course, requires that dividends be held as steady as possible, consequently when earnings are high they are accumulated to maintain dividends when the price of copper goes down.

The interest on the $51,000,000 of 4% gold bonds of the National Railways of Mexico was paid on October 1 from the loan funds which were arranged for early in the summer. The tramway system in Mexico City has been prosperous despite the revolution, and reports good earnings for the past year. The Wettlaufer-Lorrain is the reverse of prosperous, and has recently declared a dividend of 5c. per share, to be paid out of its capital. What is to be done with the remainder will be decided at the annual meeting next January. The directors of the Ohio Copper Co. are still considering the problem of how to put that much-vexed property on its feet again. There is general opposition to continuing to pay 15c. per ton for transport through the Mascotte tunnel, and it has been proposed to reduce it to 10c. per ton. As the tunnel company has little revenue from any other source, a vigorous protest from its bondholders in France may be expected in case this is done.

BOSTON

North Butte Expansion.—Hall Desulphurizing Process.—Boston & Montana Development Co.—The Lake Strike.

North Butte shares have recently been more active, resuming their speculative leadership among the coppers here, advancing to around $30, within about five points of the high price of the year and 10 points of the high price of last year. The activity and advance are based on reports of large acquisitions of new properties and of new orebodies being discovered on the 2200, 2400, and 2600-ft. levels. The Company will issue stock to pay for new territory in the northern and eastern part of Butte, 1000 to 1200 acres, which was optioned by Mr. Thornton for

ANACONDA HILL, BUTTE.

the North Butte company at a cost of about $1000 per acre. North Butte has 190,000 shares of treasury stock unissued out of 600,000 shares authorized, the unissued stock having a present market value of approximately $5,500,000. All of this stock is available for the purchase of additional mining property. The Company's original estate is about 160 acres, so the expansion will make the property about six times as large in amount of territory held, and the largest owner of mineral ground in Butte. The statement that the Guggenheims have joined Thomas F. Cole in North Butte's future plans has been denied in Boston, so vigorously as to suggest the idea that too much protesting is being done. The Guggenheims have been credited with the desire of extending the foothold they have gained in Butte, through their interest in Butte & Superior, and it is natural to suppose that North Butte would offer them a fair opportunity to do so. If North Butte takes over this new territory, including Butte & Amazon, Ida-Montana, Rainbow Development, and possibly Butte & London, it will be in a fair way to have a much larger share capitalization. If the troubles of the Tuolumne company continue, it is possible that little property would be absorbed by North Butte, and in case of a big merger and the stock market campaign which would result, Butte Main Range might be considered as within the horizon of probable consolidation. It is evident that there are big things brewing on the northern side of Anaconda hill, and the public will hear more about these as they develop.

It was reported in Boston a few days ago that an injunction was about to be served on the Hall desulphurizing process at the First National smelter. This process, or some variation of it, has been used in some of the pyrite smelters in France. The idea became current here that perhaps some of the foreign interests in the patent

were moving to make trouble. Your correspondent sent a representative to see Mr. McSweeney, of the Lawson office here, and also Mr. Clapp, Lawson's confidential broker. Mr. McSweeney said he had not heard of the reported injunction at all. Mr. Clapp admitted hearing of it, but said that it was not a matter of any consequence to the First National people. He believed it was simply a trick to rig the market.

Mexican Metals figures in Curb activity these days, but has never recovered in price since the break below 50c. per share. Officials of the Boston & Montana Development Co., which is undertaking the building of a road southwest of Butte into Deer Lodge and Beaverhead counties, announce that the first link will be from Divide, on the Oregon Short Line, to the French Gulch district, where, it is claimed, the Company's mines are in such a stage of development and equipment that shipments of ore can be started at any time to the custom plants at Butte and Anaconda. The next link of the road will be up the Wise river to Elkhorn, in Beaverhead county, where the president of the Company, W. R. Allen, former lieutenant-governor, will begin the driving of a 3000-ft. main working adit at the base of the mountain, to develop and handle the ores of the district. The engineering corps in the field recently assisted in saving the Big Hole power-plant, three miles west of Divide, on the route of the new road, from being destroyed by a forest fire. The timber in that district is extensive, supplying a great deal of material which goes underground at Butte.

The Lake strike has enforced the curtailment of disbursements among the dividend-paying companies. Those which curtailed dividends include Copper Range Ahmeek, Calumet & Hecla, Osceola, Mohawk, and Quincy, and a postponement of action as to the semi-annual declaration by Wolverine. The main support of the Western Federation in its fight to gain a foothold in the Lake district comes from Butte organized labor, and citizens of Butte are joining in their sympathy. A sympathetic mass-meeting was held at Butte recently, and a petition and memorial were sent to the United States Senate making an attack on what they called 'the Boston Coppers.'

TORONTO, CANADA

THE GIFFORD PROPERTY.—RESULTS AT THE TRETHEWEY.—NIPISSING FINANCES.—LUMSDEN DEVELOPMENTS.—HOLLINGER RESERVE, EAST DOME, SWASTIKA, AND WISEMAN PROPERTIES.

The option held by a syndicate of Montreal capitalists on the Gifford property adjoining the Beaver, has been allowed to lapse, nothing of value having been opened in several hundred feet of development work on the 200-ft. level. The net profits of the Trethewey have averaged about $8000 per month during the current year, and have lately shown a considerable increase. During August the mill treated 3068 tons of ore of an average grade of 22.4 oz. per ton, producing 55,102 oz. of silver in the concentrate, valued at $32,510, the net profit being about $13,300. The financial statement of the Nipissing as at September 20 showed: cash in bank, $1,192,297; ore and bullion in transit, $24,245; ore on hand and bullion ready for shipment, $182,980; a total of $1,399,522. The Lumsden company has found good ore at the 250-ft. level in the diabase underlying the Keewatin formation, the vein being 5 in. wide, assaying about 1000 oz. per ton. The continuance of operations at the Wettlaufer, in the South Lorrain area, depends on the result of horizontal diamond-drilling, which will be carried on until December in the hope of finding new ore-shoots. Stanley N. Graham, manager of the Peterson Lake, has resigned his position, having been appointed professor of mining engineering in the Technical College, Halifax. John Hare, a well known English financier, is on his way to Cobalt to examine a number of mining properties and report to prospective British investors. At the Seneca-Superior, the Worth vein has been cut on the 325-ft. level, where it continues as strong as on the upper levels.

The Hollinger, at Porcupine, is enlarging its mill by the addition of 20 stamps, making 60 in all, bringing the crushing capacity up to 650 tons per day. It is hoped to have the new unit in operation by the end of the year. Foundations are being laid for the permanent central power-plant, which will serve the Hollinger and the affiliated plants of the Dixon, Gillies, and Miller-Middleton. The deal by which the Lewisohns are to purchase the Hollinger Reserve, which has been under negotiation for some time, is progressing toward a conclusion, the payment of a first instalment of $20,000 on the purchase money having been made. The old Preston-East Dome properties, abandoned after the expenditure of a large amount of money, are making a good showing under the management of Harry Offer and associates. An open-cut 30 ft.

COBALT LAKE MINE, COBALT.

long by 20 ft. in depth has yielded 20½ tons of ore, returning $175 per ton. A shaft is being sunk, and development at depth will be undertaken. The Swastika has been closed until arrangements can be made for financing. High-grade ore was found between the 100 and 200-ft. levels, which led to the installation of a costly surface equipment and operations at a further depth on a large scale, which failed to meet current expenses. Harry Cecil, representing English interests, has taken an option on the two Wiseman claims adjoining the Tough-Oakes property in the Kirkland Lake district, which will be operated by a new company under the name of the Telluride Gold Mines, Ltd., capitalized at $1,500,000.

BUTTE, MONTANA

THE WASHOE SMELTER.—ALEX SCOTT, BUTTE & LONDON, PILOT BUTTE, BUTTE-BALLAKLAVA, BULLWHACKER, BARNES-KING, RAVEN, BUTTE & ELY, AND BUTTE & SUPERIOR OPERATIONS.

An unusual occurrence is about to happen at Anaconda. The fires at the big smelter will be drawn for about ten days for the purpose of cleaning out and repairing the flues leading to the stack. The cost of such a shut-down will necessarily be large, as all the furnaces will freeze. It seems unavoidable, however, that occasionally the flues must be cleaned. Incidentally, the copper production for October will be reduced considerably, but this will probably be made up before the first of the year. The concentrator and mines will continue as usual, the concentrate being stored for later use in the smelter.

The Butte-Alex Scott Copper Co. has opened a good ore-body on the 1900-ft. level of the Alex Scott mine. The Company is shipping about 150 tons per day to the East Butte smelter. The shaft is being continued to the 2200-ft. level.

As soon as the electric machinery can be installed, the work of unwatering the shaft of the Butte & London Copper Development Co. will be undertaken by the T. F. Cole interests. The shaft is to be deepened to the 2000-ft. level. The Pilot Butte Mining Co. has begun shipping copper ore to the smelters at the rate of 50 tons per day. It is planned to arrange for increasing the output in the near future. The flurry in the stock of Butte-Ballaklava Copper Co. based on the rumor that Anaconda was negotiating for the purchase of the property, was apparently a stock-manipulating scheme. C. F. Kelley, vice-president of the Anaconda Copper Mining Co., denies any knowledge

of negotiations with Ballaklava, so that there is probably nothing to it.

The long-standing lease on the Bullwhacker mine has finally expired, and the company will operate the property itself from now on. The leaching plant is nearly ready for operation, and in a short time the company expects to be shipping commercial cathodes.

The Barnes-King Development Co., which has many Butte stockholders, is apparently satisfied with development at its Marysville property, for final payments on the purchase price have just been made. The Company is now practically in complete ownership of two promising properties, the North Moccasin at Kendall and the Piegan-Gloster at Marysville. The North Moccasin has been paid for out of operating profits, and the Piegan-Gloster was purchased from capital in the treasury. Under the existing conservative management the outlook for Barnes-King is much better than at any time in the history of the Company. It will not be the policy of the management to declare any dividends, however, until the present holdings are properly equipped and on a sound producing basis. The Raven Copper Co. has apparently given up hope of making a mine at depth. The pumps have been drawn and the lower levels will be allowed to fill. The Raven property is near the border line between what are referred to as the copper and silver zones, but the veins seem to be on the wrong side of the border for copper. The minority interests in the Butte & Ely Copper Co. who tried to throw the Company into the hands of a receiver, have failed in their efforts, their prayer having been denied in the District Court here on September 16.

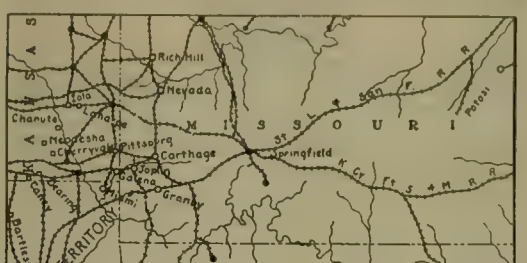
The August zinc production of the Butte & Superior certainly gives encouragement to the thought that Butte may soon be producing as much zinc as copper. And this promising state of affairs at the Butte & Superior is all the more satisfactory as it appears to be a natural outcome of what seemed like the wildest confusion at the mill a year ago. Machines were no sooner put in than out they would come again, and men and bosses were so thick that everything seemed to be in chaos. Apparently experiments were necessary, however, and have finally resulted in the evolution of a satisfactory milling practice in which 50% zinc concentrate is made with a 90% saving. This saving includes, of course, the flotation returns. The successful operation of the Butte & Superior mine and mill is undoubtedly the most important mining event in Butte since Marcus Daly opened the Anaconda mine.

JOPLIN, MISSOURI

NUMBER OF MINES PRODUCING IN MISSOURI-KANSAS-OKLAHOMA ZINC AND LEAD DISTRICT.—BIG MILL OUTPUT OF MIAMI, OKLAHOMA, CAMP.—ZINC AND LEAD NOTES.

More than 300 separate mines are contributing to the weekly production of zinc and lead ores from the Missouri-Kansas-Oklahoma district, which is now averaging about 5200 tons of zinc sulphide concentrate, 600 tons of calamine, and 1000 tons of lead ore per week. A large number of small new mines have entered the producing lists within the past few months. The bulk of the output, especially that of zinc sulphide, comes from mines that are equipped with mills, although there are a large number of mines from which the ore is treated by hand jigs. A larger percentage of the calamine production comes from hand-jig plants, as this ore, as a rule, is found in rich, shallow pockets. The mineral is often in large, free 'chunks,' ready for the smelter after the residual clays have been washed off. Considerable lead ore is also found in shallow, rich deposits, and is easily cleaned by hand jigs or is hand sorted. With the opening of more extensive orebodies, the tendency is to construct milling plants of greater capacity than formerly.

One of the twenty-odd camps of the district is distinctive in that it produces almost exclusively from big milling properties. This is Miami, Oklahoma, a region that in the four or five years of its rapid development has been almost entirely free from small mining enterprises. There are no hand jigs at Miami, no small crushing plants, nothing but large concentrating mills. In addition to the big mills now reducing ore in this district, several new plants have been completed recently and others are to be built in the near future. The district is being developed rapidly for a distance of several miles north of the present producing region, operations having been extended to a depth of 275 ft. in places. There is still a great deal of mining to be done in the upper ore-shoots at a depth of 90 to 110 ft. The shallow ore, however, is invariably heavy in iron and is thus penalized by the buyers. The deeper ore is of much better grade, the zinc concentrate containing as high as 61% metal, while the galena goes 80% in metallic lead. In most camps of the district, ore is sold from week to week to the smelters making the highest bids. Virtually all of the Miami output is sold



MAP SHOWING MISSOURI-KANSAS-OKLAHOMA DISTRICTS.

to the American Zinc, Lead & Smelting Co. on a contract, based on the price of spelter at East St. Louis, Illinois.

Coal has been opened at a depth of 45 ft. at the Shamrock mine, north of Alba, Missouri. The operators will sink to the zinc and lead formation, encountered in drilling, but are driving on their coal seam and using the fuel with which to carry on operations. A heavy tonnage of the coal is sold to nearby mining companies. The vein is 6 ft. in height and is 35 ft. wide, and the quality is good. No coal-mining of importance has been undertaken in this region heretofore.

Sludge tables and other improvements have been added to the big concentrating plant of the Bertha A. Mining Co., operated by Charles T. Orr and associates at Webb City, Missouri. After an idleness of several months, this mill is again in operation. Another large mill, of the sheet-ground district, to resume operations recently, is that of the Charleston Mining Co., one of several properties operated by the C. M. Sheldon Mining Co. The mill recovery is about 2.5% zinc sulphide and 0.5% galena.

The driving of shafts from the bottom upward is becoming of common practice throughout the district. Following the example of the Nowata Mining Co., of Duenweg, Missouri, the Hartford Mining Co., of Galena, Kansas, has driven a large shaft from the bottom upward. A drill-hole, through which a cable is passed, connects with a platform at the bottom on which the shaft men work. The shaft was driven 200 ft. in this manner, and was sunk an additional 65 ft. beneath the old drifts in the ordinary manner. Work is to be extended to a depth of 300 feet.

Prices for zinc ores at the beginning of October have weakened over those of September. The range in price for zinc sulphide ores carrying 60% metallic zinc is $44 to $46, with choicer lots bringing as high as $49 per ton. Metal is quoted at 5.55c. per pound. For the corresponding week of 1912, ore brought $58 to $62, basis, with choicer grades selling up to $65. Metal was quoted at 7.45c. Calamine sells for $21 to $23 per ton, basis of 40% metallic zinc, while choicer lots bring as high as $27. For the corresponding period of 1912, calamine brought $29 to $33, with a top of $37 for the best grades. Lead ore continues firm at $58 per ton, 80% metallic lead, compared with $68 for the corresponding week of 1912. Metal is dull at 4.50c., compared with 5c. for the corresponding week of 1912.

General Mining News

ALASKA

FAIRBANKS

An 18-in. vein, worth $30 per ton, has been opened on the 100-ft. level of the Newsboy mine. Good ore is now being extracted from the 100, 150, and 200-ft. levels, and prospecting is being done at 300 ft. The mill has been working 16 hours per day since August 17. An 18-in. vein, containing rich gold ore, has been uncovered at the Tolovana claim, on Willow creek. A shaft has been sunk 22 ft. in good ore. A trial lot will be crushed by the two Nissen stamps.

ARIZONA

COCHISE COUNTY

During the first eight months of the current year the Copper Queen mines have produced 100,799,648 lb. of copper.

GILA COUNTY

Reports on copper deposits near Superior, by F. L. Ransome, and the copper deposits of the White Mesa district by J. M. Hill, have just been issued by the U. S. Geological Survey in one pamphlet as advance chapter D of Bulletin 540. The Silver King is the most noted mine in the vicinity of Superior. It was opened in 1875 and for many years produced high-grade silver ore from a deposit of the form commonly called by miners a 'chimney.' The mine is now idle. The production of the Silver King is variously reported as between $10,000,000 and $15,000,000. The lower figure is probably too high, but the Silver King Mining Co. is known to have paid dividends up to July 1887, amounting to $1,950,000. The Queen or Silver Queen mine, about three-fourths of a mile north of Superior, although opened as early as the Silver King and credited with some production about 1880, has only recently become important through the activity of the Magma Copper Company.

The case of James A. Fleming *v.* the Black Warrior Copper Co., amalgamated, to have the transfer of that Company's holdings to the Warrior Copper Co. set aside, must be tried in the Superior Court of Gila county. Such is the decision of the Supreme Court at Phoenix.

GREENLEE COUNTY

One of the new furnaces at the Arizona Copper Co.'s new smelter 'froze' during the week ended September 20. It will be several weeks before it is in operation.

A decision involving about $50,000 has been handed down by the Supreme Court at Phoenix in the case of the Arizona Copper Co. *v.* the County of Greenlee. The Company must pay the taxes assessed against it in 1911. In addition, the Company must pay 25% for attorney's fees, 12% interest on the principal, and 6% on the attorney's fees.

SANTA CRUZ COUNTY

John B. Rice, of San Francisco, has filed suit in the federal court, district of Arizona, against R. R. Richardson, of Patagonia, seeking to collect $55,000 alleged to be due as commission on the sale of the Three R mine in the Patagonia district, from R. R. Richardson and A. E. Crepin to N. L. Amster.

YAVAPAI COUNTY

The old Octave mine, near Stanton, as soon as the debts of the old company are paid off, will resume development, as there is a fair equipment on the property. Years ago the Octave produced rich gold ore. The Schmidt group of claims has been sold. Over 3000 ft. of work has been done underground. Twenty-eight inches of $40 ore has been found at a depth of 200 ft. in the Eureka mine, near Walker.

CALIFORNIA

During August the net production of oil from all counties of the State was 8,411,704 bbl. The Midway field increased from 2,692,001 to 3,079,989 bbl. compared with July. Net shipments were 7,495,099 bbl., and stocks amount to 48,923,556 bbl. In the 16 oilfields there were 44 new rigs, 332 wells drilling, 382 wells idle, 64 completed, 5940 active, and 1164 idle producers. Twenty wells were abandoned.

The U. S. Geological Survey is carrying on studies in all parts of this state. A detailed geologic reconnaissance is being made of a large area covering the Inyo range and eastern slope of the Sierra Nevada, with special reference to the ore deposits. This is a continuation of work that was done last year and is in charge of Adolph Knopf. The area to be covered includes parts of the areas known as the Mount Whitney quadrangle, lying between latitudes 36°30′ and 37° and longitudes 118° and 118°30′; the Bishop quadrangle, immediately north of the Mount Whitney; and the Ballarat quadrangle between longitudes 117° and 118° and latitudes 36° and 37°, all in Inyo county. The total area under this investigation approximates 6000 square miles. In addition, a special reconnaissance examination will be made by Mr. Knopf of the Bodie district of Mono county and the Darwin district of Inyo county. The Panamint valley, also in Inyo county, is to be examined in connection with a search for potash deposits. This search will include drillings by C. E. Watson in the hope of finding possible buried saline deposits and is under the direct supervision of Hoyt S. Gale. W. B. Hicks will make a preliminary chemical examination of the brines and the drilling cores in the field. The copper mines of the foothills district will be visited by B. S. Butler for the purpose of noting developments, but not with a view of issuing a geologic report. The oilfields come in for more detailed geologic mapping and studies by R. W. Pack and J. D. Northrop. This work is being done primarily for the purpose of classifying the lands, but will probably lead to the preparation of an economic report on the area studied. Mr. Pack will also visit the oilfields previously studied in order to keep in touch with developments and to make such further studies as he finds necessary.

A study of the geography, geology, and mineral resources of that part of California lying south of latitude 36°30′ and west of a line drawn from the northeast corner of the San Gorgonia quadrangle (longitude 116°30′, latitude 34°30′) to the northwest corner of the Holtville quadrangle (longitude 115°30′, latitude 33°) and thence south to the international boundary, is being conducted by Robert T. Hill, who will prepare a general report of economic, educational, and scientific importance to cover the whole area. In northern California a detailed areal study of the Weaverville and Big Bar quadrangles is being made by J. S. Diller and H. G. Ferguson, geologists. These quadrangles lie between longitudes 122°30′ and 123°30′ west and latitudes 40°30′ and 41° north. Work on the Weaverville quadrangle was begun last year, and the mapping of the geology of the Big Bar quadrangle will be commenced this season.

AMADOR COUNTY

The suit between the Kennedy Extension and Argonaut companies is still being heard at Jackson. On September 26, the examination of John W. Finch, of Colorado, by Judge C. H. Lindley of San Francisco, was especially interesting. The Fremont Mining Co. will probably increase its mill from 40 to 80 stamps.

BUTTE COUNTY

The South Banner Mining Co. held a meeting at Oroville on September 26, and the capital was increased from $50,000 to $250,000. It is probable that an English company will start operation near the property shortly.

INYO COUNTY

The Bishop Creek mine has been recently examined by R. F. Barry, who states that the mine has enough profitable ore to pay the expenses of developing more territory and placing the property on a paying basis. The west drift on the 300-ft. level has been extended 50 ft., and 5-ft. samples averaged $18 per ton. The ore-shoot has no defined walls and is heavily mineralized. It will be necessary to install a 50-ton cyanide plant. Generally, the mine has been well opened.

NEVADA COUNTY

(Special Correspondence.)—The Brunswick Consolidated G. M. Co. held its meeting at San Francisco on September 25. J. W. Pew, the president, retired, and W. H. Oscanyon, of New York, was elected in his place, and A. J. Young, vice-president, retired, while R. Chester Turner was elected vice-president and general manager. The mine at Grass Valley is developing satisfactorily. It is at present worked through an incline shaft 1250 ft. deep, but a vertical shaft is being sunk from the surface, following a raise from the mine workings. This shaft will be 874 ft. vertical depth. The 20-stamp mill is working full time, treatment being amalgamation and concentration. A good recovery is made by this method. Concentrate is sold to the Pioneer Reduction Works of Nevada City.

Grass Valley, September 25.

PLUMAS COUNTY

The Copper Queen mine, 8 miles southeast of Genesee, has been bonded by J. R. Walker, of Salt Lake City, to a Utah company. A shaft is to be sunk 200 ft., equipment installed, and a road 5 miles long constructed.

SACRAMENTO COUNTY

The Natomas Consolidated of California had a gross

GENERAL VIEW OF SELBY SMELTER.

income of $239,956 during August. Operating expenses were $117,608, and interest on mortgages $74,895, leaving a net profit of $47,453. The net income for the first eight months of the current year totals $868,587, which is $174,962 more than for that period of 1912.

SHASTA COUNTY

The Mountain Copper Co. is shipping from Keswick 250 cars of ore per month. The copper ore comes from the Iron Mountain and Hornet mines, principally the former. It is estimated that the Company ships 12,500 tons of copper ore from this station every month to its smelter at Martinez.

SISKIYOU COUNTY

The Salmon River mineral district is described in the *Scott Valley Advance* of September 25. At the Cub Bear mine over 200 tons of high-grade ore is on the dump, and a long shoot has been developed. Charles Ritz is in charge. The Highland, under charge of Bert Mattern, is being actively developed, as is also the Homestake with John Boyle as manager. Underground work and installation of equipment is under way at the Hardscrabble and Big Cliff groups.

SOLANO COUNTY

As a result of the protracted litigation between the Selby Smelting & Lead Co. and the people of Solano county, the smelting company is now the owner of over 1900 acres of land near Benicia. This land consists of several of the largest farms, the Company having purchased them one by one in the past year. These farms all lie in the zone that is supposed to be damaged most by the smelter fume, and were owned by men who sued the smelting company for several years. Since selling, they have continued to live on the farms, leasing them from the Company. The commission, appointed a few weeks ago by the board of supervisors to investigate the damage done by fume from the Selby smelter, is busy collecting data concerning the composition of the air in the affected zone.

COLORADO

Press reports dealing with the coal miners' strike in Boulder, El Paso, Fremont, Huerfano, Las Animas, and Routt counties state that from 70 to 90% of the men are out. In 1912 there were 11,763 men employed in 115 mines, and over 8000 are out on strike. The annual coal output is about 9,000,000 tons. The union insists on its recognition. The Colorado Fuel & Iron Co.'s plant at Pueblo will probably shut down on account of coal shortage. About 4000 men are employed at the Minnequa plant. Mines and mills in the Cripple Creek district will be affected if the strike continues for any time, although the Portland and Stratton's mines have about three months' stock. Later reports state that men are returning to work, as many have no sympathy with the union, but it is too soon to say what the result will be. It is known that the union will make a hard fight.

There has been some rioting among the strikers, and Robert Lee, a marshal, has been shot by a Greek miner. 'Mother' Jones is much in evidence, as is usual when strikes are on in any part of the country.

CLEAR CREEK COUNTY

At the Capital mine, a large electric locomotive is to be installed for hauling ore. The company is busy above the 300-ft. level. Hummer & Son are mining a large body of ore. A promising vein has been opened in the Denver mine in East Argentine. Eastern and Denver people will probably work the Sporting Times mines on Alpine mountain.

PUEBLO COUNTY

The annual report of the Colorado Fuel & Iron Co. for the year ended June 30 shows surplus, after charges, of $1,727,192, a decrease of $74,036 from 1912, though a gain of $476,520 over 1911. Gross earnings increased over 1912 by $47,436, but increase in expenses overbalanced this gain. The Company paid 35% back dividends on its preferred stock, during the year, leaving 39% still to be paid. The Company earned 3% for the common stock after deduction of this extra payment on the preferred.

THE SAN JUAN

During August the Tomboy mill treated 11,000 tons of ore, yielding $81,500, including bullion from 1500 tons of concentrate. The estimated profit was $33,000.

The Brown Mountain smelter was blown in on September 26, and will employ 30 men, and start on a fair supply of ore. At the Mountain Top, the main north drift had been driven 455 ft. on the vein on September 22. The shoot was 323 ft. long at this point, being worth $1.20 gold and 138.84 oz. silver per ton. Beyond this the ore was broken and irregular in value, but later was worth 65.57 oz. silver over 12 inches. No. 1 raise was up 136 ft., and at 35 ft. the ore assayed $2.20 gold and 106.73 oz. silver per ton. A station will be cut at 150 feet.

The mines throughout the San Juan are busier than for two years past and ore shipments are increasing regularly.

TELLER COUNTY (CRIPPLE CREEK)

Gas was troublesome in many of the mines during the latter part of last week, and work was temporarily suspended. A mill site for the El Oro Gold Mining & Milling

Co. is being surveyed by Hills & Willis in Eclipse gulch. At No. 1 shaft of the El Paso company's Beacon hill estate, a station has been cut at 1170 ft. depth, and a drift is being driven on the main El Paso vein to a point below the shoot opened on the 1000-ft. level. It is proposed to 'sink' the South Burns shaft of the Acacia Gold Mining Co. 200 ft. by 'raising.' This will be done by cross-cutting from the American Eagles mine, 1450 ft. deep, to a point directly under the South Burns shaft, and then drive the raise.

IDAHO

Clearwater County

The dredge at Pierce was destroyed by fire, probably caused by a short-circuit, on September 25, and the loss is estimated at $45,000, the insurance being $10,000. The machine was built about three years ago, and has been the cause of litigation. R. P. Bailey, of Walla Walla, was overhauling the dredge for operation this fall.

Shoshone County

Figures obtainable from authoritative sources on the August production of the largest operating mines in the Coeur d'Alene show that the total tonnage shipped by 19 properties was 34,275 tons, according to the *Salt Lake Tribune*. Of this tonnage, the Federal Mining & Smelting Co. contributed 7682 tons; Bunker Hill & Sullivan, 6198; Hercules Mining Co., 3808; Snowstorm, 3211; Green Hill-Cleveland, 2227; Stewart, 2227; Hecla, 1899; Success, 1421; Tamarack & Custer Consolidated, 1284; Gold Hunter Consolidated, 1105; Interstate Callahan Consolidated, 1016; Ontario Mining Co., 962; Marsh, 323; Sierra Nevada, 259; Alice lease, 116; Hypotheek, 31; S. L. Shonts, 25; Knickerbocker, 22; and National, 20 tons.

The Federal properties produce lead, zinc, and silver, as do the Hercules, Green Hill-Cleveland, and Success. The properties producing only lead and silver are the Bunker Hill & Sullivan, Stewart, Hecla, Tamarack & Custer Consolidated, Gold Hunter, Ontario, Marsh, Sierra Nevada, Alice lease, Hypotheek, Shonts, and Knickerbocker. The Snowstorm and the National are producers of copper, silver, and gold. The above figures representing the production of the Green-Hill Cleveland and Marsh properties, show a curtailed output owing to suspension of operations for repairs.

On October 4, the Bunker Hill & Sullivan Mining & Concentrating Co. paid dividend No. 193, of $65,400. This makes the total amount of dividends paid $14,565,750.

MICHIGAN

Houghton County

In spite of the injunction against the strikers picketing and annoying miners at the copper properties, there was an outbreak on September 25, but this was quickly quelled by the militia. The injunction granted by Judge O'Brien last week, was suspended by him on September 29, and there is great rejoicing among the strikers, and trouble is predicted when picketing is resumed.

MONTANA

Deerlodge County

The Georgetown mining district and the Southern Cross mine are discussed in a paper presented at the Butte meeting of the A. I. M. E. by Paul Billingsley. The Georgetown mining district is situated about 20 miles west of Anaconda. It lies along the divide between the headwaters of Warm Springs creek, draining eastward, and Flint creek flowing west and north through the Philipsburg valley. On the western slope of the divide is the Southern Cross group. The ore deposits of the district may be conveniently classified into four types: (1) fissure veins in granite; (2) contact metamorphic deposits; (3) fissure veins in limestone; and (4) replacement bodies in limestone. The Granite-Bimetallic mines are the chief representative of the first class, and the Southern Cross is a characteristic replacement deposit in limestone. The latter property was located in 1866, and after many changes in ownership now belongs to the Anaconda Copper Co., which constructed a railroad to the mine. The ore, high in iron and desirable as a flux, is smelted direct at the Washoe smelter, so that the two great difficulties of the past, the long wagon haul and the refractory milling character of the ore, need not be contended with in the future.

Silverbow County

The Washoe smelter is to be shut down for two weeks for general repairs, which will reduce the copper output of the Butte district by about 10,000,000 pounds.

NEVADA

Clark County

(Special Correspondence.)—Two cars of ore, containing 36 tons of $400 and 32 tons of $150 ore, respectively, were broken from the 600-ft. level of the Quartette mine and sent to the Selby smelter. The Cyrus Noble mill is now working full time. A shaft is being sunk at the north side of the Techatticup adit and will connect the workings at the 400-ft. level. This property produced a great deal of bullion years ago. A 50-ton treatment plant is to be built on the Silver Legion Estate. Good ore is being opened in the Eldorado Empire and Mineral Farm mines.

Searchlight, September 29.

Elko County

The main adit of the Nevada Bunker Hill Mining Co., at Bullion, is in 2028 ft., and during the last 50 ft. the vein of iron ore has changed to 8 in. of lead carbonate ore assaying 30% lead. Several other claims adjoining are being developed. Moe and Dougherty will construct an aerial tramway to convey ore from the lease to the Elko dump, where it will be loaded on wagons for the railroad.

Humboldt County

Negotiations are under way for consolidation with the properties of the National Mines Co. of claims owned individually by stockholders in that concern and lying immediately east of West Virginia No. 1, now owned by the National company. The National vein is reported to have been found on this property in an adit, and while the rich ore found above has not yet been reached, the workings are none the less in good ore. In the National workings the famous ore-shoot has been traced 60 ft. on the 600-ft. level. The mine has so far produced about $6,000,000.

Lander County

(Special Correspondence.)—The Ruby Silver Mining & Development Co., which is operating the Estella and Betty O'Neal group of claims at Lewis Canyon, 12 miles south of Battle Mountain, has received returns from three carloads sent to the Western Ore Purchasing Co. at Hazen. The settlement sheets show that the average value of the 86 tons that was shipped was $79 per ton, giving a total of $6794 for the three carloads. An adit in the Topsy claim is in 345 ft., and the vein cut at 150 ft. is 5 ft. wide. At the bottom of a 105-ft. winze, 40 ft. farther in, the vein is 14 ft. wide, assaying $50 per ton, mostly in silver, but with a little gold and copper. A drift was driven 30 ft. from 50 ft. depth in the winze and opened 24 ft. of ore, 3 ft. of which averages 800 oz. silver per ton. Sixteen feet farther in the cross-cut shows 14 in. of ore worth up to 2000 oz. per ton. Another adit is in 380 ft., and in another 50 ft. a raise will be driven to connect with the winze mentioned. The property has an up-to-date equipment.

Battle Mountain, September 22.

Lyon County

From September 1 to 24, the drift on the middle level of the Douglas Hill portion of the Nevada-Douglas property averaged 7.1% copper. The drift is nearing the limestone area, which is looked upon as favorable.

Nye County

During the week ended September 27, the mines at Tonopah produced 11,503 tons of ore valued at $272,690. In the Belmont, the Shaft, Favorite, Thanksgiving, Mizpah, Fault, and Belmont veins have been opening in an extremely satisfactory way. A winze is being sunk from the 600 to the 700-ft. level, the ore on the former level being from 18 to 20 ft. wide. Generally, ue ore opened

on the 850-ft. level of the Extension is of better grade than on the level above. Two rock-crushers have been ordered for installation at the shaft. The Buckeye-Belmont has cut a vein in trachyte formation at 1200 ft. A new shoot of high-grade ore has been opened in a cross-cut above the 615-ft. level of the Montana mine.

Five years ago, Rhyolite had a population of about 6500 people, but at the present time it is stated to be practically deserted, although several pretentious buildings remain.

Bad weather has interfered with operations of the Railroad Valley Co., which is drilling for potash in the eastern part of the county. No. 3 hole is down 770 ft., 1 3/5 miles from No. 2 hole. No. 4 will be started in a few days.

(Special Correspondence.)—The Railroad Valley Co. has found gaylussite and saline clays in another well.

Tonopah, October 2.

Storey County

In the Gold Hill district, the Crown Point, Belcher, and there are over twenty companies operating mines, and the monthly payroll is about $45,000. During the first half of the current year the various mines have shipped 60,259 tons to the mills which yielded $624,210. Of this the Mexican produced 10,058 tons, yielding $246,306.

In the Gold Hill district, the Crown Point, Belcher, and Yellow Jacket companies are now engaged in installing a pumping plant that will soon make available several additional levels below the present water-line, and activity in that locality will be greatly stimulated thereby. At the north end of the lode, the Comstock Pumping Association at the C. & C. shaft is doing effective work in preparing for the recovery of new levels below the 2500-ft. level.

During the week ended September 29, the water in the old Con. Virginia winze was lowered about 4 ft. below the 2500-ft. level, this being the first time since 1885 that the water has been below that point.

NEW MEXICO

Socorro County

(Special Correspondence.)—An ore-shoot has been cut at 650-ft. below the Ernestine mill adit, and the mill's capacity has been increased from 100 to 160 tons per day. The Socorro company shipped about 1.25 tons of gold and silver bullion to the mint last week. Three leases are in operation at the Oaks property. The Little Charlie mine is shipping 50 tons of $20 ore per day. Work has been resumed at the Treasure mine. Machine drills are now employed in the Maud mine.

Mogollon, September 22.

All the mills in the Mogollon district are working full time, and the total output is valued at over $150,000 per month.

UTAH

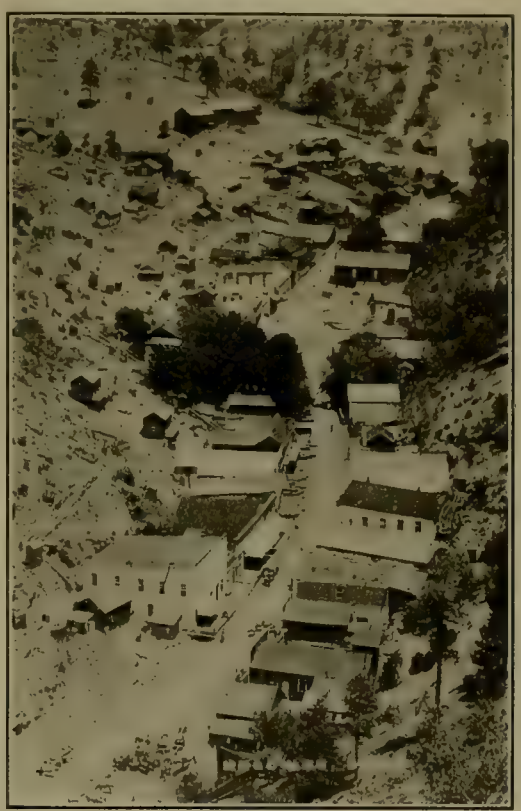
Beaver County

The geology and ore deposits of the San Francisco region of this county have been detailed by B. S. Butler in U. S. Geological Survey Professional Paper 80. This area is in the north-central part of the county and covers about 200 square miles. It is about 180 miles southwest of Salt Lake City. Frisco and Newhouse are the only important towns in the district. The altitude on the plains is from 5250 to 6500 ft., while Quartzite hill rises abruptly to 9725 ft. The climate is temperate, and vegetation and water are scarce. The mountain ranges consist of a central mass of granite, with beds of limestone, sandstone, and shale, having an easterly dip, forming the southern portion, and limestone and sandstone the northern portion. The ore deposits are in quartz monzonite, sedimentary rocks, and lava flows. To the end of 1910 the district had produced the following:

Ore, tons	995,632
Gold, ounces	15,015
Silver, ounces	15,305,624
Copper, pounds	27,935,883
Lead, pounds	328,011,019
Zinc, pounds	4,571,424
Total value	$26,905,090

Grand County

A brief report on the oil and gas development near Green river, in this county, has recently been issued by the U. S. Geological Survey as a result of a geologic investigation made last year by Charles T. Lupton, M. W. Ball, and R. V. A. Mills, of the Survey. An area of about 300 square miles was examined, the object being to determine if this area, in which considerable drilling for oil and gas has been done, contains any reservoirs of these materials. In the area examined in detail, the geologists found no anticlines or domes in which large quantities of oil or gas might be expected to collect. Traces of oil and small pockets of gas have been found in some of the wells, but in quantities so small as to afford only slight encouragement.



THE 'CITY' OF MOGOLLON, NEW MEXICO.

Juab County

Ore shipments from the Eagle & Blue Bell mine in August were worth $46,700, and operating expenses $13,700. Copper ore, assaying from 20 to 30%, is being mined on the 2400-ft. level of the Grand Central. The main shaft will be retimbered in the upper portion early in October, making the top 400 ft. completely new. Lessees on the 450-ft. level of the Opohongo are mining rich copper ore, while those at the Godiva mine are opening high-grade lead-silver and zinc ore.

Salt Lake County

It is proposed to increase the Alta Consolidated Mining Co.'s shares from 300,000 to 500,000, and to place the new ones in the treasury. There is $13,259 owing the bank, and this will be paid, besides buying more equipment. Since work started, development has covered 3233 ft., from which 2462 tons of ore was recovered yielding $57,115. Ore shipments during the summer have been disappointing, but are now of better grade. The new railroad is expected to reduce freight costs soon. Receipts during the term August 1, 1911, to September 22, 1913, were $122,930. Assets are $313,404 and actual liabilities $13,259.

Summit County

A reservoir of 40,000,000 to 50,000,000-gal. capacity is being constructed at the mouth of the Snake Creek tunnel. The present flow of the tunnel is approximately 4000 gal. of water per minute. The tunnel is in 6700 ft. and progress is being made at the rate of 12 to 15 ft. per day. The purpose of this reservoir is to conserve the flow of water from the tunnel, guaranteeing a steady and maximum flow for ultimate hydro-electric power purposes, while it will serve as a steady supply for irrigation purposes during dry seasons. The revenue from the water should be an important source of income for the company. Material for constructing the reservoir will consist of that extracted from the tunnel.

WASHINGTON

The coal resources of Cowlitz River valley, Cowlitz and Lewis counties, are described in Bulletin 531-L, by A. J. Collier, of the U. S. Geological Survey, after a brief investigation. Along the Cowlitz river, northward from its junction with the Columbia, lies an area of coal land 30 miles long and 15 miles wide. This field is probably continuous with that about Centralia and Chehalis. The prevailing rocks are soft sandstones, lying horizontally, and which locally contain beds of coal. An exposure of coal on the Coweman river, which enters the Cowlitz from the east at Kelso, shows the following: sandstone, 20 ft.; coal, 1 ft.; sandstone, 3 ft.; coal, 1 ft.; shale, 4 ft.; and coal 6 in. The Anchor mine, 3½ miles north of Kelso, has been shut down for several years, although it contains fair seams of coal. The Coal Creek mine has produced coal containing from 27.11 to 30.05% fixed carbon The Carbondale mine, 2 miles from Castlerock, is the only mine in the district producing coal, and the seam has been followed down the slope for about 1000 ft. The Lowell, Idleman, Red Ash, and others are abandoned.

Ferry County

The mineral deposits of the Covada mining district, lying within the southern half of the Colville Indian Reservation, are described in Bulletin No. 16 of the State Geological Survey, by Charles E. Weaver. The area of the district is about 40 square miles, and generally it is easy of access by wagon-road, the direct distance from Republic being 35 miles southeast. The topography of Covada district is characteristic of northwestern Washington, the entire drainage finds its way to the Columbia river, the lowest elevations are from 1200 to 1300 ft. above sea-level, there is direct evidence of glaciation even on the high mountains, and there is plenty of timber growing throughout the district. The rocks entering into the formation of the district are composed of silicious slates, slaty schists, quartzites, argillaceous quartzites, and dolomitic limestones. Mining activity in the district is of comparatively recent date, being commenced in 1898. The majority of the orebodies occur in well defined fissures, chiefly within the granodiorite mass or in the Covada metamorphic formation not far from the contact. In a number of instances, the veins consist of impregnated country rock along zones of fracturing. The vein matter consists of quartz and sometimes calcite, containing silver and lead with smaller quantities of gold, copper, and antimony. The commercial value is in the silver. There are at the present time approximately 200 claims in the district, 16 of which are patented.

CANADA

British Columbia

The Canadian Consolidated Mining Co. paid a dividend of $2 per share on September 30. The amount distributed is $110,000, making a total to date of $1,125,061.

Ontario

On the 200-ft. level of the Beaver Auxiliary mine at Elk lake, two to three inches of calcite assaying 6000 oz. silver per ton has been opened. La Rose Consolidated will pay $187,500 on October 20, making dividends of $4,099,185 to date. During August the McKinley-Darragh mill produced 212,098 oz. silver, of which 69,436 oz. came from the Savage property. The 190-ft. level of this property is producing a large quantity of ore, but the heaviest output came from No. 42 vein, a new orebody in the 'swamp' portion of the property. During August, the Buffalo Mines mill treated 5971 tons of ore yielding 115,742 oz. silver, while 413,717 oz. was paid for during the period.

The shoot on the 100-ft. level of the Tough-Oakes mine is producing some rich ore, and hand sorting is being done. The second-class ore goes to the stamp-mill.

Yukon

The Engineer mine, near Atlin, is producing rich ore, which is being crushed in a 2-stamp mill. Since July 1, the average clean-up of amalgam has been 100 oz. per day. It is stated that 100 stamps may be erected next year.

MEXICO

Jalisco

The Tonopah Belmont Development Co., of Nevada, has not completed a deal pending for the purchase of the Zuloago, Condesa, and Rosario mines in the Bolaños district. Unsettled conditions in Mexico was the main reason for allowing the business to lapse.

Mexico

The El Oro Mining & Railway Co. treated 24,180 tons of ore and 13,200 tons of tailing in August, yielding a total of $176,670. The profit, including $9000 from the railway, was $61,650. The 40-stamp mill of the Mexico Mines of El Oro treated 13,450 tons yielding $138,610. The profit was $82,370. The report of this Company, operating at El Oro, covers the year ended June 30, 1913. There was mined and treated a total of 158,630 tons averaging $8.23 gold and 5.9 oz. silver per ton. The 40-stamp mill averaged 11.15 tons per stamp day, the bullion produced being valued at $1,669,540, equal to 88.99% recovery. The ore from the lower levels is less amenable to cyanidation than the oxidized ore, and lower extractions will result. Total working costs were $4.12 per ton. Ore reserves total 403,100 tons. The year's profit was $960,000, and dividends amounting to $4.32 per share were paid, equal to $777,600.

Sonora

(Special Correspondence.)—Judging by the number of small properties resuming operations, either through lessees or their companies, mining conditions throughout the northern portion of the state are gradually getting better. Especially true is this condition in the northeastern portion of the state, and in the Nacozari district, where, during the past month several small properties have renewed operations after being idle since the first of the year. Lessees have been getting a chance to work some rich properties and some of them are doing well.

The Santa Maria mine, situated near the rich Chispas property of the Pedrazzina company, is now opening satisfactorily. The shaft is down 455 ft. and the Espiritu Santa vein is expected to be cut before the 500-ft. level is reached. Drifts on the various levels, from the 100 to 400-ft., are showing well. Twenty men are employed at present. R. B. Phillips is in charge of the operations. The Chispas mine will probably not resume operations for some time, as it is understood that orders have recently been received from the Paris offices to sell all supplies now on hand.

Cananea, September 27.

The three-compartment shaft of the Moctezuma Copper Co., at Pilares, has opened good ore at 1100 ft., and the management has decided to continue sinking to the 2000-ft. level. This will be the deepest shaft in the state of Sonora. A larger hoisting station is being cut on the 700-ft. level of the Guadalupe three-compartment shaft. It will be equipped with three-ton skips and a large electric hoist. It is the ultimate intention of the Company to make the Guadalupe the main hoisting shaft. The Nacozari Consolidated Copper Co. is now excavating ground for its 100-ton mill. The adit in this property is showing better ore as it is driven into the 'red' hill.

Schools and Societies

The American Institute of Mining Engineers, at a directors' meeting held in New York on September 22, appointed the following committee on Petroleum and Gas: Anthony F. Lucas, chairman; Mark L. Requa, vice-chairman; David T. Day, vice-chairman; William N. Best, vice-chairman; Leonard Waldo, secretary; Ralph Arnold, Frederick G. Clapp, Edwin T. Dumble, Richard S. Haseltine, C. Willard Hayes, Philip W. Henry, John Langton, William B. Phillips, William L. Watts, L. C. White, and William A. Williams. A meeting of the above committee will be held on October 15 to complete the organization. The meeting will be preceded by a dinner at the Engineers' Club.

The College of Engineering of the University of Illinois reports the following new appointments to its staff, effective September 1, 1913, C. R. Richards being acting dean of the College. L. H. Provine, as professor of architectural engineering, graduated from the University of Illinois. L. A. Harding, as professor of experimental mechanical engineering, graduated from the Pennsylvania State College. A. C. Willard, as assistant professor of heating and ventilation, graduated from Massachusetts Institute of Technology. Percy Ash, as assistant professor of architectural design, graduated from the University of Pennsylvania. W. C. Titcomb, as assistant professor of architecture, graduated from Harvard College. J. I. Parcel, as assistant professor of structural engineering, graduated from Westfield College. W. M. Wilson, as assistant professor of structural engineering, graduated from Iowa State College. E. A. Holbrook, as assistant professor of mining engineering, graduated from the Massachusetts Institute of Technology. P. S. Biegler, as associate in electrical engineering, graduated from the University of Wisconsin. S. O. Andros, as associate in mining engineering. For the past two years Mr. Andros has been field assistant in the coöperative mining work which is being carried on here by the United States Bureau of Mines, the State Geological Survey, and the Department of Mining Engineering. J. H. Forsythe, as instructor in architecture, graduated from the University of Pennsylvania in 1908 and received the degree of master of architecture from Harvard University in 1913. A. B. M. Corrubia, as instructor in architecture, graduated from Washington University in 1911 and received the degree of master of science in architecture from Massachusetts Institute of Technology in 1913. A. R. Knight, as instructor in electrical engineering, graduated from Ohio State University. Rufus Crane, as instructor in general engineering drawing, graduated from Middlebury College in 1909 and from the Massachusetts Institute of Technology. H. W. Waterfall, as instructor in machine design, graduated from the Massachusetts Institute of Technology. F. C. Torrance, as instructor in mechanical engineering, graduated from Cornell University. H. E. Babbitt, as instructor in municipal and sanitary engineering, graduated from the Massachusetts Institute of Technology. Harry Gardner, as instructor in theoretical and applied mechanics, graduated from the University of Wisconsin in 1905 and received the degree of master of science from the University of Kansas in 1911. Alexander Vallance, as instructor in theoretical and applied mechanics, graduated from Ohio State University. L. E. Young, as part-time instructor in mining engineering while carrying on graduate work in economics, graduated from Pennsylvania State College. R. B. Keller, as first assistant in the engineering experiment station, department of railway engineering, graduated from Purdue University. Sebastian Karrer, as assistant in physics, graduated from the University of Washington. B. L. Bowling, as assistant in the cement laboratory in the department of civil engineering. J. B. Nathanson as part-time assistant in physics, graduated from the Ohio State University in 1912 and received the degree of Master of Arts from the University of Illinois. J. H. Belt, as research fellow in the engineering experiment station, department of electrical engineering, graduated from the University of Illinois. Julian Montgomery, as research fellow in the engineering experiment station, department of theoretical and applied mechanics, graduated from Grayson College in 1908 and from the University of Texas. R. B. Pogue, as research fellow in the engineering experiment station, department of railway engineering.

Personal

Professional men are invited to send news of their engagements and travels. Such news is interesting to friends.

E. B. Kirby was in New York recently.

W. J. Loring visited Plymouth this week.

George H. Garrey has returned to New York.

R. B. Moran has returned to San Francisco.

C. W. Merrill has gone to Detroit and Toronto.

B. Snelling Robinson has been in New York City.

H. G. Nichols has returned to London from the United States.

Victor E. Tull, of Seattle, is in San Francisco for the winter.

Juan Felix Brandes is at the Royal Societies Club, London.

C. B. Lakenan was in New York and has returned to Nevada.

Will L. Clark was in New York City last week, and has returned to Arizona.

Robert M. Raymond passed through San Francisco returning from Oroville.

C. C. Broadwater has returned to San Francisco from London and New York.

H. N. Lawrie is in New York, where he expects to remain for about three months.

Courtenay De Kalb has returned to Tucson from a trip through northern Mexico.

Charles Hayden has gone to visit the copper properties with which he is associated.

F. L. Cole has returned to Shanghai from an examination of phosphate deposits in Indo-China.

P. H. Hunt will soon return to Redlands, California, from Charcas, San Luis Potosi, Mexico.

J. F. McClelland is at Murray Bay, Canada, and expects to return to New Haven about October 1.

William Maloney is the territorial inspector of mines for the Nome and Fairbanks districts of Alaska.

Colin Timmons has removed from Denver to Dunton, Colorado. He is manager of the Emma gold mine.

H. C. Miller, until recently with Daniels & Osmont, San Francisco, has opened an office at Bishop, California.

J. A. L. Henderson has returned to London from Canada, where he attended the International Geological Congress.

R. H. Richards and Waldemar Lindgren were in New York last week to attend the directors' meeting of the A. I. M. E.

Tadasu Hiki, professor of mineralogy in Kyoto University, is in New. York, where he expects to remain for some months.

John T. Reid has recently been appointed general manager for the Buffalo Valley Gold Mining & Leasing Co., at Anking, Nevada.

H. O. Hanke and G. W. Lambourne, of the Daly-Judge company, have returned to Salt Lake City from an extended visit to the mine at Park City.

James Brown and Archibald Stark have returned to Spain after traveling along the west coast of South America and through the United States.

John Ashworth, of Manchester, England, passed through New York recently in returning from the International Geological Congress at Toronto.

Henry H. Armstead and Alex. Smith Cochran, of New York, are in Guanajuato, Mexico, making an inspection of the properties of the Golmena Mining Corporation and the Mexican United Company.

Stanley C. Seares, who recently resigned as general manager for the Utah Apex M. Co., to enter consulting practice, is to be married on October 8 to Mrs. Robert Holmes Officer at Salt Lake City.

New York Metal Market Review

The striking feature of September was the strong statistical position of copper, which made 17c. per pound again a reality for Lake, with electrolytic nearby at 16.87½c. delivered, 30 days. Throughout most of the month the market was quiet, for the excellent reason that consumers had provided for their needs. The sold-up condition of the big agencies was proof of this. Lead declined steadily in strength and in the latter part of the month lower prices were indicated. In spelter there was no great amount of business and quotations became lower. Antimony continued dull and neglected. The consumption of tin was fair, but except for intermittent buying the market was quiet and prices declined. Aluminum was practically without action, at steady prices, awaiting the new tariff.

COPPER

The average price paid for copper by the brass mills in the Naugatuck valley, in August was 15.62½c., as against 14.75c. in July. In the last few days of August and all September the market gained steadily in strength. September 2, quotations were 16.25c. cash, for Lake, and 16.12½c., cash, New York for electrolytic. At this time the higher prices were ascribed chiefly to foreign influences, although there was a fair amount of domestic business. Throughout the month the strike situation in the Lake Superior region was a bull influence. The most important feature of the month was the Copper Producers' statement for August, which showed a heavy reduction in stocks and that only 38,314,037 lb. of metal, or a little more than the quantity required for two week's domestic consumption, was on hand August 31. If anything was needed to sustain the market the statement supplied it and prices at once advanced—electrolytic to 16.62½c. cash, New York, and Lake to 16.87½c. cash. Meanwhile buying became active, some of it for deliveries as far ahead as December. Predictions became many that copper would advance to at least 17c. before the end of the month. It did. Toward the middle of the month activity sagged off, but the strong statistical position, the strength abroad, the continuance of the Lake strike and a real scarcity of copper for prompt delivery upheld the market and on September 16, prices advanced to 16.87½c. cash, for Lake, and 16.75c. cash, New York, or 16.87½c. delivered, 30 days, for electrolytic. One foreign influence of a supporting character was a strike on the Rio Tinto railroad. Up to September 24, the market was quiet, but strong, and on September 19, Lake advanced to 17c. cash, New York. Some small resale lots which had been offered at ⅛c. lower had been taken, and then 17c. became the lowest price. The feature at this time was the sold-up condition of the big agencies so far as early delivery metal was concerned. Except in a small way, September and October copper were not to be had. Near the close of the month the market was strong despite the absence of buying and there was every promise of it holding its position. Exports up to September 24 were 25,131 tons. The total exports in August were 34,722 tons. In the eight months of 1913 there were 258,454 tons, an increase of 29,726 tons, as compared with the same period last year. The price of Lake by September 26 had softened to 16.75c. and that of electrolytic to 16.62½c. Exports to September 27 were 26,819 tons.

SPELTER

The market was quoted at 5.90c. New York, and 5.75c. St. Louis, until September 16, when there was a decline of about 10 points, making about 5.80c. New York, and 5.65c. St. Louis, the quotations. In the days following, a weaker tendency developed and the prices mentioned could undoubtedly have been shaded if the right seller had been approached. Early in the month the demand was mostly for high-grade material for brass mill use. The reduction in price caused a little more activity in the cheaper grades, but at no time was there any great amount of business. An interesting fact which came to light was that foreign spelter had been offered in the New York market, but had found no takers, not only because consumers were not eager to buy, but because some of them were unfamiliar with the qualities of the foreign metal and did not choose to buy, especially when there was no great inducement in the matter of price. Quotations on September 26 were 5.70 to 5.75c. New York, and 5.50 to 5.55c. St. Louis.

LEAD

From the first of the month until September 24 the New York quotation of the largest lead interest was 4.75c., but on the latter date the market was weak and it was freely predicted that a decline was soon to be expected. St. Louis prices gave tangible evidence of the growing weakness, quotations dropping first to 4.65c. (from 4.67½c.), then to 4.62½c. and then to 4.60c., with every indication of a still lower figure. The settlement of the strike in the lead mining district early in the month brought about an easier feeling, as was to be expected, while business also dropped off and the market continued dull until near the end of the month when this report was written. Lead could be had at 4.65c., New York, and 4.50c., St. Louis, on September 26.

ANTIMONY

Throughout September antimony was neglected, the market listless and without interest so far as new developments were concerned. The range of prices was unchanged at 7.75 to 8c. for Hallett's, 8.35 to 8.40c. for Cookson's, and 7.37½ to 7.50c. for Chinese and Hungarian grades. The heavy imports previously referred to continued, and most of the metal went into bonded warehouses to await the enactment into law of the new tariff. Some authorities stated that approximately a year's supply of the metal was stored in this manner. Others declared there was no profit in the prevailing prices and that either sales were being made of metal imported fully two years ago or sales were being made at a loss.

PIG TIN

As was the case in August, the range of tin prices in September was within rather narrow limits. September 2, sales were made at 43.05c., September 9 at 42.50c., September 16 at 42.75c., and September 23 at 41.75c. Buying, as usual, was intermittent, one of the best days being on September 8, when 350 tons was taken. Following this flurry, quiet prevailed and the pressure to sell far exceeded the inclination to buy. Consumption was fair in September, and toward the end of the month buying was looked for in good volume, but it had not materialized up to the 24th. Most of the interest in the third quarter of the month was in futures, but in these there was no business which could be called large. Supplies at this time were ample, but fairly well concentrated in a few hands, and these were not over anxious to sell at the prevailing price—a few points under 42c. Arrivals up to September 24 were 3069 tons and there was afloat on that day 3040 tons. The total visible supply August 31, 1913, was 11,261 tons, which was 24 tons below that of August 31, 1912. Tin arrivals to September 27 were 3469 tons and there was afloat September 26, 2665 tons.

ALUMINUM

Of this metal little is to be said. But slight interest was taken in it, at least up to September 24. What there was was mostly in futures. Prices for prompt domestic up to that date, underwent no change. It was quoted at 21.50 to 22.50c. The range of foreign aluminum in bond came down a little and 18 to 18.25c. was quoted. The attitude of most consumers was one of waiting for the new tariff.

The United States Civil Service Commission announces an open competitive examination for junior chemist qualified in fuels, on October 8 and 9. From the register of eligibles resulting from this examination, certification will be made to fill a vacancy in this position in the Bureau of Mines, Washington, D. C., at a salary of $1020 per year, and vacancies as they may occur in positions requiring similar qualifications in other branches of the service. Competitors will be examined in mineralogy, translation from French or German technical works, physics, chemistry, and general education.

The Metal Markets

LOCAL METAL PRICES

San Francisco is not a primary market for the common metals except quicksilver. The prices quoted below therefore represent sales of small lots and are not such as an ore producer could expect to realize. Ore contracts usually call for settlement on the basis of Eastern prices, less freight and treatment charges. The prices quoted are in cents per pound, except in the case of quicksilver, which is quoted in dollars per flask of 75 pounds.

San Francisco, October 2.

Antimony	12—12½c	Quicksilver (flask)	$39.50
Electrolytic Copper	17½—17½c	Tin	46—47½c
Pig Lead	4.85—5.80c	Spelter	7¼—7½c

Zinc dust, 1400 lb. casks, per 100 lb., small lots $9.50—9.75; large $7.50—8.50

EASTERN METAL MARKETS

(By wire from New York.)

NEW YORK, October 1.—The copper market is firm but somewhat easier. Standard, spot, and October copper is quoted at from 16 to 16.50. November and December 16.25 to 16.50; electrolytic 16.87, and Lake 17; casting 16.62 to 16.75. The foreign fortnightly statistics, as reported in London, show that the stocks have decreased 1513 tons. The Copper Producers' report will appear on October 8, and it is predicted that it will show a decrease of the stock on hand of from ten to fifteen million pounds. The London market closed with spot at £74 and futures £73 15s. Lead and spelter are weak. Tin is quiet with spot, October, and November at 41.12½, and December 41.15.

SILVER

Below are given the average New York quotations, in cents per ounce, of fine silver.

Date.		Average week ending	
Sept. 25	61.62	Aug. 20	59.16
" 26	61.87	" 27	59.46
" 27	62.00	Sept. 3	59.60
" 28 Sunday		" 10	59.58
" 29	61.75	" 17	60.20
" 30	61.25	" 24	61.59
Oct. 1	61.37	Oct. 1	61.68

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	56.25	63.01	July	60.67	58.70
Feb.	59.06	61.25	Aug.	61.32	59.32
Mch.	58.37	57.87	Sept.	62.95	60.53
Apr.	59.20	59.26	Oct.	63.16	....
May	60.88	60.21	Nov.	62.73	....
June	61.29	59.03	Dec.	63.38	....

Notwithstanding the continued scarcity of business during the greater part of the week, or perhaps on account of it, the tone of the market was decidedly more cheerful, and, apart from a slight reaction on the first day, the trend of prices was distinctly upward, according to Samuel Montagu & Co., of London, on September 11. The money stringency in India, combined with the large drop in the holding of silver in the currency reserves, has resulted in a flow of buying orders from Indian speculators anxious to cover their former sales, and prices today have further improved to 27¾d. for cash and 27 15/16d. for two months. The prospects for the immediate future are dependent to a large extent on whether China becomes a free seller or not, as, apart from the large accumulations under her control, supplies are limited.

COPPER

Quotations on copper as published in this column represent average wholesale transactions on the New York market and refer to electrolytic copper. Lake copper commands normally from 1-5 to 1-4c. per lb. more. Prices are in cents per pound.

Date.		Average week ending	
Sept. 25	16.33	Aug. 20	15.59
" 26	16.28	" 27	15.51
" 27	16.28	Sept. 3	15.69
" 28 Sunday		" 10	16.32
" 29	16.28	" 17	16.44
" 30	16.28	" 24	16.41
Oct. 1	16.28	Oct. 1	16.29

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	14.09	16.54	July	17.19	14.21
Feb.	14.08	14.93	Aug.	17.49	15.42
Mch.	14.68	14.72	Sept.	17.56	16.23
Apr.	15.74	15.22	Oct.	17.32	....
May	16.03	15.42	Nov.	17.31	....
June	17.23	14.71	Dec.	17.37	....

The copper market was quiet during last week and weaker at its close. On September 22 the nominal quotation was 17c. per pound, and it was expected that brisk buying would soon send it above this figure. The expected buying did not develop, however, and though October copper, which was scarce, was firmly held, the metal was available for more distant delivery at a lower figure. During the middle of the week, concessions were made. By September 26 some of the dealers in 'second hands' were selling small lots at 16½c., though the larger agencies were still quoting 16¾c. without eliciting much business. Exports for the week ended September 25 were reported at 6783 tons, making 26,819 tons exported since September 1, as compared with 22,798 tons in the same period last year.

Prophecies as to the change in stocks this month are now in order, and a further decrease of 5,000,000 to 10,000,000 lb. is the expectation of one of the producers. Consumers have not yet been heard from. D. C. Jackling is reported to have said that the September production of Utah Copper will exceed the August figures by 1,000,000 lb. No one seems to know what the Lake output has been during the past month. If the Washoe smelter shuts down for a week, as announced, it will cut 5,000,000 to 7,000,000 lb. off next month's output.

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.		Average week ending	
Sept. 25	4.63	Aug. 20	4.68
" 26	4.63	" 27	4.75
" 27	4.61	Sept. 3	4.75
" 28 Sunday		" 10	4.73
" 29	4.61	" 17	4.73
" 30	4.61	" 24	4.69
Oct. 1	4.58	Oct. 1	4.61

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	4.43	4.28	July	4.71	4.35
Feb.	4.03	4.33	Aug.	4.54	4.60
Mch.	4.07	4.32	Sept.	5.00	4.70
Apr.	4.20	4.36	Oct.	5.08	....
May	4.20	4.34	Nov.	4.91	....
June	4.40	4.33	Dec.	4.20	....

ZINC

Zinc is quoted as spelter, standard Western brands, St. Louis delivery, in cents per pound.

Date.		Average week ending	
Sept. 25	5.43	Aug. 20	5.51
" 26	5.40	" 27	5.60
" 27	5.38	Sept. 3	5.63
" 28 Sunday		" 10	5.65
" 29	5.38	" 17	5.59
" 30	5.38	" 24	5.50
Oct. 1	5.38	Oct. 1	5.39

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	6.42	6.88	July	7.12	5.11
Feb.	6.50	6.13	Aug.	6.96	5.51
Mch.	6.57	5.94	Sept.	7.45	5.55
Apr.	6.63	5.52	Oct.	7.36	....
May	6.68	5.23	Nov.	7.23	....
June	6.88	5.00	Dec.	7.09	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California, being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending			
Sept. 3	40.00	Sept. 17	39.50
" 10	40.00	" 24	39.50
		Oct. 1	39.50

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	43.75	39.37	July	43.00	41.00
Feb.	46.00	41.00	Aug.	42.50	40.50
Mch.	46.00	40.20	Sept.	42.12	39.70
Apr.	42.25	41.00	Oct.	41.50	....
May	41.75	40.25	Nov.	41.50	....
June	41.30	41.00	Dec.	39.75	....

TIN

New York prices control in the American market for tin, since the metal is almost entirely imported. San Francisco quotations average about 5c. per lb. higher. Below are given average monthly New York quotations, in cents per pound:

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	42.53	50.45	July	44.25	40.70
Feb.	42.96	49.07	Aug.	45.80	41.75
Mch.	42.58	46.95	Sept.	48.64	42.45
Apr.	43.92	49.00	Oct.	50.01	....
May	46.95	49.10	Nov.	49.92	....
June	45.76	45.10	Dec.	49.80	....

The Stock Markets

SAN FRANCISCO STOCKS AND BONDS

(San Francisco Stock and Bond Exchange.)

BONDS

October 1.

Listed.	Bid	Ask	Unlisted.	Bid	Ask
Associated Oil 6s	$ 99	[illegible]	General Petroleum 6s	$54	55
E. I. du Pont 4½s	83½	85½	Natomas Dev. 6s	97½	—
Natomas Con. 6s	—	73	Pac. Port. Cement 6s	99½	—
Unlisted.			Standard Cement 6s	91½	—
Ass. Oil 5s	76½	—	Santa Cruz Cement 6s	83	—

STOCKS

Listed.	Bid	Ask	Unlisted.	Bid	Ask
Amalgamated Oil	77	80	Mascot Copper	—	2½
Associated Oil	40	—	Noble Electric Steel	2½	—
E. I. du Pont pfd	86	92½	Natomas Consol	5	10
Pac. Cst Borax, com	—	100	Pacific Port. Cement	63	75
Pacific Crude Oil	20c	—	Riverside Cement	45	—
Sterling O. & D.	75c	—	Santa Cruz Cement	45	49

NEVADA STOCKS

(By courtesy of San Francisco Stock Exchange.)

San Francisco, October 2.

Atlanta	$ .14	Mizpah Extension	$ .40
Belcher	.25	Montana-Tonopah	1.25
Belmont	7.00	Nevada Hills	.88
Big Four	.20	North Star	.39
Cash Boy	.07	Ophir	.23
Florence	.22	Pittsburg Silver Peak	.45
Goldfield Con.	1.40	Round Mountain	.40
Goldfield Oro	.08	Sierra Nevada	.12
Halifax	1.50	Tonopah Extension	1.95
Jim Butler	.65	Tonopah Merger	.69
Jumbo Extension	.12	Tonopah of Nevada	4.75
MacNamara	.11	Union	.10
Mexican	1.25	West End	1.52
Midway	.42	Yellow Jacket	.33

COPPER SHARES—BOSTON

(By courtesy of J. C. Wilson, Mills Building.)

October 2.

	Bid	Ask		Bid	Ask
Adventure	$ 1½	1¾	Mohawk	$ 42½	42¾
Allouez	36	36½	North Butte	28½	28½
Calumet & Arizona	67¾	68	Old Dominion	52½	53
Calumet & Hecla	430	440	Osceola	79	80
Centennial	14	15	Quincy	59¾	[illegible]
Copper Range	40	40½	Shannon	6¾	7
East Butte	12¾	12½	Superior & Boston	2¾	3
Franklin	3½	3¾	Tamarack	31½	32
Granby	74½	74¾	U. S. Smelting	40	40¾
Greene Cananea	31	32	Utah Con.	9	9¼
Hancock	18	18½	Victoria	1½	1⅝
Isle-Royale	19½	19¾	Winona	1¾	—
Mass Copper	3¾	4	Wolverine	43½	45

NEW YORK QUOTATIONS

(By courtesy of E. F. Hutton & Co., Kohl Building.)

October 2.

	Bid	Ask		Bid	Ask
Braden Copper	7 1/16	7 1/2	Mason Valley	4 1/2	4 3/4
B. C. Copper	2 1/4	2 3/4	McKinley-Dar.	1 1/2	2
Davis-Daly	1 7/8	2 1/8	Mines Co. Am.	1 7/8	2 1/8
Dolores	[illegible]	4	Nipissing	8 5/8	8 3/4
El Rayo	1	2	Ohio Copper	3/8	1/2
Ely Con.	[illegible]	8	San Toy	18	22
First Nat.	[illegible]	3 3/8	Sioux Con.	1	3
Giroux	1 1/4	1 1/2	So. Utah	1/8	1/4
Greene Can.	6 1/2	7	S. O. Calif.	187	189
Hollinger	16 1/2	17 1/2	Tri Bullion	1/8	1/4
Iron Blossom	120	130	Tuolumne	1 3/4	2 1/4
Kerr Lake	3 7/8	4	United Copper	1/4	5/8
La Rose	2 3/8	2 3/4	Wettlaufer	12	14
			Yukon Gold	3 1/8	3 1/4

LONDON QUOTATIONS

(By cable, through the courtesy of Catlin & Powell Co., New York.)

October 2.

	£	s.	d.		£	s.	d.
Alaska Mexican	1	17	6	Kern River Oilfields	0	[illegible]	9
Alaska Treadwell	[illegible]	5	0	Mexico Mines	6	0	0
Alaska United	[illegible]	0	0	Messina	1	10	0
Arizona	2	0	0	Oroville	0	6	3
California Amalg.	[illegible]	2	6	Pacific Oilfields	0	2	6
California Oilfields	6	5	0	Rio Tinto	78	15	0
Camp Bird	0	[illegible]	9	Santa Gertrudis	[illegible]	18	9
El Oro	[illegible]	15	0	Stratton's	0	2	6
Esperanza	1	0	0	Tanganyika	[illegible]	8	9
Granville	0	11	3	Tomboy	1	6	3

AUSTRALIAN

October 2.

	£	s.	d.		£	s.	d.
British Broken Hill	1	17	6	Mount Boppy	0	15	0
Broken Hill Prop.	1	16	9	Mount Elliott	4	16	9
Golden Horse-Shoe	2	16	9	Mount Lyell	1	7	6
Great Boulder Prop.	0	12	6	Mount Morgan	3	11	3
Ivanhoe	3	0	0	Waihi	2	6	3
Kalgurli	2	1	3	Waihi Grand Junc.	1	1	3

OIL PRODUCTION IN 1912

A preliminary statement by the U. S. Geological Survey shows that California produced 86,450,747 bbl., and Wyoming increased from 186,695 to 1,572,306 bbl. compared with 1911. Higher prices were the rule in 1912, except in California, and even in that state, despite the great production, there was no considerable decline. The average world price in 1912 was 74c. per barrel, against an average of 61c. in 1911. Stocks of crude oil decreased 10% in 1912, resulting in stimulation of prices and increased activity in drilling all over the East. The decrease in stocks is ascribed to improved export conditions and increased capacity of the refiners to take care of the crude oil. While stocks did not decrease in California, expanded consumption checked increased storage of oil. The total production of the United States was 222,449,391 bbl., equal to 63.25% of the world's output.

GOLDFIELD CONSOLIDATED REPORT

The report of the general manager, Albert Burch, of the Goldfield Consolidated Mines Co., for August contains the following:

Development, feet (cost per foot, $5.40)		3,094
Ore treated, tons		32,096
Net realization		$198,784
Costs.	Per ton handled.	Total.
Mining:		
Stoping	$2.78	
Development	0.52	
		$3.30
Shipping expense	$8.21	0.34
Dump moving	1.00	0.05
Transportation		0.07
Milling		1.85
Marketing		0.05
General expense		0.27
Bullion tax		0.09
Construction		0.01
Total costs		$6.03
Miscellaneous earnings		0.04
Net costs		$5.99

During the month, driving on No. 7 level of the Combination mine was continued on the vein previously cut by a diamond-drill, but no pay-ore was opened till about the end of the month. The 136-BX sill was extended and produced 161 tons of $29 ore. The 3-R sill in the Mohawk was extended and produced 28 tons of $12 ore, and an extension of the 170-CX sill produced 100 tons of $15 ore. The 139-X cross-cut and 141-X drift on the first level, about 400 ft. north of the shaft, produced 153 tons of $17 ore, and the drift continues to look promising. New stopes are being gradually started in the 202 territory, between the first and second levels southwest of the shaft, and five are now in operation, producing a good tonnage of moderate grade ore. An extension of the 241 drift in the Laguna produced 104 tons of $6 ore, and the drift has probably reached the northern end of the orebody. Stoping, which has been commenced above the drift, produces a much better grade of ore than was obtained from driving. No important developments of pay-ore have resulted from the month's work at the Clermont-Jumbo. The 916 cross-cut mentioned in last month's report was continued across the vein, which was proved to be 40 ft. wide, but no ore of a shipping grade was found at this point.

THE Seoul Mining Co., operating in Korea, will pay a dividend equal to 25% on the capital stock outstanding on October 16, the result of operations for the first half of 1913.

Current Prices for Ores and Minerals

(Corrected monthly by Atkins, Kroll & Co.)

The prices are approximate, subject to fluctuation, and to variation according to quantity, quality, and delivery required. They are quoted, except as noted, f.o.b. San Francisco. Buying prices marked *.

	Min.	Max.
Antimony ore, 50%, ₱ ton	*$22.00	$25.00
Arsenic, white, refined, ₱ lb	0.03	0.03½
Arsenic, red, refined, ₱ lb	0.08	0.08½
Asbestos, chrysotile	100.00	350.00
Asbestos, amphibole	5.00	25.00
Asphaltum, refined, ₱ ton	11.50	20.00
Barium carbonate, precipitated, ₱ ton	42.50	45.00
Barium chloride, commercial, ₱ ton	42.50	45.00
Barium sulphate (barytes), prepared, ₱ ton	20.00	30.00
Bismuth ore, 15% ₱ ton	*250.00	upward
Chrome ore, according to quality, ₱ ton	10.00	12.50
China clay, English, levigated, ₱ ton	15.00	20.00
Cobalt metal, refined, f. o. b. London, ₱ lb	2.50	
Coke, foundry, ₱ 2240 lb	14.50	15.00
Diamonds:		
Ballas according to size and quality, ₱ carat	70.00	
Borts, according to size and quality, ₱ carat	2.00	15.00
Carbons, according to size and quality, ₱ carat	55.00	90.00
Feldspar, ₱ ton	5.00	25.00
Firebrick:		
Bauxite, ₱ M	175.00	
Magnesite, ₱ M	190.00	275.00
Silica, ₱ M	50.00	55.00
Flint pebbles for tube-mills, ₱ 2240 lb	19.50	22.50
Fluorspar, ₱ ton	10.00	15.00
Fullers earth, according to quality, ₱ ton	20.00	30.00
Gilsonite, ₱ ton	35.00	40.00
Graphite:		
Amorphous, ₱ lb	0.01½	0.02½
Crystalline, ₱ lb	0.04	0.13
Gypsum, ₱ ton	7.50	10.00
Infusorial earth, ₱ ton	10.00	15.00
Magnesite, crude, ₱ ton	5.00	7.50
Magnesite, dead calcined, ₱ ton	20.00	25.00
Magnesite, brick (see firebrick).		
Manganese ore, oxide, crude, ₱ ton	10.00	25.00
Manganese, prepared, according to quality, ₱ ton	30.00	70.00
Mica, according to size and quality, ₱ lb	0.05	0.30
Molybdenite, 95% MoS_2, ₱ ton	400.00	450.00
Monazite sand (5% thoria), ₱ ton	150.00	200.00
Nickel metal, refined, ₱ lb	0.45	0.60
Ochre, extra strength, levigated, ₱ 100 lb	2.25	3.25
Osmiridium, ₱ oz	50.00	65.00
Platinum, native, crude, ₱ oz	30.00	45.00
Silex lining for tube-mills ₱ 2240 lb	35.50	37.50
Sulphur, crude, ₱ ton	20.00	25.00
Sulphur, powdered, ₱ ton	35.00	45.00
Sulphur, 80%, ₱ ton	16.50	18.50
Talc, prepared, according to quality, ₱ ton	20.00	50.00
Tin ore, 60%, ₱ ton	500.00	550.00
Tungsten ore, 65%	425.00	450.00
Uranium ore, 10% min.	25.00	per unit
Vanadium ore, 15% V_2O_5, ₱ ton	150.00	180.00
Wolframite (see tungsten ore).		
Zinc ore, 50% up, ₱ ton	*15.00	20.00

Current Prices for Chemicals

(Corrected monthly by Braun-Knecht-Heimann Co.)

Prices quoted are for ordinary quantities in packages as specified. For round lots lower prices may be expected, while in smaller quantities advanced prices are ordinarily charged. Prices named are subject to fluctuation. Other conditions govern Mexican and foreign business.

	Min.	Max.
Acid, sulphuric, com'l, 66°, drums, ₱ 100 lb	$0.75	$1.00
Acid, sulphuric, com'l, 66°, carboy, ₱ 100 lb	1.00	1.50
Acid, sulphuric, C. P., 9-lb. bottle, bbl., ₱ lb	0.13	0.18
Acid, sulphuric, C. P., bulk, carboy, ₱ lb	0.09½	0.12
Acid, muriatic, com'l, carboy, ₱ 100 lb	1.60	3.00
Acid, muriatic, C. P., 6-lb. bottle, bbl., ₱ lb	0.15	0.20
Acid, muriatic, C. P., bulk, carboy, ₱ lb	0.10½	0.15
Acid, nitric, com'l, carboy, ₱ 100 lb	6.00	6.50
Acid, nitric, C. P., 7-lb. bottle, bbl., ₱ lb	0.16	0.22
Acid, nitric, C. P., bulk, carboy, ₱ lb.*	0.12½	0.15
Argols, ground, bbl., ₱ lb	0.10	0.20
Borax, cryst. and conc., bags, ₱ 100 lb	3.00	4.35
Borax, powdered, bbl., ₱ 100 lb	3.38	4.50
Borax glass, gd. 30 mesh, cases, tin lined, ₱ 100 lb	10.50	13.50
Bone ash, 60 to 80 mesh, bbl., ₱ 100 lb	5.50	6.50
Bromine, 1-lb. bottle, ₱ lb	0.55	0.65
Candles, adamantine, 14 oz., 40 sets, ₱ case	4.60	4.80
Candles, adamantine, 14 oz., 60 sets, ₱ case	5.25	5.45
Candles, Stearic, 14 oz., 40 sets, ₱ case	5.00	5.20
Candles, Stearic, 14 oz., 60 sets, ₱ case	5.70	5.90
Clay, domestic fire, sack, ₱ 100 lb	1.50	2.00
Cyanide, 98 to 100%, 100-lb. case, ₱ lb	0.20½	0.23½
Cyanide, 98 to 100%, 200-lb. case, ₱ lb	0.20	0.23
Cyanide, 120%, 100-lb. case, ₱ lb	0.25	0.27
Cyanide, 120%, 200-lb. case, ₱ lb	0.24	0.26
Lead acetate, brown, broken casks, ₱ 100 lb	9.50	10.50
Lead acetate, white, broken casks, ₱ 100 lb	10.50	10.75
Lead acetate, white, crystals, ₱ 100 lb	12.50	13.25
Lead, C. P., test., gran., ₱ 100 lb	13.00	15.00
Lead, C. P., sheet, ₱ 100 lb	15.00	18.00
Litharge, C. P., silver free, ₱ 100 lb	11.50	13.50
Litharge, com'l, ₱ 100 lb	8.00	9.50
Manganese ox., blk., dom. in bags, ₱ ton	20.00	25.00
Manganese ox., blk., Caucasian, in casks, ₱ ton (85% MnO_2—1% Fe)	36.00	47.50
Nitre, double ref'd, small cryst., bbl., ₱ 100 lb	7.00	8.00
Nitre, double ref'd, granular, bbl., ₱ 100 lb	6.50	7.50
Nitre, double ref'd, powdered, bbl., ₱ 100 lb	7.25	8.00
Potassium bicarbonate, cryst., ₱ 100 lb	12.00	15.00
Potassium carbonate, calcined, ₱ 100 lb	7.50	9.00
Potassium permanganate, drum, ₱ lb	0.10½	0.13
Silica, powdered, bags, ₱ lb	0.03	0.05
Soda, carbonate (ash), bbl., ₱ 100 lb	1.50	1.75
Soda, bicarbonate, bbl., ₱ 100 lb	2.25	2.75
Soda, caustic, ground, 98%, bbl., ₱ 100 lb	3.15	3.50
Soda, caustic, solid, 98%, drums, ₱ 100 lb	2.65	2.85
Zinc shavings, 850 fine, bbl., ₱ 100 lb	11.80	12.50
Zinc sheet, No. 9—18 by 84, drum, ₱ 100 lb	10.20	11.00

*Extra charge for packing nitric acid for shipment to conform to regulations.

The Iron Ranges of Minnesota

*The first mention of iron-bearing formation in Minnesota is by Norwood in 1852, but it was not until 1875 that there was any record of work being done to establish the economic value of the district. In this year A. H. Chester examined the Missabe range from Embarrass lake eastward to Birch lake. In the greater portion of the district examined, the formation is highly magnetic, and has never produced bodies of merchantable ore. Shortly afterward attention was almost wholly diverted from the Missabe by the discovery of ore on the Vermilion range.

In the early eighties George C. Stone succeeded in interesting Charlemange Tower in the ore deposits on the Vermilion range near Tower. The first shipment of ore was made in 1884. In 1886 the whole property, including mines, railroad, docks, and land grant, was sold to the Minnesota Iron Co., and later, on the organization of the United States Steel Corporation, became a part of the holdings of that corporation. The first mine to be developed near Ely, 21 miles east of Tower, was the Chandler, which began shipping in the fall of 1888. Since then the Pioneer, Zenith, Sibley, and Savoy have been opened in what is known as the Ely trough. A new mine, called the Section 30, is being worked on another trough three miles east of Ely.

On the Missabe range, ore was discovered in the fall of 1890, near the present Mountain Iron mine, by the Messrs. Merritt of Duluth, and in the fall of the following year on the Biwabik property by the same men.

The Cuyuna range was located from the results of magnetic work done by Cuyler Adams about the year 1895. Very little was done, other than magnetic research work, until the year 1904, when the first drilling was started in Section 16, Township 46, Range 28, about a mile southeast of Deerwood. The first shipment of ore from the Cuyuna range was made in 1911 from the Kennedy mine.

Minnesota furnishes yearly about three-fifths of the iron ore produced in the United States, the shipments during 1912 amounting to 34,197,501 tons.

	Tons.
Missabe range	32,047,409
Vermilion range	1,844,981
Cuyuna range	305,111
Lake Superior district	48,221,546

Total iron ore produced to Jan. 1, 1913:

Lake Superior district		574,125,258
Minnesota:		
Missabe range	279,067,325	
Vermilion range	33,262,473	
Cuyuna range	452,542	
		312,782,340

*Compiled by W. W. J. Croze for Lake Superior Mining Institute.

Mine Production of Colorado in 1912, by Counties

By Charles W. Henderson, U. S. Geological Survey.

County.	Ore treated.	Gold.		Silver.	Copper.	Lead.	Zinc.	Total value.
		Placer.	Deep.					
	Short tons.			*Fine ounces.*	*Pounds.*	*Pounds.*	*Pounds.*	
Boulder	9,838	.....	$119,126	72,335	22,176	305,922	.....	$181,333
Chaffee	10,287	$4,619	92,870	104,686	133,570	992,578	736,392	279,387
Clear Creek	102,894	331	415,463	373,940	449,401	3,523,733	1,744,493	1,028,166
Costilla	.....	470	.....	3	.....	.....	.....	472
Custer	4,330	.....	15,898	25,426	2,006	10,444	.....	33,336
Dolores	8,185	.....	7,556	100,288	689,915	1,212,490	812,029	293,658
Douglas	.....	75	.....	.....	.....	.....	.....	75
Eagle	34,164	20	49,274	163,735	147,176	1,240,156	5,659,261	620,571
Fremont	1,015	.....	253	3,429	35,903	55,956	447,507	41,688
Gilpin	118,652	.....	904,505	316,205	1,025,770	1,351,600	25,377	1,330,796
Gunnison	14,046	651	124,676	29,035	8,097	306,867	483,881	191,717
Hinsdale	9,554	.....	6,811	34,722	53,739	1,257,800	11,926	94,456
Lake	507,591	.....	1,103,230	3,000,397	2,065,800	26,234,244	105,945,783	11,780,131
La Plata	2,761	.....	135,391	47,948	918	6,756	.....	165,334
Mesa	22	.....	9	257	5,685	20	.....	1,106
Mineral	66,488	.....	86,002	714,909	23,885	5,730,222	308,681	808,771
Moffat	64	4,432	.....	134	25,085	.....	.....	8,653
Montrose	.....	687	.....	10	.....	.....	.....	693
Ouray	89,975	.....	1,049,590	545,177	400,552	2,989,044	140,667	1,595,178
Park	2,696	19,223	48,758	31,234	10,321	167,756	132,275	105,569
Pitkin	91,791	.....	165	528,504	22,952	8,465,333	484,507	740,653
Rio Grande	133	.....	5,549	896	29,673	313	.....	11,010
Routt	.....	638	.....	16	.....	.....	.....	648
Saguache	9,159	.....	3,805	19,309	29,479	504,845	534,928	80,172
San Juan	140,917	.....	523,574	714,974	1,063,291	9,114,334	2,478,504	1,719,894
San Miguel	455,696	.....	2,399,234	1,153,709	845,497	7,429,622	2,943,783	3,785,726
Summit	46,606	392,739	33,276	164,665	16,412	4,402,422	9,342,725	1,372,749
Teller	849,172	.....	11,008,362	66,117	.....	.....	.....	11,049,024
Total, 1912	2,576,626	423,885	18,164,677	8,212,070	7,107,303	75,242,267	132,222,812	37,320,966
Total, 1911	2,377,936	319,759	18,682,216	7,330,168	8,024,488	69,679,289	94,607,456	32,418,218
Increase (+) or decrease (−), 1912	+198,690	+104,126	−517,539	+881,902	−917,185	+5,562,978	+37,615,356	+4,902,748

Mineral Production of Quebec

The total mineral production of the province of Quebec during the year 1912 reached a total value of $11,187,110, according to the 'Report on Mining Operations' by the Department of Colonization. These figures represent the revised compilation of the returns received direct by the Quebec Mines Branch from the producers. In the previous year the value of the products of the mines and quarries was $8,679,786. There is, therefore, recorded an increase of $2,507,324 for 1912, or a proportional increase of 28.9 per cent.

The collecting of mineral statistics is done as carefully as possible, and a list of producers of nearly one thousand names has been compiled. But it must be understood that, in spite of all the care exercised, the figures which are given are not complete, more especially as regards structural materials. The figures represent strictly the compilation of the figures received by the Quebec Mines Branch direct from the producers.

Only a small proportion of the metallic minerals enters into the total figures of the mineral production of the province of Quebec. In 1910 they only represented 2.16%; in 1911 this proportion increased to 3.17%, whereas in 1912 it reached 6.09%. This is insignificant when compared with Ontario, where in 1912 the metallic minerals made up 74% of the total mineral production of the province. As it was pointed out in the preceding report, practically the total mineral production of the province of Quebec is from the old settled portions of the province, but as the same geological conditions prevail in the northern part of Quebec as in northern Ontario, it is quite justifiable to foresee developments of the mineral industry in the northern parts of Quebec in the near future, owing in part to the active movement of railway construction which will open up vast areas. By the National Transcontinental, direct communication will soon be established between Quebec and the Abitibi region, and it is expected that within two years the North Railway will be open for traffic between James bay and the Transcontinental, following the valleys of the Nottaway and Bell rivers. It is true that the conditions in that part of the province are rather trying for the prospector. For, although the underlying rocks belong to Archean formations, which in other parts of Canada have proved mineral bearing, still it is a fact that all the region lying north of the height of land was at the close of the glacial period, submerged under an immense sheet of water in the bottom of which was deposited a heavy burden of clays, silts, and sands, which now cover the rocky floor of the ancient lake. However, the strong current of colonization which is now being directed toward these regions, which are eminently fitted for agriculture, will doubtless bring about mineral discoveries which will help to increase the proportion of metallic minerals produced in the province of Quebec.

Increasing the Capacity of Slime Thickeners

Slime settlement has received much study at Anaconda, and in the August *Bulletin* of the American Institute of Mining Engineers is an exhaustive account of the experimental work, by Ralph Hayden. Among other points of interest, he shows that the depth of Dorr thickeners can be greatly decreased without seriously lessening the capacity. For example, a 3-ft. tank has 85% of the efficiency of a 9.7-ft. tank when operating at 98% efficiency. Similarly, a 2-ft. tank has about 85% of the capacity of a 3-ft. tank. To take advantage of this situation in existing plants, the Dorr Cyanide Machinery Co. is furnishing trays for placing in tanks of the old style, whereby in one case an 85% increase in capacity was realized, with the same floor space and head room previously occupied.

Costs at the Hollinger mine, Porcupine, during the month ended August 12 were as follows (per ton):

Prospecting	$0.009	Plant alterations, etc.	0.041
Mining	1.557	Boarding-house, etc.	0.272
Development	1.300	Administration, general, etc.	0.628
Treatment	1.395		
Marketing bullion	$0.072	Total	$5.274

Oil production from shale in Scotland is about 250,000 tons annually, and is highly satisfactory as a fuel. The shales in New South Wales, Australia, yield about 120 gal. of oil per long ton subjected to distillation.

Electric blasting is to be used underground at the Meyer & Charlton mine on the Rand, as it has been proved that the fine dust and fume are greatly reduced.

Company Reports

RHODE ISLAND COPPER COMPANY

This is one of the Dow Michigan companies, formed in 1898, with a capitalization of $2,500,000. It is controlled by the Franklin Mining Co., which owns nearly all the shares. The property, 800 acres, adjoins the Franklin, Jr., and has been explored by diamond-drilling and underground work. The most promising ground is in depth, and exploration will hereafter be carried on from the deep levels of the Franklin. The treasurer's statement at December 31, 1912, shows that receipts from copper were $42,928 and other revenue $46,021, while cash on hand was $14.25.

HOUGHTON COPPER COMPANY

This Company, organized in 1910, is controlled by the St. Mary's Mineral Land Co., from which it bought the mineral rights to 160 acres lying between the Isle Royale and the Section 16 mine in Michigan. Out of 100,000 shares of $25 each, 67,000 have been issued, $5 paid, of which the St. Mary's company holds 37,228. The ground was explored by diamond-drilling and two copper-bearing beds found. The lode has been determined to correspond with the Superior, but where explored has so far proved rather irregular in copper content. A shaft has been sunk 623 ft., and a winze extends 200 ft." deeper, the best ore having been found in this winze. The general manager, L. L. Hubbard, has recommended sinking the shaft.

CONSOLIDATED GOLD FIELDS OF NEW ZEALAND, LIMITED

The Company was registered in 1896 to adopt an agreement made with David Ziman for the purchase of properties on the west coast of New Zealand. The property consists of the Wealth of Nations, Blackwater, and Progress mines. The capital is £300,000, in 299,999 ordinary shares of £1 each, and one founder's share of £1; 242,377 ordinary shares and the one founder's share have been issued and are fully paid. The founder's share takes 25% of the profits after 100% has been paid on the original capital. The report for the year ended December 31, 1912, shows that 10,936 tons from the Wealth of Nations yielded bullion valued at, exclusive of concentrate, £17,432, or 31s. 10.56d. per ton. The working expenditure was £11,719, or 21s. 5.19d. per ton. In addition to the tonnage milled, 7325 tons of sand was treated in the cyanide plant, and 59.5 tons of concentrate was obtained from current work. The ore reserves are estimated at 34,000 tons of an average value of 11 dwt., together with an additional 10,000 tons of ore partly developed. The total costs for mining, milling, general expenses, and bullion charges amounted to 21s. 5.19d. The Company's interest in the Blackwater Mines, Ltd., remains at 93,224 shares. The holding in the Progress mines remains at 169,943 shares. The revenue of the Company was as follows: gold from the Wealth of Nations mine, including £467 from gold reserve, £17,899; dividends on investments, rent, interest, and sundry receipts in New Zealand, £1936; a total of £19,835. The expenditure in New Zealand and London on mining and milling and general administration expenses, including special expenditure during strike, amounted to £16,638, leaving a balance of £3197. As the ordinary shareholders received dividends amounting in the aggregate to 100%, the founder's share is now entitled to receive 25% of the annual profits available for distribution, or equal in amount to one-third of all future dividends declared, and a final payment of £2019 has already been made thereon.

THE PROGRESS MINES OF NEW ZEALAND, LIMITED

The Company was registered in 1896 to acquire from the Consolidated Gold Fields of New Zealand, Ltd., a gold mining property covering 733 acres on the west coast of South Island, New Zealand. A coal area of 48 acres has also been acquired. A 40-stamp mill has been working since 1898, and 25 stamps since March 1900, making 65 stamps and cyanide plant now at work. The capital is £275,000, in 275,000 shares of £1 each; all the shares are issued and fully paid. The report for the year ended December 31, 1912, shows that 8770 tons of ore was milled. This yielded 2043 oz. of fine gold valued at £8650. The total ore cyanided was 9035 tons, yielding 754 oz. fine gold worth £3183. The whole product was worth £12,536. In addition, 92.82 tons of concentrate was produced, the estimated value after deducting returning charges being £1633. A loss of £2448 was made on the year's work, caused by the miners' strike.

THE BLACKWATER MINES, LIMITED

The Company was registered in 1906 to acquire from the Consolidated Gold Fields of New Zealand, Ltd., and the Progress Mines of New Zealand, Ltd., a gold-mining property at Blackwater, Reefton district, New Zealand. The capital is £250,000, in 250,000 shares of £1 each, all the shares being issued and fully paid. The report for the year ended December 12, 1912, gives the total ore mined as 12,847 tons, at a cost of 15s. 5.14d. per ton. Of this, 11,538 tons was milled. Following is a summary of the ore treated.

Owing to labor troubles, the working operations of the Company covered only a period of less than five months,

THE BLACKWATER, PROGRESS, AND WEALTH OF NATIONS PROPERTIES ARE AT REEFTON IN THE SOUTH ISLAND.

making a considerable increase in the cost per ton. One hundred thirty-two tons of concentrate was produced from current work, while 229.15 tons of accumulated concentrate was sold for a net return of £2170. The ore reserves are estimated at 71,905 tons, and, in addition, a further tonnage of 27,715 tons of only partly developed ore, making a total of 99,620 tons of an average value of 10.18 dwt. over 26 in. During the year, £28,750 was realized from gold, which with £141 for rent and sundry receipts in New Zealand makes a total gross revenue of £28,891. The total expenditure in New Zealand and London was £22,221, leaving a gross profit of £6670. Since the close of the Company's financial year, for the first six months of the current year 21,680 tons has been crushed, yielding gold to the value of £43,099, or equal to 39s. 9d. per ton, and showing a working profit of £20,559, or 18s. 11½d. per ton. This is sufficient to dis-

charge the outstanding liabilities at the end of the financial year, and, given normal conditions, it is anticipated that the payment of dividends will be resumed during the current half-year. The profit over revenue expenditure during 1912 was £7238.

BEAVER CONSOLIDATED MINES, LTD.

The report of this Cobalt company for the three months ended August 31 gives the following information:

Underground work, feet	1,083
Stoping, square yards	1,058
Operating profit	$40,000
Cash on hand	26,098
Due from smelters, ore on hand, net	127,910

The main shaft is down 800 ft. and a station was cut at this level. On the 460-ft. level there is ore in both drifts and stopes. This shoot is 3 to 4 in. wide on the 530-ft. level, and further cross-cutting opened a 2-in. vein assaying 1950 oz. per ton. No. 5 vein is now opened from the 200 to the 700-ft. level. A new hoist of 1500-ft. capacity and a 6-ft. mill have been ordered for the mine and plant, respectively.

WINONA COPPER COMPANY

This Company was organized in 1898 and has the usual Lake Superior capitalization of $2,500,000, in shares of $25, of which $11 has been paid in. The Company owns about 1600 acres and has timber rights over an equal area. There are four shafts on the Winona amygdaloid. During the year 181,148 tons of ore was milled, yielding 2,307,237 lb. of refined copper, or 12.74 lb. per ton. Experiments were made in regrinding the tailing in Hardinge mills. It was thus found that an additional recovery of 1.2 lb. copper per ton could be made. Three mills have been installed, and three more have been ordered, to be placed in tandem, it being thus hoped to save ½ lb. additional per ton. Development work in the mine is estimated to have opened a reserve of 240,000 tons of milling ore.

Expenditure during 1912 for mining, hoisting, rock-house, transportation, stamping, surface, office, and incidental, totaled $406,264.85. Diamond-drilling cost $239, and construction $23,036.12. Assets total $177,678 and liabilities $115,644.

ALGOMAH MINING COMPANY

This is one of the Dow properties, and was launched in 1910 with a capital of $2,500,000, of which $1,750,000 has been paid in, $1,500,000 in shares having been exchanged for the property, and 10,000 shares having been sold at $10. The property, 480 acres, is just south of the Lake mine, in the Superior region. Some diamond-drilling was done. The No. 6 hole discovered three promising beds of amygdaloid, and sinking the shaft is being continued, as it is proceeding in the direction of the hole. The Company lost nearly $29,000 by the failure of S. R. Dow & Co., and, with the other Dow companies, is now controlled by the United States Smelting, Refining & Mining Co. The statement of expenses at the mine for the year ended December 31, 1912, is as follows: mine work, $32,284, and office and taxes, $10,560.

The cost of diamond-drilling was $3.13 per foot, driving and cross-cutting cost $9.09 per foot. The assets of the Company are given as $616,836 in real estate and improvements, general expense account $165,463, and cash assets sufficient to bring the total to $788,633.49.

PRINCE CONSOLIDATED MINING & SMELTING CO.

This Company operates near Pioche, Lincoln county, Nevada, and the report covers the past fiscal year. The manager, A. Y. Smith, stated on August 15 that underground work had covered 3775 ft. at a cost of $5.90 per foot. The mine is in excellent condition, and extraction of ore can be conducted for a considerable time with little development. From an area of 1052 sq. ft. there was shipped 86,428 tons of ore, and there is 10,977 tons in the stopes, this making 10.8 cu. ft. of ore per ton in place. A 50-hp. hoist has been installed. The railroad from the mine to Pioche, 9.71 miles, gave satisfactory service. Diamond-drilling from No. 6 level has proved a large sulphide zone below water-level. The Company has a contract with the International Smelting & Refining Co. at Tooele, Utah, for daily ore shipments of from 150 to 250 tons. Trial lots were sent to the United States Smelting, Refining & Mining, and American Smelting & Refining companies' plants in Utah, but returns from the Tooele plant were the most satisfactory. To this plant was sent 39,544 tons of ore averaging silver, 2.66 oz.; lead, 3.01%; iron, 29.68%; lime, 6.41%; manganese, 11.07%; and insoluble, 13.46%. The net smelter return was $2.63 per ton. From early milling operations at Bullionville and Dry Valley, about 12 and 6 miles from Pioche, respectively, 220,000 tons of tailing remained. Part of this was concentrated and 50,000 tons shipped to Salt Lake smelters. It is estimated that there is 100,000 tons of tailing available for local treatment at a net profit of about $350,000. The net profit for the year from all sources was $58,860, less $25,394 depreciation.

OTAVI MINES & RAILWAY COMPANY

The Company was formed in Berlin, in 1900, in accordance with an arrangement with the South West Africa Co., Ltd., the Direction der Disconto Gesellschaft of Berlin, and the Exploration Co., Ltd., to develop the mineral and railway rights in the territory of the South West Africa Co., Ltd., and took over from that Company 1000 square miles of mining rights and 500 square miles of freehold land in the Otavi district of German Southwest Africa. A railway from Swakopmund, in the mining district of Tsumeb, was finished in August 1906, and in 1910 was sold to the German government for 22,000,000 marks. The Company has leased the line for ten years with the option to extend the lease for a further twenty years. The Tsumeb copper mine is being opened, and the Company has interests in the Otavi Exploring Syndicate, Ltd. The capital is 4,000,000 marks, divided into 200,000 fully paid shares of 20 marks, or $4.80 each; all the shares are issued and fully paid. There are also 200,000 deferred shares of no face value. The report covering the period from April 1, 1912, to March 31, 1913, gives the amount of ore raised at 54,100 tons. Of this, Tsumeb accounted for 52,200 tons, that is, 11,200 tons in the open workings and 41,100 tons at depth. The cost price of the ore has been reduced to about 20 marks per ton. Extensive trials in Germany, made with a view to dressing by wet mechanical process the ore from the eruptive body, which had so far been left in the mine as worthless, have been entirely successful, even the results from the poorest part of the eruptive body were satisfactory. A dressing plant has been ordered to treat at the start a daily quantity of 50 tons of eruptive ore. The Otavi Valley mines gave 1900 tons. Shipments totaled 44,500 tons, with average contents of 13% copper, 25% lead, and 230 gm. silver per ton. The lower metal content of the ore, compared with the previous year, is explained by the shipment of the 8000 tons of low-grade ore which had been lying on the dump at Tsumeb. An occurrence of mottramite was discovered at Tsumeb-West, from which about 200 tons of copper and lead-bearing vanadium ore containing on an average about 10% vanadium oxide was mined and shipped. The Otavi Exploring Syndicate shipped a first lot of about 500 tons copper and lead ores from Asis-East, and about 35 tons high-grade tin ore from various tin properties. The smelter was at work for only 112 days, as the quality of the Tsumeb ores and favorable metal prices made it possible to export a larger proportion. The productions amounted to 655 tons of copper matte, with an average content of 48% copper, 25% lead, and 440 gm. silver per ton; and 400 tons metallic lead, with average contents of 98% lead and 910 gm. silver per ton. The smaller proportion of metallic lead to copper matte, compared with the previous year, is due to the fact that a larger part of the galena was sold at the favorable prices then ruling, and pyrite was used instead of the galena to supply the sulphur required in smelting. The net profit for the year was 3,820,310 marks, 36 pf. A dividend of 5%, equal to 1 mark per ordinary share, on 4,000,000 marks, amounted to 200,000 marks. Seven marks super-dividend per ordinary share amounted to 1,400,000 marks, and 7 marks per deferred share to 1,400,000.

Concentrates

Most of these are in reply to questions received by mail. Our readers are invited to ask questions and give information dealing with the practice of mining, milling, and smelting.

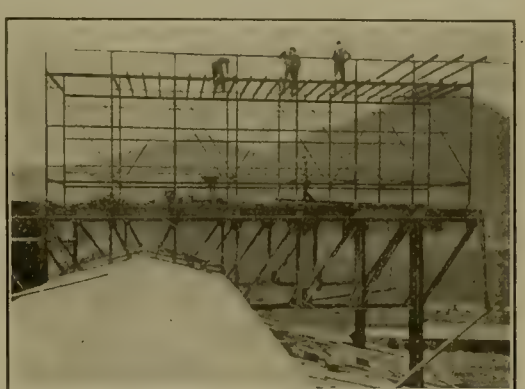
In sampling cakes at the Waihi filter plant, the sample is taken from every basket and every other leaf of each basket throughout the 24 hours. The samples from each unit of the plant are reduced by cutting and the three bulked together, the final weight of sample being about 20 lb. This is wrapped in clean filter-cloth and squeezed between two vertical iron plates by screwing-up bolts. The solution squeezed out is caught and 20,000 gr. assayed by evaporation (over water bath) with litharge. The squeezed sample is then further reduced, thoroughly broken up in water by hand, washed by decantation, and assayed in triplicate, 1000 gr. being taken for each charge.

Wood-stave pipe of 4-ft. diam. and about one mile long is being constructed for a hydro-electric scheme in Tasmania. There will also be three-quarters of a mile of steel pipe. The source of the power, 40,000 hp., is the watershed of the Great Lake, which has an area of 210 square miles. Turbines will drive three-phase alternating generators, producing 6600 volts, which will be stepped up to 88,000 volts for transmission over 60 miles to Hobart over aluminum lines. The towers will be similar to those used in the United States. Power will be used for making calcium carbide and will be sold to numerous factories. The total cost of the plant will be nearly $3,000,000.

Lindley's definition of mineral land may be stated as follows: "The mineral character of the land is established when it is shown to have upon or within it such a substance as is recognized as mineral, according to its chemical composition, by the standard authorities on the subject, or is classified as a mineral product in trade or commerce, or such a substance as possesses economic value for use in trade, manufacture, or ornamental arts, and it is demonstrated that such substance exists therein or thereon in such quantities as to render the land more valuable for the purpose of removing and marketing the substance, than for any other purpose, and the removing and marketing of which will yield a profit, or it is established that such substance exists in the land in such quantities as would justify a prudent man in expending labor and capital in the effort to obtain it."

Precipitation of gold from cyanide solutions on zinc wafers, as devised by J. S. MacArthur and details published in the *Mining and Scientific Press* of March 15, 1913, has recently been tried at the Waihi mills, New Zealand, and the City & Suburban mill on the Rand. In the first instance, the trays in a zinc box of eight compartments were covered with three inches each with wafers. Solutions entering the box assayed gold 4 dwt. and silver 32 dwt. per ton, the strength being 0.023 to 0.07% KCN. The result of a number of tests, according to J. H. G. Banks, showed the extraction to be 50 and 65% of the gold and silver, respectively, against 95 and 99% by ordinary zinc-shaving precipitation. At the Rand property, according to E. G. Baskett, in the *Journal* of the Chemical, Metallurgical, and Mining Society of South Africa, four compartments of a zinc box were filled to a depth of 3½ in. with wafers, and three compartments filled with zinc shavings, the eighth cell, between the wafers and shaving, being left empty, but fitted with a sampling tap. The solutions assayed from 0.97 to 1.11 dwt. per ton and tested an average of 0.056% KCN. Extraction varied from 31 to 37%. White precipitate on the wafers hindered precipitation. The zinc shaving in the lower cells gave 94% extraction. Tests with stronger solutions gave an average of 32% recovery.

Dust from roasting, reverberatory, and blast-furnaces, and kilns at cement works, may be greatly reduced by means of the Cottrell electrical precipitation process. At the Riverside Portland Cement Co.'s plant at Crestmore, California, this process is in successful operation, and the following notes were supplied the *Riverside Daily Press* by the Western Precipitation Co., of Los Angeles, which controls the patents. The work was begun in 1900, and although the final improvements have not been applied to the whole dust-catching plant, yet results recently obtained on part of the apparatus show remarkable efficiency. The dust-treating plant has now been in steady operation since January last, and from the splendid results obtained, it would seem as if the dust troubles of the Riverside Portland Cement Co. are practically over. For various reasons it was judged by the Company's engineers to be desirable to place the dust-treating apparatus on top of the existing stacks. Each kiln has a separate double treater, entirely independent from others, thus, should it become desirable for any reason to shut down one-half of any individual treater, the whole volume of gas and dust can be passed through the other half, or any kiln and its treater be shut down without affecting the rest of the treating system. Each half treater is rectangular in shape, 14 ft. high by 12 ft. wide by 35 ft. long. The treater boxes contain a system of discharge and collecting electrodes, between which flows a constant discharge of approximately



BUILDING FRAMEWORK FOR COTTRELL PRECIPITATING APPARATUS AT RIVERSIDE CEMENT WORKS.

60,000 volts of uni-directional electric current. To obtain this high voltage it is first necessary to step-up the alternating current entering the electrical apparatus at 220, to 60,000 volts, then, by means of a special rectifying machine, change this 60,000 volts of alternating current to 60,000 volts of direct current. All the high-tension wires are enclosed in screen cages, and it might here be mentioned that there never has been an accident of any kind due to careless handling of this high-tension current. The dust-laden gases enter the Cottrell treater without previous cooling, at about 325°F. and at nearly 4000 ft. per minute velocity. This means that it takes about three seconds for a unit of gas to pass through a treater, and during this three seconds the dust is precipitated by electrical means and left behind, the gases escaping through an outlet stack free from all solid particles. Once each hour the treaters are cleaned by mechanical devices, the collected dust, falling into hoppers, being weighed on automatic scales and conveyed to bins, where it is available for shipment as fertilizer or other uses. The only color showing at the outlet stacks is that of the smoke from the burning oil and minute quantities of potash, which leave the stacks as gases, condensing after they meet the colder outside air. This potash, largely soluble in water, is of the same chemical composition as the high-priced fertilizing potash purchased by all orange growers. Measurements show that each kiln stack delivers to its corresponding treater over 5,000,000 cu. ft. of gas per hour, carrying about 700 lb. of dust, or a total of over 90 tons of dust per 24 hours for the whole plant. The 90 tons of dust sold as fertilizer or asphalt filler brings in a revenue more than sufficient to pay for the entire operating costs of the Cottrell treaters, including electrical energy, labor, depreciation, and interest on the investment.

Recent Publications

DULUTH AND THE MINNESOTA IRON RANGES. Compiled and arranged by W. W. J. Croze for the Lake Superior Mining Institute, eighteenth annual meeting, August 1913. P. 70. Ill. Duluth, Minnesota.

THE WEATHERING OF ABORIGINAL STONE ARTIFACTS, No. 1. A consideration of the Paleoliths of Kansas. By N. H. Winchell. Minnesota Historical Society. Vol. XVI, part I. P. 186. Ill., map, index. St. Paul, Minnesota, 1913. Those interested in the study of the antiquity of man will find interesting material in this well arranged if somewhat technical volume.

REPORT ON MINING OPERATIONS IN THE PROVINCE OF QUEBEC IN 1912. Compiled by Theo. C. Denis, superintendent of mines. Mines Branch publication. P. 241. Ill., maps, index. Quebec, 1913. A preliminary statement was published in February, and the present volume gives final figures, and reports on the field work done during the summer of 1912. The total value of all minerals produced during 1912 was $11,187,110, an increase of $2,507,324 on that of 1911. The geology and natural resources of the Harricanaw and Nottaway river districts is discussed in detail.

Washington Geological Survey, Olympia, 1913:

BIBLIOGRAPHY OF WASHINGTON. GEOLOGY AND GEOGRAPHY. By Gretchen O'Donnell. Bulletin No. 12. P. 63. Index.

GEOLOGY AND ORE DEPOSITS OF THE COVODE MINING DISTRICT. By Charles E. Weaver. Bulletin No. 16. P. 87. Ill., maps, index. This report deals with the district lying south of the Colville Indian reservation, in Ferry county.

United States Geological Survey publications, Washington, 1913. Advance chapters from Bulletin 531, Contributions to 'Economic Geology,' 1911, part II:

THE CERRILLOS COAL FIELD, SANTA FE COUNTY, NEW MEXICO. By Willis T. Lee. Bulletin 531-J. P. 30. Maps.

COAL IN TERTIARY LAKE BEDS OF SOUTHWESTERN MONTANA. By J. T. Pardee. Bulletin 531-G. P. 20. Maps.

COAL RESOURCES OF THE COWLITZ RIVER VALLEY, COWLITZ AND LEWIS COUNTIES, WASHINGTON. By A. J. Collier. Bulletin 531-L. P. 12. Map.

RECONNAISSANCE OF THE BARSTOW-KRAMER REGION, CALIFORNIA. By R. W. Pack. Bulletin 541-E. P. 16. Map.

Advance chapters from Bulletin 540, Contributions to 'Economic Geology,' 1912, part I:

PRELIMINARY REPORT ON THE RED IRON ORES OF EAST TENNESSEE, NORTHEAST ALABAMA, AND NORTHWEST GEORGIA. By Ernest F. Burchard. Bulletin 540-G. In coöperation with the Tennessee State Geological Survey. P. 54. Maps.

POTASH IN WESTERN SALINE DEPOSITS. By James H. Hance. Bulletin 540-P. P. 15.

A GEOLOGIC RECONNAISSANCE OF THE FAIRBANKS QUADRANGLE, ALASKA. By L. M. Prindle. With a detailed description of the Fairbanks district by L. M. Prindle and F. J. Katz, and an account of lode mining near Fairbanks by Philip S. Smith. Bulletin 525. P. 220. Ill., maps, charts, index.

Bureau of Mines publications, Washington, 1913:

THE INFLUENCE OF INERT GASES ON INFLAMMABLE GASEOUS MIXTURES. By J. K. Clement. Technical Paper 43. P. 24. Ill.

THE PRODUCTION AND USE OF BROWN COAL IN THE VICINITY OF COLOGNE, GERMANY. By C. A. Davis. Technical Paper 55. P. 15.

MINING AND TREATMENT OF FELDSPAR AND KAOLIN IN THE SOUTHERN APPALACHIAN REGION. By A. S. Watts. Bulletin 53. P. 171. Ill.

SANITATION AT MINING VILLAGES IN THE BIRMINGHAM DISTRICT, ALABAMA. By D. E. Woodbridge. Technical Paper 33. P. 27. Ill.

THE TITANIFEROUS IRON ORES IN THE UNITED STATES; THEIR COMPOSITION AND ECONOMIC VALUE. By J. T. Singewald, Jr. Bulletin 64. P. 145. Ill.

RULES FOR MINE-RESCUE AND FIRST-AID FIELD CONTESTS. By J. W. Paul. Miners' Circular 15. P. 12.

The Bureau of Mines has copies of these publications for free distribution, but cannot give more than one copy of the same bulletin to one person.

MINING AND TREATMENT OF FELDSPAR AND KAOLIN IN THE SOUTHERN APPALACHIAN REGION. By A. S. Watts, U. S. Bureau of Mines. Bulletin 53, Mineral Technology No. 1. P. 170. Ill., maps, index. Washington, 1913.

Machinery Trade in Switzerland

The total exports of Swiss machinery in 1912 amounted to $17,773,341, and in the preceding year were only $16,092,557, showing that 1912 was a prosperous period for the machine manufacturers. The industry is centred in the Zurich district, and there are several large and well known concerns, such as Sulzer Bros. and the Swiss Locomotive Works, at Winterthur; Escher, Wyss & Co., of Zurich; Brown, Boveri & Co., of Baden; and the Oerlikon Machine Works, at Oerlikon-Zurich. The first-named company manufactures Diesel oil-engines, the second makes all of the locomotives used on the Swiss state railways. Escher, Wyss & Co., and Brown-Boveri are important manufacturers of large turbines of various kinds and machinery for hydro-electric plants. All of these firms report a favorable business year during 1912, and the Oerlikon firm especially has been benefited by the movement toward the complete electrification of the federal railways. They are manufacturers of electric locomotives, and during the past year have constructed those for use on the new Loetschberg-Simplon route to Italy, upon which electric traction will be employed. These locomotives weigh 112 tons complete, and contain two motors of 3000 hp., weighing 27 tons each. The cost of construction is about twice that of an ordinary steam-engine, being about $40,500.

The principal machinery exports from this district are electric dynamos, gas and oil engines, milling machinery, hydraulic machinery, and steam-engines. It is estimated that nearly three-fourths of the total exports of machinery from Switzerland come from this district. Exports of machines and parts thereof from Zurich to the United States in 1912 were valued at $91,978, as compared with $54,052 in 1911. Included in this amount were several shipments of adding and calculating machines and of ball-bearings, the trade in which seems to be increasing.—*Daily Consular Report.*

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Sworn to and subscribed before me this twenty-fourth day of September, 1913. HENRY B. LISTER,
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EDITORIAL

QUESTION as to the relative merits of the 'Giants' and 'Athletics' has for the time being taken precedence over the less important Mexican and Japanese problems, currency reform, income tax, and other minor subjects of debate.

NOW that the new tariff schedule has gone into effect and the high-cost-of-living question relegated to the past, we can only hope that the contemplated currency reform will make two dollars appear where there was formerly but one. However, as the proof of the pudding is in the eating, bank books, when balanced a year from now will be the real criterion whereby the wisdom of our reformers may be judged.

RECENT concessions granted by governments of Colombia and Ecuador to S. Pearson & Son for the privilege of prospecting for oil throughout these countries, marks the establishment of another important enterprise in Latin America. While the project is speculative in nature, oil has been produced in Ecuador, and the history of Lord Cowdray's Mexican enterprises permits an optimistic attitude toward this, the latest of his ventures. A field force is already at work in Colombia, we understand, under the capable direction of Mr. A. C. Veatch.

NOME, the sturdy little city of the Far North that has contributed so much to the world's stock of gold, suffered a most severe disaster in the great storm that swept the beach last Sunday. Details are few as yet, but such as are available are given in our news pages. While the city itself lost much, and prompt action is necessary to prevent hardship due to destruction of food supplies, but two dredges, the Roberts and the Sioux-Alaska, are reported seriously injured. Mining on the beach itself is no longer important, as the hydraulic mines and most of the dredges are back some miles from the shore. Our sympathy goes out to the men of the North, but they are of too plucky stock to be more than temporarily discouraged even by the fiercest of storms.

COMPLETE presentation of the oil resources of California in a single volume is promised by work just undertaken by the State Mining Bureau, Mr. F. McN. Hamilton, the state mineralogist, having arranged for Mr. R. P. McLaughlin to devote a year to the task. The geology of the individual fields has been elaborately studied by the United States Geological Survey, and technical features of oil production in the state have been described by the Bureau

of Mines and numerous writers in *Western Engineering*, and other technical journals. We present this week an admirable though brief review of present production, written by Mr. J. H. G. Wolf, and it is a type of the excellent papers written by many engineers connected with the oil industry. There is, however, a real need for a general summary volume, and Mr. Hamilton is to be congratulated on taking such effective means to meet this need.

AT this time of the year the movement of gold is away from the great financial centres, and some uneasiness is expressed by the hoarding tendency of India and the present status of gold in Brazil and Egypt. The shipments of gold to Egypt, in view of the present price of cotton, will approximate £10,000,000, according to advices from London. From Brazil there is reported a shortage in note currency due to the export of sovereigns. The new Minister of Finance is said to be determined to sell the Dreadnaught, which is being constructed in England, in order to direct the exportation of gold to Brazil. The Indian financial question is considered by some British bankers as the most pressing of their problems, and the enormous drain of gold in that direction is one of the worries of the bankers of the world. A royal commission was appointed some time ago to inquire *inter alia* into complaints from the Indian business community that under the present system the government is taxing India unnecessary to keep large balances in London. The committee reports that the balances are no larger than needed to meet the payments on revenue and capital account. The commission urges that the gold standard reserve be kept where it would be needed if the exchange were in jeopardy, that is in London. It is also proposed to establish a state or central bank to act as banker for the government balances in India, manage the paper currency, and participate in the sale of drafts on India for meeting the government requirements in London. The consensus of opinion is against any organized effort to force a gold currency on India, by the free coinage of gold at an Indian mint or otherwise, as it is believed that such a coinage would be absorbed in jewelry and hoards, and enough is flowing into these channels at the present time.

REVISION of the mining law is proposed on many sides and serious work toward shaping that revision is under way. From the first meeting of the American Mining Congress the resolutions committee has always had before it a number of definite complaints and of proposals for revision. Eventually a special committee was appointed to consider the subject, and of this, Mr. E. B. Kirby is the active and efficient chairman. In a report made in 1911, and printed in the *Mining and Scientific Press* on October 28 of that year, a number of the points in the United States mining law that required change were listed and a demand for a general consideration of the subject by a commission or otherwise as Congress might elect, was presented. The next national organization to take up the matter was the Mining and Metallurgical Society, and we print this week the report of a committee, consisting of Messrs. H. V. Winchell, C. W. Goodale, and M. L. Requa, which has studied the subject for nearly two years. It will be noted that this committee also concludes that the time has come for a thorough re-study of the law and has reached definite conclusions as to certain points that need change. This report is now before the members of the Society for vote, and we purpose at another time to discuss in detail certain of the particular recommendations. A third organization, the American Institute of Mining Engineers, has just taken steps looking toward joining in this movement, in that a committee on mining law has been appointed, with Mr. H. V. Winchell as chairman, Mr. John W. Finch secretary, and an excellent and authoritative membership. We understand that it is proposed to devote the February meeting of the Institute to discussion of questions raised by this committee. We are firm believers in the need of many changes in the mining law. Just how many and what they should be are proper subjects for differences of opinion, and we shall be glad to hear from our readers, especially those who disagree with the conclusions of the committees. We would not arrogate to ourselves all wisdom, and it is just as well that at times the voice of the standpatter should be heard in the land.

Educating the Public Regarding Mining

Horse shows, automobile shows, electrical shows, cement shows, all these have come to be annual features of the life of many of our great cities. The county fair, devoted at least ostensibly to development of agriculture, is the great yearly event at thousands of county seats, and the larger and grander state fair each autumn brings crowds of the curious to capitals. Nearly every business pursued in the United States is annually brought to public attention through exhibitions of some sort—nearly every business save the ancient and honorable pursuit of mining. That alone of the important industries of the country has neither a great permanent, nor an established annual, exposition devoted to informing its followers of improvements in the art, and to educating the public to the importance of the industry. So accustomed is the public to this state of affairs that few have noted the absence of mining exhibitions. In years gone by Ottumwa in Iowa supported a 'coal palace,' and it served a useful purpose in that it taught the farmers of that great state that mineral, as well as agricultural, wealth forms a basis for the prosperity of a community. In other cities spasmodic attempts have been made to attract public attention to mining, and in the public and school museums there may usually be found by a persistent visitor, hidden behind geographic models, cases of natural history specimens, the usual wealth of old armor, and the inevitable spinning wheel of our foremothers, a dusty and often inaccurate model of a mine or mill. This is hardly the way to educate the great general public to a sense of the importance and dignity of one of the basic industries of civilization, and it is not surprising that mining suffers greatly from public ignorance and misapprehension. In a country of varied industries and popular law-

making, each individual business must work under laws framed by people a majority of whom are ignorant of it. A mining man is so rarely a member of any legislative body that such a one is apt to be pointed out to visitors as one of the curiosities of the chamber, and he is always hopelessly in the minority. It is not surprising that there is loud complaint of discrimination against mining by taxing bodies, though it is anomalous that in Colorado, the home of so many mines, the legislature should pass a law providing for assessment of mining property at its full cash value, plus one-half the gross output, plus all the net for the previous year! Such a basis of taxation applied to farms would produce a revolution.

Laws equally discriminatory have been enacted and are now enforced against mining in other states, and the mining men are largely to blame. They have been persistent in the excellent matter of attending to their own business, but have done this too narrowly. They have forgotten that in a democracy no industry can prosper unless there is a healthy and informed public opinion regarding it. Up to the present the fake promoter, the peddler of ten-cent shares based upon a hole in the ground and a whole lot of regardless optimism, has been the only one willing to spend money even to misinform the public about mining. It is because of this that mines are foolishly regulated, inequitably taxed, and "nobody can raise money for a prospect without lying about it." Is it not time to call a halt?

One of the best features of the work the American Mining Congress has done, and it has several to its credit, is the persistent effort that it makes to give the general public correct ideas about mining. In conducting this work the officers of the Congress have this year brought into service a new agency, in that provision has been made for a mining show at Horticultural Hall, Philadelphia, in connection with the annual meeting of the Congress, October 17 to 25. We understand that the available space was promptly taken and that an excellent exhibition is assured. No doubt there will be many things to be seen that will be of interest and value to mining men themselves; the more so since from the situation the exhibits are likely to be especially strong in all that relates to coal mining, and Western metal miners have much to learn from their associates in the East who work at the prosaic but necessary task of digging the coal that forms 'the mainspring of civilization.' If, however, there was nothing shown that was of direct benefit to the mining men, such an exhibition would be distinctly worth while. It will be seen by thousands who have never had any independent means of forming a correct estimate of mining, and these thousands none the less, in one way or another, exert an influence upon the conditions under which mining must be conducted. Supplemented as this exhibition will be by the presence of hundreds of mining men, and by the active discussions of the Congress itself, the total influence toward sound thinking in mining matters is bound to be important. Mining men should get away from thinking of exhibits, whether at such an exposition as this or at the Panama-Pacific, as merely opportunities for manufacturers to show goods; they must not measure the value to them of such organizations as the Mining Congress by the papers they read and the ideas they receive. They must learn to look upon these agencies as means of educating the public. If the general public realized the actual conditions under which bituminous coal mining is now conducted, the laws would be promptly changed; if the fact that mining involves liquidation of capital was properly appreciated, tax laws would be better framed; if there were a more general ability to measure the risks and rewards of mining, there would be less money foolishly wasted and dishonestly appropriated, and more capital for legitimate development. The key to all this is education of the public, and in this great work the American Mining Congress is playing an honorable part.

The Rand Banket

By T. A. Rickard.

With this issue we begin the publication of a series of articles, constituting a comprehensive treatise, on the great ore deposits of the Witwatersrand, in South Africa. The author is Mr. C. B. Horwood, an Associate of the Royal School of Mines and a graduate in science from the University of London. In addition to his scientific training, Mr. Horwood brings to his task the essential qualifications of observation and experience underground in the mines that now contribute 40% of the world's annual production of gold. He has served his apprenticeship as assayer, sampler, surveyor, shift-boss, and underground superintendent, passing finally from these minor posts to that of general manager of a large property. His last appointment on the Rand was as joint manager of the Randfontein Central group of mines. Thus he is fully qualified for the work he has taken in hand. Indeed, it is our opinion that to such men, familiar alike with the tenets of science and the teachings of observation, we must look for illumination upon the many problems that obscure the genesis of ore deposits. Deduction from principles must be checked by induction from facts. Spencer said that Huxley's idea of a tragedy was a beautiful theory killed by an ugly fact. Many are the tragedies so enacted since the conglomerate lodes of the Rand came into prominence. Nor has the scientific drama lacked such touches of comedy as are inherent in the human approach to Nature's secrets. Before the curtain is lowered we may hope to see and hear further duels between brutal facts and iridescent theories, for we expect that Mr. Horwood's latest contribution to a fascinating subject will be followed by a discussion on the part of the many authoritative writers whom he quotes so conscientiously. Among these are Messrs. George F. Becker, J. S. Curtis, E. T. Mellor, A. R. Sawyer, L. De Launay, J. W. Gregory, F. H. Hatch, George J. Corstorphine, R. B. Young, S. J. Truscott, and H. F. Marriott. In making reference to lateral questions arising from the immediate subject, Mr. Horwood quotes from writings familiar to our readers, particularly those of Messrs. James F. Kemp, Waldemar Lindgren, Franz Posepny, Malcolm Maclaren, C. R. Van Hise, S. F. Emmons,

J. H. L. Vogt, R. W. Raymond, R. K. Duncan, and F. W. Clarke. In other words, this study of the 'banket' has been undertaken in a scholarly manner. Incidentally, Mr. Horwood refers frequently to his own previous writings, which, in effect, are summarized and brought up to date by this, his latest and most finished, contribution.

By way of introduction to Mr. Horwood's treatise, we may be permitted to give a brief outline of the general geologic conditions on the Rand, as we have inferred them from the literature of the subject. The White Waters Range or Witwatersrand is a low ridge marking the northern edge of a big syncline, the major axis of which runs east and west. Sedimentary rocks, consisting of quartzite, conglomerate, and shale, are found dipping southward, at first steeply near the surface and then flatly as depth is attained. These constitute the Witwatersrand system, the age of which is pre-Cambrian or Algonkian. It is overlain by patches of coal measures and by dolomite. Among the beds of the Witwatersrand system are several composed of conglomerate in which gold exists in such proportion as to make the rock economically valuable. The chief group of gold-bearing conglomerate is called the Main Reef series. Whatever the origin of the gold, that of the conglomerate or 'banket' in which it now lies is not open to dispute. It is part of a marine deposit accumulated along a subsiding shore modified by east and west currents. The quartzites exhibit ripple markings, indicating periods of shallow water. The pebbles of the conglomerate vary in size from a plover's to a goose's egg; they consist mainly of quartz; but they also represent rounded fragments of the rocks from which that quartz was derived. It would appear that the ancient land, of which these consolidated sediments represent the wreckage, was crossed by numerous veins of quartz and by porphyritic granite rich in quartz. The pebbles are imbedded in a matrix composed mainly of sand cemented by pyrite and secondary silica. The gold lies chiefly in the matrix, and is closely associated with the pyrite. More cannot be said without trespassing on debatable ground. It remains only to add that by the subsequent elevation of these sedimentary deposits and the later bending of the strata, they were upturned. This plication, ending in the formation of a big syncline, is connected with the intrusion of diabase and other geologic changes of a profound character. In the end the upturned edges of the conglomerate were found outcropping at a steep angle, and by mine openings it was ascertained that the dip flattened gradually to 20° at a depth of from 3000 to 4000 feet. This flexure was accompanied by fracturing, now expressed by faults, and was followed by the injection of igneous matter, now appearing as dikes of diabase. Thus far we may go without protest from either side in the great debate that has ensued concerning the origin of the gold in the conglomerate. We now return to Mr. Horwood's presentation of the case.

In his first article, Mr. Horwood states the purpose of his writing. He furnishes a concise description of the general structural conditions modifying the local geology of the Rand. In doing so, he indicates his line of approach to the investigation, which immediately takes him to the lode theory of the deposits as against the placer idea. In one of his earliest paragraphs we find mention of the shale beds that limit the diffusion of the gold in the conglomerate series. A preliminary reference to the dikes, illustrated by a beautiful photograph, will prepare the reader for the implied participation of thermal activity in the precipitation of the gold within the interstices of a porous rock. The concomitant faulting, also clearly illustrated, further opens the eyes of the student to an appreciation of the structural complications involved, and prepares him for a logical line of argument such as has served elsewhere to explain the formation of orebodies. Then comes the key to the whole problem, as viewed by our author. In the nodules of pyrite he finds his clue. These so-called pebbles of pyrite have caught the eyes and excited the scientific imagination of successive observers. Messrs. Becker and De Launay considered them to be water-worn fragments or real pebbles. Later observers, such as Mr. Ernest Schwarz, Professor R. B. Young, and Mr. Horwood himself have combated this view successfully. In the present paper, our author gives abundant evidence in support of his case, namely, that these 'pebbles' are metasomatic concretions and replacements. In his second article he quotes examples studied by him in great detail, both underground and with the microscope, from the Crown Reef, Rietfontein, and Randfontein mines. Many fine photographs are included in his evidence. Of these the pyritic pellets of the Buckshot Reef are the most remarkable. They show how the original matrix of the 'banket' has been replaced, not always completely, by the pyrite, films of which also have been detected lining minute cracks that pass through both the matrix and the pebbles of the conglomerate. Another point, vital in economic geology, is illustrated, namely, the observed tendency of the gold to be concentrated with these pyritic nodules. Indeed, the association of gold with iron sulphide is a far-reaching observation, for it prepares the way for the further evidence, in the third article of this series, indicating that thermal activity came in the wake of such eruptive action as is represented by the diabase dikes, especially those that have intruded along the strike of the sedimentary strata. The circulation of mineral solutions, thus stimulated, has been modified by structural conditions typified by the shale, which, by confining the precipitation of the gold within recognizable limits, has induced a concentration that resulted in the formation of orebodies having great economic value. This thesis is further elaborated and confirmed in the succeeding articles, on which we defer comment. Enough has been said to suggest the great interest of this latest presentation of the banket problem. We hope that the usefulness of it may be further enhanced by discussion involving criticism both penetrating and polite, such criticism as evolves light rather than heat; light to illumine those dark places underground where the miner seeks with unwearied persistence not only for gold and silver but for the more precious knowledge that shall aid the generations yet to come in their search for the metallic implements of our material civilization.

The Rand Banket and Its Gold Content—I

By C. B. Horwood

Introduction

The object of this paper is first of all to describe the mode of occurrence and origin of the pyritic replacements found in the gold-bearing conglomerates or 'bankets' of the Witwatersrand, in the Transvaal province of the Union of South Africa. For the benefit of those unacquainted with the Rand, a brief account is given of these conglomerates and the formation in which they occur. The most remarkable of the replacements are the so-called 'pebbles' of pyrite; and it is therefore with these that the first part of this paper chiefly deals. This necessarily involves a study of the structure of the 'pebbles',[1] and of the whole subject of replacement, or metasomatism, which recently has been so ably elucidated by Waldemar Lindgren.[2] Incidentally, it becomes necessary to enter somewhat fully into the question of concretions, and also that of the shape of these 'pebbles.' Then, the consideration of their origin introduces other subjects, such as the retaining influence of underlying shales and the close association between the occurrence of the pyrite 'pebbles' and high gold contents. These again lead us to consider the distribution of the gold, and, as they also have an important bearing on the genesis of the pyrite and gold in the banket, this final phase of the subject is somewhat fully discussed.

Occurrence and Description of the Auriferous Conglomerate.

The auriferous conglomerates, or 'reefs',[3] of the Rand occur in the Witwatersrand system, which covers an area of over 1600 square miles in the southern Transvaal, and is also developed to a small extent in certain parts in the north of the Orange Free State. This system is underlain, unconformably, by the Swaziland system and by the Basement, or Old Grey, granite of South and Central Africa. Above, and separated from it by another unconformity, are the volcanic rocks of the Ventersdorp system. The accompanying section, Fig. 1, from the Magaliesberg hills through Johannesburg and the ancient synclinal valley of the Witwatersrand and continued through the Nigel district, illustrates the succession of the strata from the Old Granite upward through the Witwatersrand and Ventersdorp systems and then through the Black Reef, Dolomite, and Pretoria series of the Potchefstroom system.

Witwatersrand Rocks

The Witwatersrand rocks are composed of sediments fully 20,000 ft. thick, consisting of metamorphic and highly indurated quartzites and slates in which diabase intrusions and occasional beds of conglomerate occur. Owing to the absence of fossils and to want of correlation with European or other rocks of known age, it is impossible to fix the exact geological period during which they were laid down, but they are certainly of far greater antiquity than the Devonian period.[4] The underlying granite is Archean, and the Swaziland system is almost certainly the same.[5]

The scenic aspect of the system is diversified by alternations of low hills and valleys, with few trees, little water, and scanty vegetation. The quartzites form the hills, which are characterized by steep escarpments and well defined dip-slopes. The valleys have been eroded in the slates and diabases, and, of these, the diabase valleys are the more fertile, owing to their greater richness in alkalies and alkaline earths. Where the dip of the beds is steep,[6] as on the Rand, the vegetation is adversely affected.[7]

For the sake of convenience, the Witwatersrand system is divided into an Upper and a Lower division. There is no unconformity between them; the division, which is purely arbitrary, is placed at the base of the Main Reef series.[8] The Lower division covers an area of about 970 square miles in the southern Transvaal. It is characterized by frequent alternations of quartzites and slates with comparative freedom from conglomerates, and has a total

[1]Throughout this paper when the term 'pebble', in single inverted commas, is used, it refers to one of the rounded masses of pyrite occurring in the auriferous conglomerates of the Witwatersrand which were formerly thought to be water-worn pebbles of pyrite.

[2]'The Nature of Replacement,' *Economic Geology*, Vol. VII, No. 6 (1912), pp. 521-535.

[3]Owing to the conglomerate beds of the Witwatersrand having been prospected and mined for gold, the term 'reefs' was applied to them by the early prospectors; and this Australian term has been retained and is now in general use. It is used as a synonym for vein or lode. It has no special significance as regards shape or appearance. It is really a nautical term. T. A. Rickard informed the writer that it was applied to veins or lodes by sailors who deserted from their ships to go to the early Australian diggings.

[4]Hatch and Corstorphine, 'The Geology of South Africa' (2nd Ed.), Macmillan & Co. (1909), pp. 343-344.

[5]C. B. Horwood and A. Wade, 'The Old Granites of the Transvaal and South and Central Africa,' *Geol. Mag.*, Decade V, Vol. VI (Oct.-Dec. 1909), pp. 548-549.

[6]The dip varies according to the locality from about 30 to 80°. Along the Central Rand it varies from about 50 to 80 degrees.

[7]I have particularly noticed a pronounced instance of a similar effect at Rio Tinto, in southern Spain. There Paleozoic schist and slate, pierced by igneous intrusions, cover wide tracts of country. The slate and schist are either vertical or dip at a steep angle, and little vegetation will flourish on their upturned edges.

[8]E. T. Mellor has suggested that the division should be put about 125 to 400 ft. lower, so as to include certain coarse quartzites of varying thicknesses, locally known as the Red Bar, since the latter are of the same character, and form an integral part of the big succession of quartzitic rocks to which the Main Reef series belongs. 'The Normal Section of the Lower Witwatersrand System on the Central Rand, etc.,' by E. T. Mellor, *Trans.* Geol. Soc. So. Af., Vol. XIV (1911), p. 110.

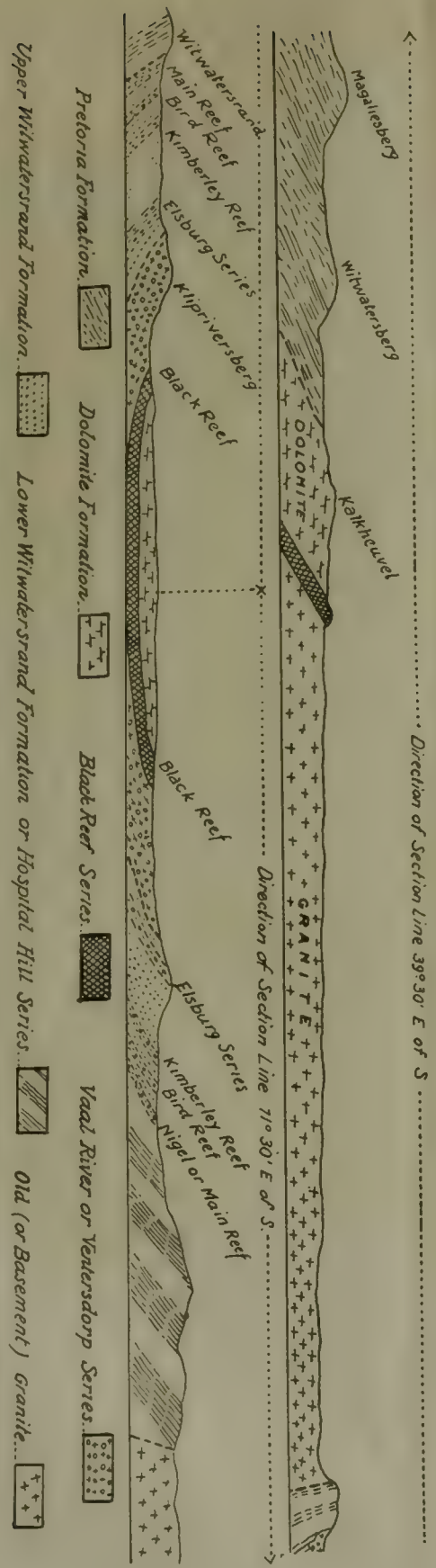

FIG. 1. SECTION FROM THE MAGALISBERG THROUGH JOHANNESBURG AND THE NIGEL, ILLUSTRATING THE SUCCESSION OF THE WITWATERSRAND FORMATIONS AND ASSOCIATED BEDS.
(From Hatch's Geological Map of Southern Transvaal, 2nd Ed., 1903.)

thickness of some 10,000 to 12,000 ft. The three[9] chief series of conglomerate beds in it are, from below upward, the Promise, the Coronation, and the Government reefs.[10] Of these, the only one that is well developed and persistent for long distances is the Government Reef series; and this compares poorly with the principal members of the Upper division. This division has a thickness of rather over 10,000 ft.; it is characterized by being remarkably free from slates and by containing numerous persistent and well defined conglomerates,[11] which are divided from below upward into five main groups or series, known as the Main Reef, Livingstone, Bird, Kimberley, and Elsberg series. Of these, the Main Reef, Kimberley, and Elsberg are the largest and most important, and each contains several beds of conglomerate.

The Main Reef Series

Of these, the one selected in lieu of fissures,[12] by the gold-bearing mineralizing solutions for circulation and deposition of their mineral contents, was the Main Reef series. This series is divided into two sub-series, which are separated from one another by some 40 ft., to as much as 200 ft., of quartzites. The lower is known as the Main Reef series proper and comprises the Main Reef Leader[13] and the Main Reef. The former varies in thickness from 3 to 4 inches up to 24 in. and occasionally much more in thickness. Frequently below this there is a fine-grained persistent band of shale, some 3 to 8 in. or more thick, by which it is either separated directly from the Main Reef; or below this again there may also be varying thicknesses of quartzite (up to as much as about 6 ft.) separating it from the Main Reef. The latter varies from about 4 to 5 in. up to 3 ft. on the Far East Rand to as much as 12 ft. in places along the Central Rand. The upper sub-series is known as the South Reef series. As typically developed along the Central Rand, it consists of three bands of conglomerate, varying in thicknesses and distances apart. Their occurrence in the western portion of the Consolidated Langlaagte mines, about 5 miles west of Johannesburg, may be taken as representative. There the upper or hanging wall banket is from about 9 to 18 in. thick and is separated by some

[9]The Du Preez series, which is auriferous and is profitably worked at the New Rietfontein mines, about 9 miles east of Johannesburg and about 4 miles north of Germiston, has not been included because it is still an unsettled question whether it belongs to the Lower Witwatersrand beds or whether it occurs as a faulted portion of the Upper beds.

[10]For the best description of these reefs, see E. T. Mellor, *loc. cit.*

[11]Other very noticeable differences between the Lower and Upper Witwatersrand beds are that the slates of the former are generally ferruginous and the quartzites are frequently chloritic, more compact, crystalline, and contain less sericite. The quartzites of the latter contain much sericite and a little talc, and, speaking generally, are less compact and less crystalline than those of the Lower beds.

[12]For reasons to be explained later.

[13]The term 'leader' is applied to a bed of conglomerate, that as usually developed is of small thickness, or relatively so compared to the other conglomerate beds in the same series.

FIG. 2. A MAIN REEF LEADER STOPE IN THE ROBINSON MINE.

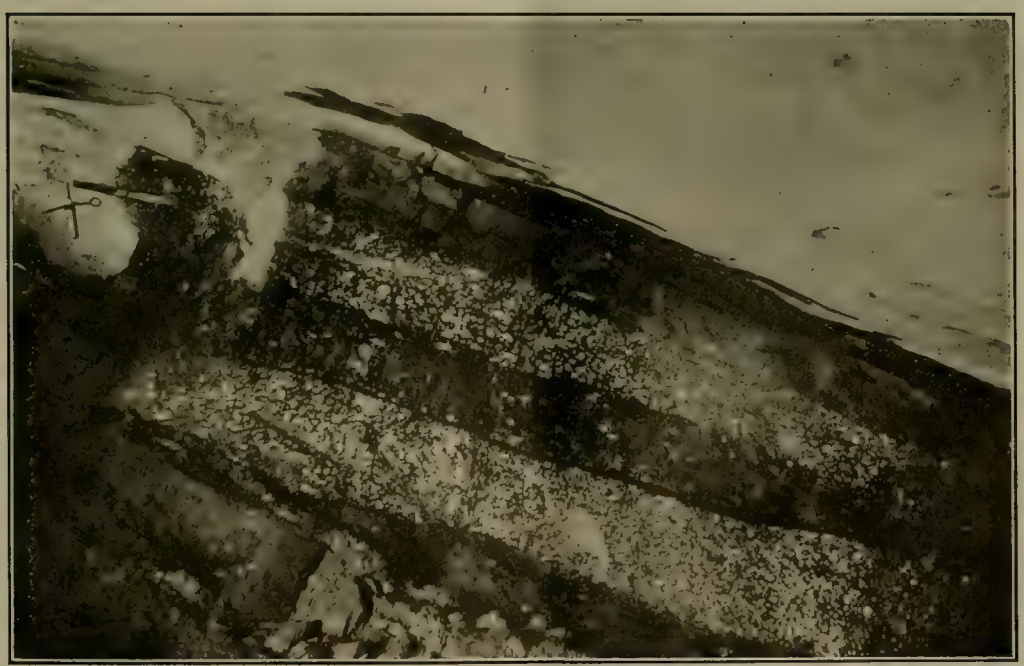

FIG. 3. THE SOUTH REEF IN A STOPE IN THE ROBINSON MINE.

8 to 12 in. of quartzite from the Middle Reef, which is usually about 3 to 5 in. thick. This again is separated by 8 to 12 in. of quartzite from the underlying South Reef Leader. The latter varies from a mere streak,[14] or a single-pebble layer 1 to 1½ in. thick, up to a band of conglomerate 5 or 6 in. or more.

The face of a Main Reef Leader stope in the Robinson mine, at Johannesburg, is illustrated in Fig. 2. It shows machine 'boys' drilling holes for blasting, and the conglomerate beds in the quartzite can be distinctly seen. Fig. 3 shows a face of a South Reef stope in the same mine, and gives a good section of two banket layers separated by a parting of quartzite; and it also shows the quartzite above and below them. A good example of faulting and of a small dike, in the Nourse Deep mine near Johannes-

[14]Which is often only traceable by the differences in color and texture of the foot and hanging wall quartzites. In this mine, as is usually the case elsewhere, the South Reef Leader occurs in a dense, hard, black crystalline quartzite, and there is usually a sharp well defined line of demarcation between this quartzite and the light gray, or white, comparatively soft foot-wall quartzi e on which it rests.

burg, is seen in Fig. 4.[15] On the left-hand side of the figure the banket is faulted upward, the amount of displacement being equal in thickness to about one-half the width of the banket. Just to the right of the centre, a dike is seen, which has faulted the reef up on the right-hand side for a distance of about twice as much as in the previous case.

The Conglomerates

These conglomerates consist mainly of well rounded spherical, or ellipsoidal, quartz pebbles,[16] light gray, bluish gray, and smoky colored, with occasional black ones. They usually vary in size up to 1 or 1½ inches in greatest diameter, though occasionally much larger ones occur.[17] Few, and rather smaller, indurated dark-gray or black quartzite pebbles of similar shape are also present, and occasional black, or dark striped, angular, cherty-looking pebbles composed of hard slaty quartzite, varying up to about 1½ or 2 inches in greatest length. Small well rounded quartz pebbles up to about ¼ in. diameter, of a light sky-blue color are sometimes found. Speaking generally, they may be said to vary in size from that of a pea to that of a hen's egg; the average dimensions being, probably, about those of small walnuts.[17] These pebbles are embedded in a fine-grained quartzitic matrix containing sericite, talc, chlorite, and some chloritoid.[18] It is in this matrix that the gold of the banket is found This gold is not pure; it contains some 10% of silver.[19] Usually it occurs in minute hackly crystalline particles, which are seldom visible, and it is intimately associated with, and often mechanically bound up in, iron pyrite, which forms 2 to 3% by weight of the banket.[20] The way in which the pyrite occurs in the banket has been so frequently described that it is not necessary to repeat in detail here. Speaking generally, it may be said to be finely disseminated in small crystals and rounded grains throughout the banket. The chief gangue is secondary quartz, which finally sealed these conglomerates against the further passage of mineralizing solutions.

The group of strata comprising the Witwatersrand system has usually been regarded as the result of deposition along a shore-line. However, E. T. Mellor,[21] who has made a close study of these beds, thinks that the Lower division and the conglomerate of the Main Reef series were laid down under estuarine, or more probably deltaic, conditions on a large scale, alternating with comparatively deep-water conditions. He maintains that the evidence points to an interrupted, but on the whole progressive, cycle of changes from the moderately deep-water conditions of the lowest portions of the system through deltaic phases, resulting in the conglomerates of its middle portions, to the actual shore conditions exhibited by the uppermost beds, including the Elsburg conglomerates. De Launay[22] had previously called attention to the great extent of these deposits, the relative regularity of the beds, and the frequent presence of flattened pebbles; and he expressed the opinion that they are marine rather than lacustrine deposits; but, since coastal deposits of shingle rarely have more than a small width transversely to the shore, they rather suggested a vast fluviatile formation, or torrential deltas spread along an alluvial plain like that of Lombardy. He further concluded that they originally occupied a nearly horizontal position and owe their present dip to subsequent compression which brought about a great northeast-southwest syncline.

Typical Shore-Line Deposit

This system has its best known and probably most typical development on, and immediately to the south of, the Witwatersrand,[23] which is a low range of hills stretching from the town of Boksburg on the East Rand to Krugersdorp on the West Rand, a distance of over 30 miles. This range forms the divide between the watersheds of the Limpopo on the north and the Vaal river on the south. The former flows into the Indian Ocean and the latter into the Orange river, which discharges into the Atlantic. These hills, their southern slopes, and the ground immediately to the south, together with the areas where the Main Reef series is being worked beyond their eastern and western limits, constitute what is now known as the Rand, famed as the biggest goldfield the world has ever known. It is situated about 35 miles south of Pretoria,

[15]These three photographs were taken by R. Neilson, of Johannesburg, who kindly gave permission to reproduce them.

[16]The quartz pebbles may have been derived to some extent from quartz veins in the older Swaziland system and in the Basement granite, but probably owe their origin for the most part to the granite itself, including its numerous pegmatite veins. See 'The Witwatersrand and Associated Beds,' by C. B. Horwood, Esson and Perkins, Johannesburg (1905), p. 47. See, also, C. B. Horwood and A. Wade, *loc. cit.*, p. 549.

For a fuller description of these pebbles see 'The Pebbles of the Rand Banket,' by R. B. Young, *Trans.* Geol. Soc. So. Af., v. XV (1912), pp. 1-87.

For a fuller description of the bankets, see 'The Gold Mines of the Rand,' by Hatch and Chalmers (Macmillan & Co., 1895).

'The Witwatersrand Goldfields,' by S. J. Truscott (Macmillan & Co., 1902).

'The Geology of South Africa,' by Hatch and Corstorphine (Macmillan & Co., 2nd Ed., 1909), pp. 131-158.

'The Petrography of the Witwatersrand Conglomerates, etc.,' by F. H. Hatch and G. S. Corstorphine, *Trans.* Geol. Soc. So. Af., Vol. VII, part III.

[17]In the Main Reef Leader, pebbles are frequently found as large as 3 or 4 in.; up to as much as 7 inches in greatest length.

[18]'The Petrography of the Witwatersrand Conglomerates,' by F. H. Hatch and G. S. Corstorphine, *Trans.* Geol. Soc. So. Af., Vol. VII, part III (1904), p. 142.

'Notes on the Auriferous Conglomerates of the Witwatersrand,' by R. B. Young, *Trans.* Geol. Soc. So. Af., Vol. X (1907), pp. 19-20. Mr. Young has done much valuable laboratory work, in the form of petrological research, on the Rand bankets.

[19]The average fineness of Rand gold may be taken as being 875 parts of gold per thousand, the rest being practically all silver. 'The Mode of Occurrence and Genesis of the Carbon in the Rand Bankets,' by C. B. Horwood, *Trans.* Geol. Soc. So. Af., Vol. XIII (1910), p. 82.

[20]According to A. Crosse; see C. B. Horwood, *loc. cit.*, p. 72.

[21]E. T. Mellor, *loc. cit.*, pp. 122-123.

[22]'Observations on the Rand Conglomerate,' by L. De Launay, *Eng. and Min. Jour.*, April 4, 1903, p. 519.

[23]Witwatersrand is the Dutch name; it means 'White waters range.'

about 390 miles due west of Delogoa Bay, about 470 miles northwest from the port of Durban, and about 1040 miles northeast of Cape Town. In altitude it varies from about 5400 to about 6000 ft. above sea-level. The climate resembles that of Arizona. Snow rarely falls, and the rainy season is from about November to April.

Structure of the Witwatersrand

The Witwatersrand, together with the extension of the system for some 16 miles eastward beyond Boksburg, forms the northern rim[24] of what is usually considered a great synclinal basin, the longer axis of which trends northeast.[25] On the Far West Rand this rim bends south between Krugersdorp and Randfontein. On the Far East Rand it sweeps southward a few miles east of the township of Springs, and then trends southwest past the town of Heidelberg to form the southeastern edge of this 'basin.' It is, however, significant that the southern and southwestern boundaries are missing. If, now, this 'basin' be carefully studied on a geological map,[26] it will be noticed that the outcrops of the various beds of the Witwatersrand system form V shapes, with their apexes pointing northeast. These contours suggest that the so-called basin really consists of an ancient synclinal valley formed by the Ventersdorp diabase having broken through, poured over, and loaded the strata of the Witwatersrand beds, which, in consequence of the weight of the enormous superimposed masses of volcanic rock and the removal of them from below, sank, dipping inward toward the region whence the material had been withdrawn. Thus the dip everywhere is toward what is now the main axis of this synclinal valley. This axis naturally marks the line along which the main fracturing and resultant vents occurred. This intrusive activity would have also produced numerous lateral fractures up which igneous matter would have been forced, represented today by the big dikes, roughly parallel to the strike of the banket beds, which are encountered in the mines and occur here and there throughout the Witwatersrand beds. The Ventersdorp diabase and the overlying Black Reef and Dolomite formations have protected this ancient valley from subsequent erosion. The apex[27] of the contours of the sub-outcrop[28] of the Main Reef series is situated 16 miles to the east of Boksburg at the head of this valley, on the Far Eastern Rand. This area appears to have been subjected to less disturbance than the rest of the Rand, for the Witwatersrand beds in this district have not been tilted at high angles, the dip varying from about 6 to 10°. The width across the syncline from Boksburg to Heidelberg is about 22 miles. It then rapidly widens, so that 26 miles farther to the southwest its width, measured southeast from Krugersdorp, has increased to 50 miles. These structural features of the Witwatersrand should be carefully borne in mind, as they have an important

FIG. 4. FAULT AND DIKE CROSSING A LODE OF GOLD-BEARING CONGLOMERATE IN THE NOURSE DEEP MINES.

[24]Which is over 45 miles in length.

[25]As just mentioned, L. De Launay more accurately termed it a great northeast-southwest syncline; *loc. cit.*, p. 519.

[26]The best geological map of the Southern Transvaal is that by F. H. Hatch (1903), published by E. Stanford, London.

[27]In plan.

[28]The Witwatersrand beds are here covered by about one thousand feet of Dolomite, with its thin basal Black Reef formation.

bearing on the genesis of the gold in the banket, and will be referred to again when this latter subject is discussed.

The Mode of Occurrence and Origin of the Pyrite 'Pebbles'

From the early days of the Rand goldfield, the occasional occurrence of 'pebbles' of iron pyrite in the auriferous conglomerate, or banket,[20] has been known. The largest of them are usually only about an inch in greatest diameter. They were noticed when mining had reached a depth of 200 to 300 ft., and had passed from the weathered, free-milling ore of the oxidized zone to the 'blue' pyritic banket.

In the following pages some of the best known and most typical occurrences are described. The particular form of pyrite pebble that characterizes one of the banket lodes in the Rietfontein mines is present in considerable quantity in that 'reef,' as will be seen later from the illustrations. Other forms can also be occasionally found there by careful search. In some of the Randfontein mines various forms of these 'pebbles' can frequently be found during the progress of mining, if carefully sought; and the writer believes the same can be said with regard to Lancaster West, Lancaster, and other West Rand mines. In the Crown Reef mine the presence of the 'pebbles' was mainly confined to one particular portion of the workings. Apart from these occurrences, one may say that throughout the mines of the Rand they are rare. Here and there an occasional one has been found in the Kimberley series of conglomerates. It is noteworthy that they are fairly plentiful in the much higher geological horizon of the Black Reef series of the Potchefstroom system, in the banket at the Machavie mine in the Potchefstroom district, some 70 miles southwest of Johannesburg.

Gold-Bearing Pyrite Pebbles

From time to time these pyrite 'pebbles' have attracted attention; formerly, many observers considered them to be water-worn particles of pyrite. [illegible] De Launay[21] states that "the gold-bearing pyrite is present in the form of [illegible] grains irregularly distributed through the siliceous cement, or often forms a trail of grains partly continuous vermicles, around a fragment of quartz, as is observed frequently in quartz veins. The trails of pyrite grains may be either parallel to the general stratification or oblique to it; and conforming to a false bedding. This pyrite, examined by a lens, or under the microscope, looks at times as if rolled or broken, this being notably the case in the parallel veinlets; more often it is well crystallized and presents sharp angles, difficult to reconcile with the idea of a prolonged trituration." Even if water-worn pyrite were originally present in the banket, it is difficult to imagine how such an easily decomposable mineral as iron pyrite could have continued to exist in these ancient conglomerates of the Witwatersrand. Especially is this so when one realizes that the original conglomerates must have been very porous before they were subjected to igneous intrusion and the consequent enormous pressure that has compressed and tilted them into their present position; and before they were cemented, or their pores closed by the deposition of secondary silica. That water-worn lumps of pyrite could have so long survived the forces of dissolution is hardly conceivable to anyone who, like the writer, is familiar with some of the enormous masses of iron pyrite mined today[22] and who has seen how heavily the issuing mine-waters are charged with iron sulphate owing to the solubility of the pyrite. If indeed these 'pebbles' were water-worn and contemporaneous with the formation of the banket, then we would naturally expect that similar ones, of undoubtedly contemporaneous origin, would occasionally have been found in more recent, or now-forming, conglomerates. So far, however, as the writer is aware, none has ever been recorded. Similarly, flint occurs in the chalk beds of England and elsewhere, yet none has ever been found in the deep-sea ooze, which is its nearest equivalent at the present day, and on which so much light has been thrown by the Challenger expedition. The explanation is that the pyrite 'pebbles', or the flints, as the case may be, were formed not while the beds were being laid down, but afterward, by secondary processes. In the former case any pyrite present while the conglomerate was being deposited, owing to its easy solubility, would surely have been carried away in solution in the form of sulphates. Thus it is reasonable to assume that the pyrite now present in these beds[23] has been subsequently introduced. On the other hand, the flints are derived from the more soluble hydrous variety of silica known as opal, which was originally present as the substance of the skeletons of silicious organisms, chiefly sponges.[24] It seems probable that the pyrite was introduced into the con-

[illegible] conglomerates were so named on account of their supposed resemblance to almond rock the burnt wood for which is famous.

[illegible] 'The Witwatersrand Conglomerates,' G. F. Becker, Washington, [illegible] p. 167.

[illegible] The Witwatersrand Banket, with Notes on Other Gold-Bearing Pudding Stones, by G. F. Becker, 18th Ann. Rep. U. S. Geol. Surv., part V [illegible] p. 191.

[illegible] Researches on the Rand Conglomerates, by L. De Launay, [illegible] Trans.

[illegible] Researches on the Rand Conglomerates' by J. Kuntz, Eng. and Min. Jour., [illegible] 1897.

Mr. Kuntz states that [illegible] in the Kimberley reef as well as in the Main Reef series.

Dr. Kuntz [illegible] See J. Kuntz, [illegible]

George Denny, [illegible] Proc. S. A. Assn. Engrs., Vol. II, No. [illegible] 1905, p. [illegible]

[illegible] Such, for example, as those that are worked at the Rio Tinto mines in southern Spain, where the iron pyrite occurs as metasomatic contact deposits, which contain a little over 2% of copper, and are exploited for copper and sulphur.

[illegible] As already stated, according to A. F. Crosse, the average amount of iron pyrite present in the auriferous banket of the Rand varies from about 2 to 4 per cent.

See, also, 'The Mode of Occurrence and Genesis of the Carbon in the Rand Bankets,' by C. B. Horwood. *Trans.* Geol. Soc. So. Af., Vol. XIII, [illegible], p. 72. L. De Launay, *loc. cit.*, says the pyrite forms fully 5% of the weight of the rock. The present writer considers Crosse's estimate as the more accurate.

[illegible] For 'The Origin and Formation of Flints,' see 'The Age of the Earth,' by W. J. Sollas (1908), chapter VI (T. F. Unwin, London).

glomerate at a late stage, while the conglomerate was still pervious to mineral solutions, and yet sufficiently near the time of final cementation to have insured its preservation from attack and dissolution by still more recent solutions. Later we shall see that the pyrite forming the pebbles is secondary, and was introduced long after the formation of the banket.

The writer's studies of this subject have extended over the last seven and a half years. His observations were made first-hand, underground, during the stoping and development operations of ordinary mining work, which afforded exceptional opportunity for continuous inspection of the various 'reefs' while fresh exposures of them were being laid bare. These have been supplemented by the collection and examination of a large number of specimens taken at the actual working faces in various mines, and also by detailed petrological work, including the microscopical examination of a great number of slides.

Pyrite Pebbles at the Crown Reef Mine

In a paper read before the Geological Society of London in February 1907,[35] he described an occurrence of these 'pebbles' that had come under his notice about the end of the year 1905, in one of the gold-bearing conglomerate beds of the Crown Reef mine, near Johannesburg. He showed that they had been formed in place by metasomatic replacement of quartz; and, at that time, expressed the opinion that they were pseudomorphs after quartz pebbles. This view was a new one, advanced for the first time; and it met with a considerable amount of opposition.[36]

At that time the writer had no slides of these pyrite 'pebbles' for examination under the microscope. Since then he has had several sections made, but it will be advisable first, before describing them, to give a brief description of the conditions under which the 'pebbles' exist in the banket. This description furnishes a clue to the solutions that dissolved portions of the silica and precipitated pyrite in its place.

At the Crown Reef mine, in a stope[37] between the 600 and 700-ft. levels, 'pebbles' of iron pyrite were found at the base of the Main Reef Leader (a thin bed of conglomerate immediately overlying a band of shale), and in close proximity to a diabase dike. The length of the stope was about 130 ft., and the bottom of it was 630 ft. vertically below the surface. The 'reef' or lode dipped south at an angle of 38 degrees.

In this stope the matrix of the Main Reef Leader was very pyritic, especially at its base. The Leader was from 9 to 10 in. wide, and was underlain by a thin but persistent band of shale, which averaged 2.8 to 3.5 in. thick. Small stringers of quartz, running parallel to the bedding, occurred here and there in the shale band, affording evidence of the action and course of former mineralizing solutions. Immediately below this shale was the bed of conglomerate known as the Main Reef, which in this mine varied from 10 to 15 ft. in thickness, and, except occasionally in places, is poor in gold. In mining the overlying Main Reef Leader, a portion of the Main Reef was also extracted, it being impossible to carry the stopes sufficiently narrow to remove only the Leader.

The Crown Reef Dike

The dike, known as the Crown Reef dike, was black in color, of very basic character, highly decomposed, and had developed,[38] parallel to its strike, a shaly fissile structure. The intrusion of the dike was accompanied by a reversed faulting movement,[39] which threw the beds up a distance of 76 ft. on the south side, so that the South Reef series on the north side was exactly opposite the Main Reef series on the south side of the dike. At the bottom of the particular stope in which the pyrite 'pebbles' were found, and at the contact of dike and banket, on the north side of the former, the dike was altered for a thickness of about three inches into a light bluish gray clayey decomposition product, and was here, where it passed through the lower end of the east face of the stope, about 40 feet wide. Its strike was approximately 16° north of east, and south of west; it was almost vertical (near the surface it was slightly overtilted and dipped about 88° north); it could be traced throughout the mine, that is, for a distance of about 3000 ft.; and it extended westward into the Langlaagte Estate mine. Its average width in the Crown Reef mine was about 35 feet.

At, and for some 20 ft. from, the dike contact, the shale underlying the Main Reef Leader was changed into a yellow brittle flaky porcelainite; above this it gradually assumed its ordinary character.

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[38]Doubtless due to pressure.

[39]De Launay pointed out that the principal faults on the Rand are strike-faults accompanied by reversed faulting, indicating pressure from the south at right angles to the strike of the beds (*loc. cit.*, p. 519).

bearing on the genesis of the gold in the banket, and will be referred to again when this latter subject is discussed.

The Mode of Occurrence and Origin of the Pyrite 'Pebbles'

From the early days of the Rand goldfield, the occasional occurrence of 'pebbles' of iron pyrite in the auriferous conglomerate, or banket,[29] has been known. The largest of them are usually only about an inch in greatest diameter. They were noticed when mining had reached a depth of 200 to 300 ft., and had passed from the weathered, free-milling ore of the oxidized zone to the 'blue' pyritic banket.

In the following pages some of the best known and most typical occurrences are described. The particular form of pyrite pebble that characterizes one of the banket lodes in the Rietfontein mines is present in considerable quantity in that 'reef,' as will be seen later from the illustrations. Other forms can also be occasionally found there by careful search. In some of the Randfontein mines various forms of these 'pebbles' can frequently be found during the progress of mining, if carefully sought; and the writer believes the same can be said with regard to Lancaster West, Lancaster, and other West Rand mines. In the Crown Reef mine the presence of the 'pebbles' was mainly confined to one particular portion of the workings. Apart from these occurrences, one may say that throughout the mines of the Rand they are rare. Here and there an occasional one has been found in the Kimberley series of conglomerates. It is noteworthy that they are fairly plentiful in the much higher geological horizon of the Black Reef series of the Potchefstroom system, in the banket at the Machavie mine in the Potchefstroom district, some 70 miles southwest of Johannesburg.

Gold-Bearing Pyrite Pebbles

From time to time these pyrite 'pebbles' have attracted attention; formerly, many observers considered them to be water-worn pebbles of pyrite.[30] De Launay[31] states that "the gold-bearing pyrite is present in the form of isolated grains irregularly distributed through the silicious cement; it often forms a trail of grains, rarely continuous veinlets, around a fragment of quartz, as is observed frequently in quartz veins. The trails of pyritic grains may be either parallel to the general stratification or oblique to it; and conforming to a false bedding. This pyrite, examined by a lens, or under the microscope, looks at times as if rolled or broken, this being notably the case in the parallel veinlets; more often it is well crystallized and presents sharp angles, difficult to reconcile with the idea of a prolonged trituration." Even if water-worn pyrite were originally present in the banket, it is difficult to imagine how such an easily decomposable mineral as iron pyrite could have continued to exist in these ancient conglomerates of the Witwatersrand. Especially is this so when one realizes that the original conglomerates must have been very porous before they were subjected to igneous intrusion and the consequent enormous pressure that has compressed and tilted them into their present position; and before they were cemented, or their pores closed by the deposition of secondary silica. That water-worn lumps of pyrite could have so long survived the forces of dissolution is hardly conceivable to anyone who, like the writer, is familiar with some of the enormous masses of iron pyrite mined today[32] and who has seen how heavily the issuing mine-waters are charged with iron sulphate owing to the solubility of the pyrite. If indeed these 'pebbles' were water-worn and contemporaneous with the formation of the banket, then we would naturally expect that similar ones, of undoubtedly contemporaneous origin, would occasionally have been found in more recent, or now-forming, conglomerates. So far, however, as the writer is aware, none has ever been recorded. Similarly, flint occurs in the chalk beds of England and elsewhere, yet none has ever been found in the deep-sea ooze, which is its nearest equivalent at the present day, and on which so much light has been thrown by the Challenger expedition. The explanation is that the pyrite 'pebbles', or the flints, as the case may be, were formed not while the beds were being laid down, but afterward, by secondary processes. In the former case any pyrite present while the conglomerate was being deposited, owing to its easy solubility, would surely have been carried away in solution in the form of sulphates. Thus it is reasonable to assume that the pyrite now present in these beds[33] has been subsequently introduced. On the other hand, the flints are derived from the more soluble hydrous variety of silica known as opal, which was originally present as the substance of the skeletons of silicious organisms, chiefly sponges.[34] It seems probable that the pyrite was introduced into the con-

[29]The conglomerates were so named on account of their supposed resemblance to almond rock, the Dutch word for which is 'banket.'

[30]"The Witwatersrand Conglomerates,' G. F. Becker, Washington (1896), p. 167.

'The Witwatersrand Banket, with Notes on Other Gold-Bearing Pudding Stones,' by G. F. Becker, 18th Ann. Rep., U. S. Geol. Surv., part V (1897), p. 153.

[31]'Observations on the Rand Conglomerate,' by L. De Launay, *loc. cit.*, pp. 519-521.

See, also, 'Remarks on the Rand Conglomerates,' by J. Kuntz, *Eng. and Min. Jour.*, Oct. 17, 1903.

Mr. Kuntz speaks of them as occurring in the Kimberley reef as well as in the Main Reef series.

Dr. Koch (of Berlin). See J. Kuntz, *loc. cit.*

George Denny, Jour. Proc. So. Af. Assn. Eng., Vol. II, No. 1 (1903), p. 10.

[32]Such, for example, as those that are worked at the Rio Tinto mines in southern Spain, where the iron pyrite occurs as metasomatic contact deposits, which contain a little over 2% of copper, and are exploited for copper and sulphur.

[33]As already stated, according to A. F. Crosse, the average amount of iron pyrite present in the auriferous banket of the Rand varies from about 2 to 3 per cent.

See, also, 'The Mode of Occurrence and Genesis of the Carbon in the Rand Bankets,' by C. B. Horwood, *Trans.* Geol. Soc. So. Af., Vol. XIII (1910), p. 72. L. De Launay, *loc. cit.*, says the pyrite forms fully 5% of the weight of the rock. The present writer considers Crosse's estimate as the more accurate.

[34]For 'The Origin and Formation of Flints,' see 'The Age of the Earth,' by W. J. Sollas (1908), chapter VI (T. F. Unwin, London).

glomerate at a late stage, while the conglomerate was still pervious to mineral solutions, and yet sufficiently near the time of final cementation to have insured its preservation from attack and dissolution by still more recent solutions. Later we shall see that the pyrite forming the pebbles is secondary, and was introduced long after the formation of the banket.

The writer's studies of this subject have extended over the last seven and a half years. His observations were made first-hand, underground, during the stoping and development operations of ordinary mining work, which afforded exceptional opportunity for continuous inspection of the various 'reefs' while fresh exposures of them were being laid bare. These have been supplemented by the collection and examination of a large number of specimens taken at the actual working faces in various mines, and also by detailed petrological work, including the microscopical examination of a great number of slides.

Pyrite Pebbles at the Crown Reef Mine

In a paper read before the Geological Society of London in February 1907,[35] he described an occurrence of these 'pebbles' that had come under his notice about the end of the year 1905, in one of the gold-bearing conglomerate beds of the Crown Reef mine, near Johannesburg. He showed that they had been formed in place by metasomatic replacement of quartz; and, at that time, expressed the opinion that they were pseudomorphs after quartz pebbles. This view was a new one, advanced for the first time; and it met with a considerable amount of opposition.[36]

At that time the writer had no slides of these pyrite 'pebbles' for examination under the microscope. Since then he has had several sections made, but it will be advisable first, before describing them, to give a brief description of the conditions under which the 'pebbles' exist in the banket. This description furnishes a clue to the solutions that dissolved portions of the silica and precipitated pyrite in its place.

At the Crown Reef mine, in a stope[37] between the 600 and 700-ft. levels, 'pebbles' of iron pyrite were found at the base of the Main Reef Leader (a thin bed of conglomerate immediately overlying a band of shale), and in close proximity to a diabase dike. The length of the stope was about 130 ft., and the bottom of it was 630 ft. vertically below the surface. The 'reef' or lode dipped south at an angle of 38 degrees.

In this stope the matrix of the Main Reef Leader was very pyritic, especially at its base. The Leader was from 9 to 10 in. wide, and was underlain by a thin but persistent band of shale, which averaged 2.8 to 3.5 in. thick. Small stringers of quartz, running parallel to the bedding, occurred here and there in the shale band, affording evidence of the action and course of former mineralizing solutions. Immediately below this shale was the bed of conglomerate known as the Main Reef, which in this mine varied from 10 to 15 ft. in thickness, and, except occasionally in places, is poor in gold. In mining the overlying Main Reef Leader, a portion of the Main Reef was also extracted, it being impossible to carry the stopes sufficiently narrow to remove only the Leader.

The Crown Reef Dike

The dike, known as the Crown Reef dike, was black in color, of very basic character, highly decomposed, and had developed,[38] parallel to its strike, a shaly fissile structure. The intrusion of the dike was accompanied by a reversed faulting movement,[39] which threw the beds up a distance of 76 ft. on the south side, so that the South Reef series on the north side was exactly opposite the Main Reef series on the south side of the dike. At the bottom of the particular stope in which the pyrite 'pebbles' were found, and at the contact of dike and banket, on the north side of the former, the dike was altered for a thickness of about three inches into a light bluish gray clayey decomposition product, and was here, where it passed through the lower end of the east face of the stope, about 40 feet wide. Its strike was approximately 16° north of east, and south of west; it was almost vertical (near the surface it was slightly overtilted and dipped about 88° north); it could be traced throughout the mine, that is, for a distance of about 3000 ft.; and it extended westward into the Langlaagte Estate mine. Its average width in the Crown Reef mine was about 35 feet.

At, and for some 20 ft. from, the dike contact, the shale underlying the Main Reef Leader was changed into a yellow brittle flaky porcelainite; above this it gradually assumed its ordinary character.

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A few 'pebbles' of pyrite occurred at the immediate contact of dike and banket, and for about 10 ft. from the former; above that they were of frequent occurrence as far as the top of the stope.[40] Similar pyritic 'pebbles' were also occasionally found farther away from the dike, on the western face of the stope, as also in the stope immediately below. These 'pebbles' varied in size, up to one inch, in greatest diameter, they were mostly circular, but some were oval, and they were all well rounded. When fractured, they sometimes showed an internal radial fibrous structure, which of itself is sufficient evidence that they were formed in place and are not water-worn pebbles. Some, even in hand specimens, showed that the quartz of the original pebbles had not been entirely replaced, and, in others, the pyrite could be seen entirely surrounding the quartz, and, as it were, eating into it, so that if the pyrite were removed, what were undoubtedly originally smooth water-worn pebbles would present irregular, fretted, and corroded surfaces.

(To Be Continued.)

Malay Tin

The Federated Malay States have recently come to attain name and fame as the producers of a large percentage of the world's supply of tin. The Chinese were the earliest discoverers of tin, but they worked the land in a primitive way. Later British miners, adopting scientific methods, have developed the industry to its present magnitude. At the present time there is still some alluvial tin mining, but the rich mines are the lode workings, chief of which are the Trenoh, Ula Pia, Kramat Pulai, and Tekka Limited. These rich mines are confined to the state of Perak and principally controlled by officers in the town of Ipoh, Destrien Kinta. But tin is not confined to Perak; throughout the Federated Malay States there exists tin, and many a rubber plantation is growing on land which could more profitably be worked as a mine, for where rubber means much initial outlay and the employment of a large number of coolies, a tin mine needs a comparatively small outlay. The days when tin mines were worked with expensive overhead machinery have passed, and today the one and only system is hydraulic power. A strong pressure of water ejected through a monitor does all the work. This disintegrates the soil, which is pumped up in a semi-liquid mass to flumes elevated to as high as sixty feet, with a small incline, and at every six feet or so is a riffle which obstructs the progress downward of the heavier mineral. Small particles do escape, but not for long, for the water is screened below in a reservoir, which is an important operation; even the water is not lost, but passes on to a pond to render further service as required. The value of the sediment in these ponds is something yet to be calculated. A side issue at mines is the tributary system. Land not actually being worked is let out to Chinese and Malays and the result of their work is bought by the operators. There is no expense to the company and the gain is considerable, but it would not be good practice to work a mine purely on the tribute system. The land will suddenly become unproductive and later these abandoned properties have returned the largest dividends. It is not uncommon for a few yards to yield as much as 75% of tin and immediately adjacent similar land to be absolutely barren.

Some mines, like the Lahat, six miles from Ipoh, adopt the puddling principle before the soil pumped up passes into the channels. It is more expensive, and no doubt the thorough liquifying of the soil does render the subsequent work easier, but, all things considered, the difference is small. Women are only employed in working with the stream of tin after passing over the riffles, and a dozen is sufficient. Experience is an important factor in tin mining, and the Chinese are born to the business. Even Chinese women may be seen by the hundreds examining the water running through the drains adjoining mines in search of tin, and they must realize some profit or they would not be working at it from early morning to dark.

The regulations affecting mines in the Malay States are all in favor of the worker. He must be housed and fed, and a hospital provided on the premises, with a doctor visiting the hospital daily, otherwise there are severe fines and penalties. The Government is naturally rich. It toils not neither does it spin, but it waxes rich in royalties and taxes, but for the present the miner does not demur, as he is also prospering. At Penang and also at Singapore are extensive smelting works, where their agents are buying freely throughout the Malay States. Nearly every tramcar passing the works stops to pick up a wagon laden with ingots of tin, while hardly a ship leaves either port without a large cargo.—*The National Review.*

Titaniferous Iron Ores of the United States

One of the problems that confronts American ironmasters is the efficient reduction of magnetite containing a high percentage of titanium, as ores containing over 1% of titanium are troublesome to smelt in the blast-furnace. From time to time the discovery of enormous bodies of workable titaniferous ore has been reported, and the available literature dealing with the geologic occurrence and the economic value of the titaniferous magnetite in the United States contains a mass of information that in part is based on incomplete observation and even on hearsay. In an attempt to ascertain just what the economic possibilities of the larger deposits of titaniferous iron ore may be, the Bureau of Mines took up the study of the possible utilization of these ores through some concentrating process. The conduct of this investigation was assigned to J. T. Singewald, Jr., and the results are presented in Bulletin No. 64, which may be obtained from Washington, D. C. "It is to be regretted," says J. A. Holmes, of the Bureau of Mines, "that the results of Mr. Singewald's careful study of the ores are chiefly negative. Some deposits of titaniferous iron ore are clearly not as extensive nor as high in iron as they were reported to be."

[40]They seem to be especially numerous about half way up the stope.

Revision of United States Mining Laws

By Horace V. Winchell, C. W. Goodale, and M. L. Requa

*No argument is needed to convince a man of the importance of his own chosen profession. Familiar with its traditions and its history, knowing its progress, and having himself contributed to its development, he is inspired by the greater achievements of his colleagues and is impressed with its importance in human affairs. It is possible, however, to be so engrossed in the details and routine of every-day work as to lose the perspective of the profession as a whole, just as a spectator in the grandstand who knows nothing of the technique of a horse race may yet have a much more comprehensive view of its progress and the conditions surrounding it than any one of the scientifically trained contestants. Thus, even when it is generally realized that there is something wrong with the body politic, very few members of that body are equal to the task of diagnosing the trouble and prescribing the proper remedy.

Even with a widespread feeling that our present system of mining law is defective, and a general demand for its revision, it would still not be surprising if it should develop that mining engineers have not as yet united in a concrete, well-developed conviction as to the remedies indicated, and the course of treatment to be adopted. It will be admitted that it is not an easy task to cover all conditions and all minerals in all lands and under different climes with one statute. It may be possible, however, to agree finally upon some of the fundamental principles which are most wholesome for the mining industry and which should find expression in the laws under which it may be inaugurated and conducted.

It should be stated at the outset that the mining laws referred to in this discussion are those which concern the title or possession of minerals and ores, and the lands in which they are found, as distinguished from mining regulations which govern the operation of mines and the relations which exist between labor, landed proprietor, and the government.

Proprietorship of Ores and Minerals.

Different fundamental conceptions as to the title to ores and minerals are developed in the laws of various countries. Indeed, the progress of human civilization is said[1] to find an expression in the mining laws from time to time enacted by different governments. Since ores are valuable only after they have been severed from their birthplace in the ground, and adapted for the use of man, from time immemorial a difference has been noted between a title to land and that to the mineral wealth which the land contained. Lands might be granted or leased, but the metallic treasures beneath the surface were subject to the separate control and disposition of the reigning authority. Especially was this true of the metals gold and silver, which were wholly the property of the crown "for the purpose of coinage and to support its dignity"[2] in nearly all European countries; and in many of them it persists, at least in theory, to the present day. This regalian right "followed the principles of the civil law, by which it was established that the ownership of all lands was primarily vested in the state," and that "all mines of gold and silver in public lands belong to the state or sovereign as a part of the sovereign patrimony; whence it followed that the right of severance could be exercised" and the minerals and land granted separately. By the rule of the common law from the earliest time the owner of the soil owned all beneath it with the limitation only that royal mines belonged to the crown.[3] In many of the royal grants to the colonies forming the original thirteen states there was an expression of this theory of regalian right, and a reservation of a fixed portion of all the royal metals discovered.[4] The Virginia charters reserved likewise one-fifteenth of all copper. It is only occasionally and for brief periods of time, however, that one finds governments or monarchs attempting to extend their royal rights over the baser metals and coal (although the salt deposits are still held as government monopoly in several countries).

State and Federal Proprietorship

In the United States there are two different kinds of sovereign proprietorship of minerals and mining rights, state and federal. The original thirteen states derived their rights prior to the formation of the federal government. Other states have at various times and in different ways acquired rights.

The mining laws which are the subject of this discussion are those federal statutes which control the prospector and miner in discovering and acquiring title to deposits upon the public domain in the states and territories and possessions which come within the scope of such laws. It is known to every intelligent dweller upon this continent that by far the largest part of our gold, silver, copper, and lead comes from the mining states, west of the Missouri river, and the importance of legislation which will encourage and promote the discovery and development of more mines is emphasized by every political economist. The best mining laws are those which result in the greatest good to the greatest number for the greatest period of time, and which lead to the largest output and consumption of mineral products with the smallest amount of waste. It is to the interest of all the people to see that such laws are enacted; but since the people at large are not so well versed in those matters as the mining men themselves, it is the latter who should take the initiative whenever new conditions create the necessity for new laws.

*Report of the Committee of the Mining and Metallurgical Society of America.

[1]Hoover's 'Agricola,' Historical Note on the Development of Mining Law, p. 82 *et seq.*

[2]Rogers, 'Law of Mines, Minerals, etc.,' 2nd Ed., p. 175.

[3]'Snyder on Mines,' I, pp. 5-6.

[4]Snyder, I, p. 11.

Necessity for Revision.

As to the need for mining law revision there seems to be no doubt whatever. Congress has been memorialized by our greatest statesmen and economists, by presidents, cabinet officers, and directors of the land department and of the geological survey, associations of commercial and mining men in all parts of the land have voiced the necessity, and committee after committee has formulated its suggestions and presented them to a heedless congress. Mining journals have teemed with articles upon the subject; prominent attorneys and jurists have discussed it; the expensive and sometimes disastrous apex litigation in almost every mining district, where the mine proprietors have not prudently by mutual agreement nullified the extralateral right provision of the statutes under which their title was acquired, has attracted widespread attention to some of the worst defects in our present law until scarcely anyone attempts to defend it; and yet nothing is done.

It is often a simple matter to criticize and point out defects, but a far more difficult task to suggest constructively what should be done to improve the situation. If, however, it is possible to single out weak points and hold them up to the light of criticism there shall at least be performed a work necessarily preliminary to that of finding the remedy. Let us first, therefore, consider some of the bad features of our present law.

Lack of Protection to Prospectors.

It is a custom which, like many others, has been sanctioned by legal enactment in many countries, to reward the discoverer of a new vein or mineral deposit, or a new mining district. Sometimes this reward is offered in the nature of a cash bonus, but it more frequently takes the shape of permission to locate for himself a larger claim than is allowed to subsequent locators. In the attempt to incorporate this principle into our mining law every right was made dependent upon a discovery of ore in place, and until such discovery the prospector has no possessory rights. Instead of being permitted and authorized by law to stake out his ground wherever he chooses on the public domain (in many countries this right is extended also to private estates, and the owner is compelled to grant a prospecting permit to any applicant unless he wishes himself to explore his own ground) and there, under proper conditions as to continuity of work, being protected in his exclusive right to explore, he is actually an unlicensed, unauthorized, and unprotected trespasser until he has discovered "veins or lodes of quartz or other rock in place bearing gold, silver, cinnabar, lead, tin, copper or other valuable deposits."[5]

Upon this point, W. L. Fisher, recently Secretary of the Interior, speaks as follows:

"It is becoming increasingly evident that the lode mining law needs changes in one respect, at least. The law at present does not provide for the creation of any rights in supposedly mineral land, except by the issuance of patents, and in that regard congress has provided that a patent can follow only on a legal location and has said 'but no location of a mining claim shall be made until the discovery of the vein or lode within the limits of the claim located.' As long as Congress desires to adhere to the policy at present embodied in statute law of disposing of mineral land absolutely, the law quoted above tends fairly well to the development of mineral properties where the ore can be discovered at or near the surface of the ground, but it seems to be ill-calculated for a district where, as is the case notably in some of the copper mining districts, the ore lies at depths of hundreds and sometimes thousands of feet. The expense of actual discovery of the vein or lode within the limits of any particular claim in such cases involves deep exploration, either by drilling or by the sinking of a shaft from the surface, or the extension of a tunnel into the claim. Either of these operations may involve great expense, and it has been repeatedly urged on the department that investors are reluctant to spend the money required without further assurance than the law as it reads at present can give them. On this ground the department has been strenuously pressed to so construe the law as not to require the actual discovery of the lode which is supposed to exist within each claim, but to patent the claims upon evidence of the existence of mineral at or near the surface wholly disconnected with the supposed lodes below and of no value in itself, either present or prospective, it having been further urged that in these cases it was a matter of geological inference that ore bodies did exist far below the surface.

"It is obviously the duty of the department to carry into effect the intention of Congress expressed in statutory form. Congress having said that no lode claim should be patented without discovery of the vein or lode, within the limits of the claim, it would be an evident usurpation of power for this department to patent lode mining claims without proof of actual discovery. The frequently repeated assertions that the recent rulings of the department have overturned interpretations placed upon the law for 30 years seem utterly without foundation, as is pointed out in the recent departmental decisions. On the contrary, had the department decided that it could dispense with actual discovery it would have overturned the practically unanimous holdings both of the courts and of the department ever since the enactment of the lode-mining law. Doubtless in some cases claims have been patented where there was little or no proof of actual discovery, but the patenting of such claims is evidently to be laid to a misapprehension of the facts by employees of the land office, and not to a misconstruction of the law by the department.

Relation of Law to the Prospector

"It seems, however, possible by a change in the law to keep in force the policy of the Government expressed in the mining law of rewarding the actual discoverer of valuable veins, while at the same time giving such protection during the work preliminary to actual discovery as would make it possible for capital to invest, taking no more risk than that inherent in the question whether there is or is not in fact valuable mineral in the place where it is sought.

[5]Rev. Statutes U. S., Sec. 2320.

I suggest that the law should be amended so as to give a prospector, for a term of years, an exclusive right of possession and of prospecting within a limited area of land. In case actual discovery were made within the time given, patent would issue. The prospector should be obliged to perform a reasonable amount of work during the existence of the permit in order to make evident his good faith in attempting to find mineral within the limits of the claim. He should, however, be given the right by proper proceedings, to settle disputed questions of intervening claims, both in case of conflict with other mineral claims and also cases of conflict with agricultural claimants, so that he might at the earliest possible moment know whether or not his title would be absolutely clear upon his making discovery."

Location of Lodes Within Placers

Placer mines are likewise located by discovery and held by annual work and acquired by purchase in fee simple forever. Known veins within placer locations must be declared and paid for separately; otherwise they are excepted from the placer patent and can be located by others in 'lode claims.' All veins on placer ground not known to exist at the time of application for patent belong to the grantee, but without extralateral or apex rights. If an applicant for a placer patent can be shown to have had knowledge of a valuable lode within his lines prior to the making of his patent application, his title as to that vein may be cancelled for fraud at any time upon application of a contesting locator. There is no limit to the time for such contests, and they are still being brought in some cases 20 years after the placer patent was granted.

The law is very defective on this point; for it frequently happens that veins discovered today have a value by reason of improved transportation facilities or metallurgical processes, although these same veins were of no value whatever when the placer claim was located and patented. The owner of such a claim is sometimes put to the expense and annoyance of defending such contests repeatedly, since there is no limit to the number of contestants. The law should be amended so as to make it impossible to attack a placer patent on such charges after a reasonable term of years.

Multiplicity of Claims Locatable

Another defect in our present law is that permitting a prospector to locate an indefinite number of mining claims and to hold them without actually doing his assessment work. Many promising districts are kept from becoming hives of industry and producers of mineral wealth by the tying up of their territory in this way. The prospector should be restricted in the number of his locations, and real development work should be exacted.

Faulty Provision for Recording Claims

Still another weak point in our present system is in the provision for recording notices of location. It frequently happens that mining claims are located within the boundaries of some railroad or other land grant. The locator files his notice in the office of the local recorder, and the railway company files its selections with the Commissioner of the Land Department at Washington. Both selections are approved or at least allowed to stand, perhaps for years, each claimant believing his equitable title unclouded until an application is made for patent. Then a contest ensues, bitter feelings are engendered, and much money is needlessly spent because of the imperfect statutory provision for filing notices of location.

Lack of Provisions for Appeal

Still another serious defect in the United States and Alaskan mining and land laws is the lack of any provision for appeals to the courts from the decisions of administrative officers. It is contrary to the general spirit of our institutions and an anomaly in constitutional government to take away from any citizen property rights to which he considers himself justly entitled under the law, by the mere fiat of an appointed government official who is here today and gone tomorrow. To place in the hands of such officers the final dicta in matters involving property valued at hundreds of thousands of dollars, and to provide no method of appeal to any duly constituted nonpolitical judicial tribunal, is not only to subject the said officials to great and unnecessary tests of moral courage and fidelity, but to require in them the qualifications of superior judges and an experience in the interpretation of the law which many of them cannot be expected to possess. Serious injustice may be done without any remedy at law to the defeated applicant. In the interests of justice, provision should be made for appeals in important cases, and perhaps in all cases, from decisions of the commissioners of the General Land Office, or of the Secretary of the Interior, to some court of competent standing and jurisdiction, whose decisions could and would be accepted by the public and the interested parties as justified by the law and the evidence.

Extralateral Rights

The crowning absurdity of our present mining law is what is known as the apex provision, which permits the owner of the outcrop of a vein to follow it on its downward course into the earth and beneath the surface of property owned by another. This is the law that has made us famous among miners the world over. Not that the practice originated here, for it was tried by the medieval Germans and abandoned, as is said by an authority on Prussian mining law because "interminable lawsuits were inherent in the system," and it was in force in British Columbia for a brief period and likewise abolished; but it has been held here for half a century or more, and although our reputation for progress and right thinking is fairly high, the miner is burdened with this pernicious principle. Opinions without number could be quoted against it and but seldom one in its favor.

Hoover says:[6] "Lest the Americans think that the apex law was a sin original to themselves, we may mention that it was made use of in Europe a few centuries before Agricola."

George Otis Smith, director of the United States

[6]Hoover's 'Agricola,' p. 83, footnote.

Geological Survey, says:[7] "The law of the apex has proved more productive of expensive litigation than of economical mining."

A. Montgomery, state mining engineer of Western Australia, who is certainly well qualified to express an opinion, says, in a letter to your committee: "The extralateral right principle obtaining in portions of the United States is a standing marvel to the rest of the world, and that it could be seriously proposed to perpetuate it outside of cases in which it has already been unfortunately granted, seems incredible to most outside engineers with whom I have come in contact."

Many others have expressed themselves to us in a similar vein, and a synopsis of their views accompanies this report. From the replies thus received in answer to letters sent out by the committee one is convinced that the sentiment of mining men is overwhelmingly opposed to it in principle, and that the majority, although not so large, is in favor of its repeal at as early a date as possible.

Miscellaneous Defects

There are many other shortcomings in our present law. There are no adequate and proper provisions for the location and operation of oil wells, phosphate deposits, rare earths, haloids, and many other mineral substances. Our coal land laws are imperfect; the petroleum and natural gas resources should be safeguarded; assurance should be given as to the titles already granted, and the prospector should be again encouraged to go upon the public domain and discover additional treasures for the benefit of himself and the nation at large.

Recommendations

This committee has not felt called upon to make any attempt to draft a new code of mining laws, nor does it feel competent to do so. Such a task might engage the attention of a commission of business men, mining engineers, and attorneys, all selected because of their peculiar qualifications and experience in such matters. Indeed there is ample material to occupy the time of such a commission for at least one year in working out a harmonious scheme by which all interests should be properly subserved and the best results obtained. The committee gathered together a library on the subject of mining laws and have investigated the statutes of many countries, and it has seemed best at this time simply to call for an expression of opinion from members of the Society on certain elementary principles. In this way it will be possible for us to arrive at a correct conception as to the framework on which may later be built a complete structure. The committee begs to submit for the consideration of the Society the following recommendations, in the form of a series of resolutions:

1. The mining law should be revised, not piecemeal, but thoroughly, so as to coördinate and harmonize its various provisions.

2. Mining claims should be locatable regardless of a 'discovery' and held only so long as the specified development work is performed.

3. Placer locations should be limited to deposits of loose material above solid bedrock. The locator should have a preference right to locate also any lodes developed on his placer ground.

4. A statute of limitations should establish a reasonable term of years beyond which placer patents shall be immune from attack on the ground of fraud.

5. Provision should be made for the location and working of petroleum, phosphates, rare earths, haloids,and other mineral substances not specifically mentioned in the present law.

6. Full privilege of appeal to some competent court of law should be provided for in all cases of contests between rival claimants, or between a locator and the Government.

7. Notices of mining locations should be so recorded as to give the fullest possible notice to the world and to all concerned.

8. The apex law should be abolished.

9. Existing titles should be reaffirmed and fully recognized and no effort should be made to create retroactive legislation.

10. For the purpose of giving the fullest consideration to the needs of every branch of the mining industry in every part of the country, it is de-sirable that a government commission be created by act of Congress, whose duty it shall be to investigate by every proper means the questions and interests here referred to, and to make recommendations as a basis for the proposed mining law revision.

[7]Annual report for year ended June 30, 1911.

Unremunerative Rand Mines

Of the fifty-three mines which declared outputs to the Chamber of Mines in respect of the June, 1913, operations, twenty have not declared dividends for the first half of the current year. Of these the Lancaster merely recorded a small final clean-up, while the Spes Bona is a privately owned concern. The eighteen others had a capital in issue of over fifteen millions sterling. The name of the New Kleinfontein might also be added to the list. This concern, although it did not declare any output for the month on account of the strike, is under normal circumstances a regular producer of gold, the capital in issue being £970,000. Those who are loud in their denunciation of the mining companies as mere dividend-earning machines for foreign capitalists would do well to take the figures to heart. At most of these mines the margin of profit is very small, while the grade of ore is such as to admit of little possibility of improvement. In the event of further serious depletion of native labor complements the majority of the mines noted would have to close down immediately, and it is certain that a number of them would not resume operations. The effect of the application of closure at these mines would inevitably react on the workers themselves. The obvious consequences would be so appalling that it is difficult even at this time to imagine that the labor leaders will urge the continuation of a fight which must inevitably throw hundreds of white workers permanently out of employment as well as destroy confidence in the mineral industry of the Rand.—*South African Mining Journal.*

Waste Heat Boilers in Reverberatory Furnace Flues

By S. Severin Sorensen.

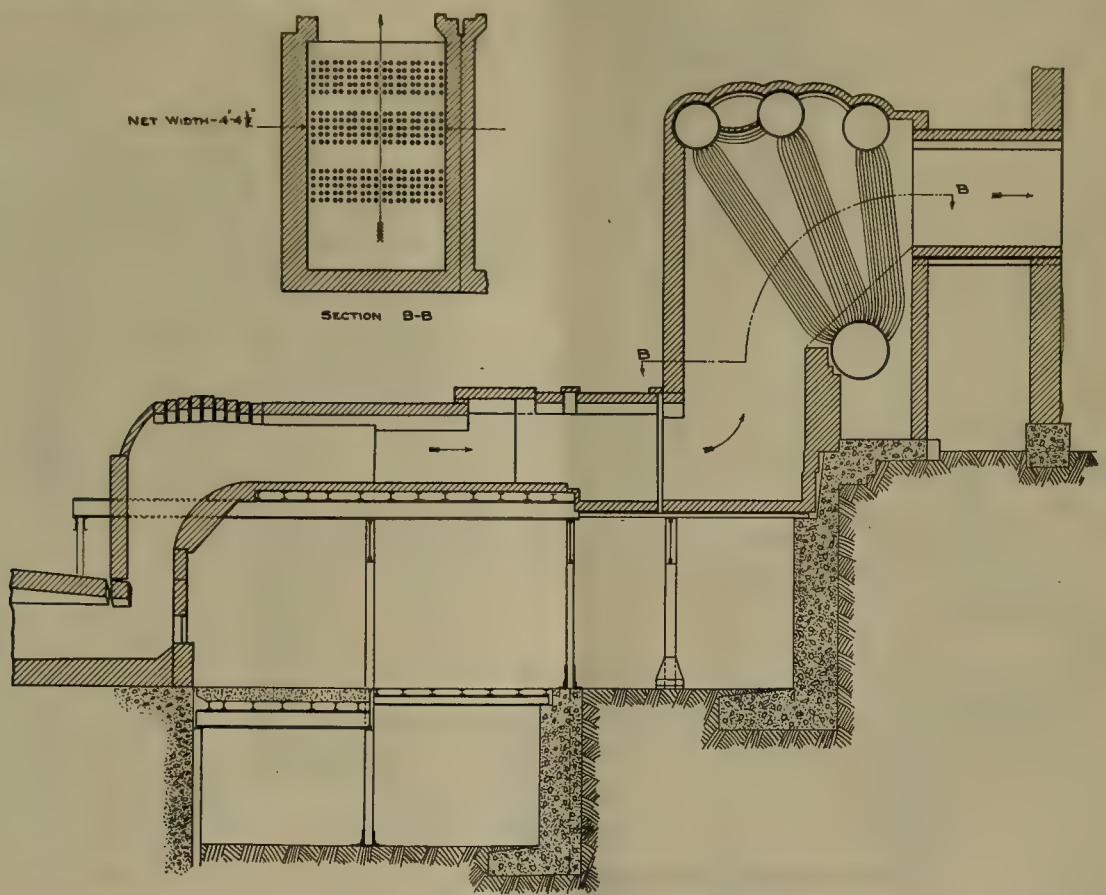
As there are probably few of those who are interested who are also in a position to make comparisons of actual results between two leading types of boilers when used to recover heat from the flue gases of metallurgical smelting furnaces, the following notes may be useful.

Stirling and the Babcock & Wilcox Boilers

The types here compared are the Stirling and the Babcock & Wilcox. The former are very widely used for this special purpose in copper smelters because of their large flue gas area and small obstruction to draft. They are specified as class 'S' No. 19 and are 400 nominal boiler horsepower each. There are no baffles used in setting, the gases only taking one curved pass through the tubes before leaving.

The Babcock & Wilcox are a specially designed pattern for this particular installation, described by them as $\frac{14-26}{2-36}$ —10—D, each having 4054 square feet of heating surface. No baffles are used in them either but their rows of tubes are staggered in respect to the flow of the gases, which is not the case with the Stirlings. The latter have straight open passages between rows of tubes. This is rendered necessary in order to provide means of getting their bent tubes in and out for repairs.

The illustrations show the settings of the two types of boilers in elevation. Inserts A–A and B–B show the arrangement of their tubes by cross-sections on planes parallel to the flow of the gases. As far as constriction of the passage and cutting down of draft goes there is a little in favor of the Stirling type. When it is remembered that they were originally introduced in coal fired plants where draft is possibly both more essential and more sensitive, one reason for the favor they have enjoyed is explained.



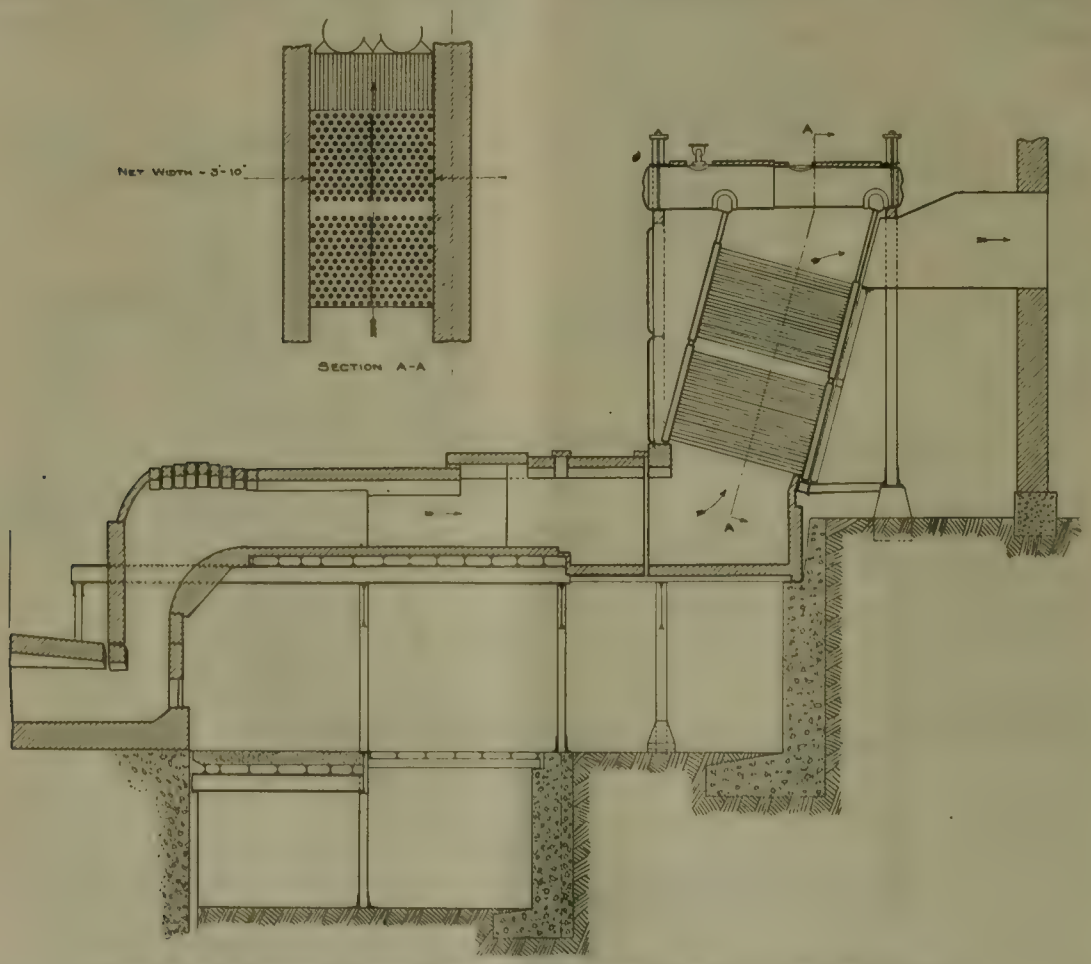
FLUES AND BOILER SETTING, STIRLING BOILER, STEPTOE VALLEY S. & M. CO., M'GILL, NEVADA.

It will be noted that the Babcock & Wilcox tubes lie flatter than the average of the Stirling bent tubes. The latter are 3¼ in. diameter and the former 4 inch.

In the early days of this plant I was in favor of the Stirlings because they were so much more quickly accessible for cleaning, having only four manholes to remove against 732 hand-holes each of which had a gasket to be removed and renewed. It thus took longer and cost more in direct charges for cleanings and repairs. In addition to the direct labor and material charges there was the extra time lost in the case of the Babcock & Wilcox boilers, which took longer than the Stirlings to clean. This extra time meant a loss when the cleaning was not done within the time required for repairs by its smelting furnace. So it looked like a walk-over victory for the Stirling

type. For a long time this conclusion held undisputed sway, for in the absence of data it was based on the assumption of equal efficiencies of the two types. It was only after separate meters for measuring the feed water to each battery of boilers were obtained and comparisons of evaporative performances were made that it was seen that the Babcock & Wilcox were giving a higher evaporative duty. At first I suspected the figures. But having changed meters and checked results in various ways the truth was borne in on me that the money was being put on the wrong horse. For the higher evaporation obtained from the Babcock & Wilcox boilers far

Material repairing	22.81	7.58
Labor repairing	30.19	29.07
Material cleaning	24.63	3.94
Total	$172.17	$95.34
Average number of days in service	83.5	88.40
Average number of days down, cleaning and repairing	7.54	6.56
	91.04	94.96
Time down as per cent total time	8.28	6.93
Number of boiler repairs per 100 days	1.10	1.056
Repair cost per 100 days	$189.39	$100.69
Water evaporated by battery of two boilers per day, lb.	861,111	621,472



FLUES AND BOILER SETTING, BABCOCK & WILCOX BOILER, STEPTOE VALLEY S. & M. CO., M'GILL, NEVADA.

more than compensates for the extra cost and extra time lost in cleaning and repairing. In proof of this conclusion I append the figures on which it is based. They speak for themselves. I may add that the meters are calibrated every month at various rates by gauging in a measured tank, allowance being made for temperature differences. From the meter readings a deduction is made for blow-downs which are made and automatically recorded twice every 8-hour shift.

	Babcock & Wilcox.	Stirling.
Period covered in comparison, year	1912	1912
Number of boiler repairs	11	23
Average cost of repair and cleaning per repair, opening, cleaning, closing, testing	94.54	54.75
Average boiler horsepower	520	375
Water evaporated in 100 days, less days lost cleaning and repairing, lb.	78,998,598	57,840,429
Evaporation lost during cleaning and repairs, lb.	7,112,802	4,306,803
Equivalent oil recovered at 14 lb. H_2O per 1 lb. oil, barrels	16,793	13,203
Recovered, dollars	27,708	21,785
Lost, barrels	1,512	917
Lost, dollars	2,494	1,512
Cost of repairing and cleaning per 100 days	189.39	100.69
Total loss and cost per 100 days	2,683.39	1,612.69
Net recovery in 100 days	25,024.61	20,172.31
Balance in favor of battery Babcock & Wilcox type, per annum	17,710.90	

Other figures point to the same conclusion. For, with the same assumptions and the same methods in

testing, checking and figuring, the pounds of water evaporated from and at 212 F. per pound of oil burned in the smelting furnaces was 3.315 for the Stirling boilers as against 7.91 for the Babcock & Wilcox type. To show that this was not due to deferred combustion favoring the boiler duty at the expense of the furnace smelting through faulty firing it is only necessary to state that for the same period the net oil per ton solid charge for the furnace with the Babcock & Wilcox boilers was only 77% that of the others with the Stirling. It is true the former burned 5% more oil gross per ton solid charge than the others. This may be due to inferiority of the furnace. But it is evident from the above figures that it more than compensated for that extravagance by its greater net efficiency.

From an examination of the two settings as shown in the sectional elevation in the illustrations it is evident that apart from the staggered as opposed to the straight line setting of the tubes the Stirlings lose by reason of the larger percentage of comparatively ineffective tube lengths. This might be improved both in front and at the back where structural conditions and levels permit. And on the other hand the Babcock & Wilcox records for cost of cleaning and repairing could be improved were the hand hole joints of the metal to metal type instead of being made up with fabric gaskets.

The Electrolysis of Cyanide Solutions

By Edward F. Kern.

*The experiments upon which this article is based were conducted by E. H. Koenig and S. E. Woodworth in the Metallurgical Laboratory of the School of Mines of Columbia University. The work was undertaken with the idea of determining the validity of some of the conflicting statements which were found in reviewing the literature on the electrolysis of cyanide solutions.

The electrolysis of cyanide solutions which are used for the treatment of gold and silver has caused much speculation, not only on account of the application of electrolysis as a means of recovering the gold and silver from leaching solutions, but also as a means of regeneration of the cyanide. Two of the main items of expense of the modern cyanide process are the consumption of cyanide and the cost of recovering the gold and silver in a fairly pure state.

Electrometallurgists and electrochemists, having in mind the reduction in cost of treatment of gold and silver ores, have developed a number of processes in which electrolysis has been applied for the recovery of metals from leaching solutions and for the regeneration of the cyanide, which during the treatment has been converted into cyanide compounds whose solutions do not dissolve gold and silver.

Conclusions from the Literature on the Subject

The conclusions, which may be drawn by making a digest of the literature on the electrolysis of cyanide solutions, are as follows: 1. Electrolysis has, under favorable conditions, been utilized as a means of precipitating and recovering gold and silver from cyanide leach solutions by electrolyzing the solution with suitable electrodes and with a current density of 0.01 to 0.6 ampere per square foot (0.11 to 6.5 amp. per square meter). The metal was deposited as a dense film when the current density was properly regulated with regard to the composition, the concentration, and the circulation of the solution. The deposit formed is pulverulent and non-adherent if the solution is dilute, the circulation sluggish, and the current density high. 2. Iron anodes dissolve in cyanide electrolytes, causing consumption of cyanide and contamination of the solution by precipitates of iron compounds. 3. Carbon and graphite anodes are satisfactory in cyanide electrolytes when used at low current density, but they disintegrate at high current density, causing fouling of the solution. 4. Peroxidized lead anodes are not dissolved during electrolysis of cyanide solutions, and the consumption of cyanide by their use is less than when metallic iron anodes are employed. 5. Fused iron oxide anodes are permanent in cyanide electrolytes, and the cyanide consumption by their use is small. 6. Oxygen, supplied to cyanide leaching solutions either by additions of chemicals or by electrolysis, is beneficial for the treatment of certain refractory ores, in that the extraction is thereby accomplished more rapidly and more efficiently. Electrolysis is claimed to be a cheaper and more efficient method of supplying oxygen to cyanide leaching solutions than by the addition of chemical oxidizers. 7. Regeneration of cyanide work solutions, which contain cyanogen compounds, is possible by electrolysis. There is controversy as to whether alternating current can be used for this purpose. 8. Electrolysis of solutions containing sulphocyanide and cyanimide by means of direct current at high current density (50 amperes per square foot, 540 amperes per square meter) produced solutions of cyanide. Fused iron oxide anodes were found to be the most satisfactory for this purpose. 9. Electrolysis of solutions containing only cyanide produces cyanates, which will not dissolve gold and silver. 10. Telluride gold ores were effectively treated by use of solutions which contained an halogen-cyanide compound, which was generated by electrolysis of solutions containing an halide salt and cyanogen compounds, employing direct current at high current density for producing the active halogen-cyanide compound.

Experiments.

The object in view, when the experiments were undertaken, was to determine: (1) which kind of anodes are the most permanent, and which kind give the highest efficiency as regards the regeneration of cyanide solutions; (2) whether the electrolysis of

*Abstract of paper presented at the twenty-fourth general meeting of the American Electrochemical Society, at Denver, Colo., September 9-11, 1913.

cyanide leaching solutions is beneficial in increasing the extraction of gold and silver from ores, and in reducing the cyanide consumption; (3) whether high or low current density produces the greatest amount of active solvents in cyanide leaching solutions, the active solvents being those which are active in dissolving gold and silver; (4) whether a relative difference in current density at the anode and the cathode affects the consumption of cyanide, and what effect this relative difference in current density has upon the production of active solvents in cyanide solutions; (5) what effect the alkalinity of cyanide leaching solutions has upon the results of electrolysis; (6) whether electrolysis of cyanide leaching solutions is beneficial in reducing the time required for the efficient treatment of gold and silver ores; and (7) what current density at the anode and at the cathode is most suitable for the regeneration of cyanide leaching solutions which contain ferrocyanide and sulphocyanide.

Conclusions.

A summary of the results of the experiments on the electrolysis of cyanide solutions is as follows:

1. The electrolysis of cyanide solutions by direct current and by means of insoluble anodes is accompanied by progressive consumption of cyanide, which is the result of oxidation of the cyanide to oxycyanide compounds.

2. Anodes of metallic iron, nickel, and lead are dissolved during the electrolysis of cyanide solutions; these metals on entering the solution are immediately precipitated, the lead as hydroxide, and the iron and nickel as a mixture of hydroxide and cyanogen compounds. The consumption of cyanide by means of these anodes was relatively greater the lower the current density, as at high current density oxygen was simultaneously liberated, and consequently less metal was dissolved. The consumption of cyanide was less in case of the lead anodes than with either the iron or the nickel.

3. Peroxidized lead and 'passive' iron anodes were found to be more permanent than metallic anodes of either iron, nickel or lead. There was no apparent corrosion of either the peroxidized lead or the passive iron anodes so long as they kept continuously in use, but exposure to the atmosphere for several days destroyed their permanency, due to spontaneous oxidation. The passive iron anodes were found to be more satisfactory than peroxidized lead anodes for electrolyzing cyanide solutions, in that the cyanide consumption was much less and the voltage was slightly less in most cases.

4. Electrolysis of cyanide solutions which were used for leaching a special refractory gold and silver ore containing sulphide minerals was found not to be beneficial either in reducing the cyanide consumption or increasing the percentage of extraction.

5. Low current density at both the anode and the cathode gave less consumption of cyanide, and in several cases seemed to have produced a slight amount of active solvents, but not enough to compensate for the loss of cyanide which resulted by the electrolysis.

6. The cyanide consumption during electrolysis of cyanide solutions was greater when the current density at the cathode was run higher than at the anode, which suggested that the loss of cyanide is the result of oxidation, with the formation of oxycyanogen compounds. The lower the current density at the anode and the higher it is at the cathode, relatively greater is the cyanide consumption.

7. When cyanide solutions containing sulphocyanides or ferrocyanides are electrolyzed, the cyanide consumption was much less than that which occurred in pure cyanide solutions, which indicates that sulphocyanide and ferrocyanide act as protective agents during the electrolysis of cyanide solutions.

8. The increased alkalinity of cyanide solutions reduced the cyanide consumption during electrolysis, due to increasing the conductivity of the solution. The higher the voltage the greater the cyanide consumption, and vice versa.

9. The electrolysis of cyanide leaching solutions had no apparent effect upon reducing the time required for treating a refractory ore nor in increasing the percentage of extraction.

10. Peroxidized lead anodes and passive iron anodes are corroded in cyanide electrolytes which contain sulphocyanide, if the electrolysis is conducted at high current density. No apparent corrosion occurred when a low current density (below 3 amperes per square foot, or 32 amperes per square meter) was used.

11. Passive iron anodes are more satisfactory than peroxidized lead anodes for the electrolysis of cyanide solutions which contain either sulphocyanides or ferrocyanides, in that by their use the cyanide consumption is very much less and the voltage slightly less. The lower the current density the smaller the consumption.

12. The regeneration of cyanide solutions which contain sulphocyanide and ferrocyanide does not occur by electrolysis with direct current, whether the conditions of electrolysis be made oxidizing or reducing by varying the relative current densities at the anode and the cathode.

The suggestions which were stimulated by the foregoing experiments will form the basis of a series of future experiments, which it is hoped will contribute something more to the knowledge of what occurs during the electrolysis of cyanide solutions.

Electric smelting of tin ore has been tried in Cornwall by the Grondal-Kjellin company of London. The results were favorable, according to the *Revue Industrielle*, pure ores giving metal of 98% purity, while Bolivian ores containing 49.5% of tin and about 15% of iron yielded metal of 92% to 97% purity, which could be further refined to 99.75% or more by blowing air through the molten mass. The energy consumed amounted to 1700-kw. hours per ton on the average. By working with two furnaces, one to treat the rich slag and the other to produce the metal, the company hopes to reduce this consumption to 1400-kw. hours, giving an efficiency of 55%. There is a saving of 25% of labor. It is stated that at mines where hydro-electric power is available, the process will be commercially practicable and economical.

Coal output of India in 1912 was 14,044,360 tons.

California Oil Production for 1913

By J. H. G. Wolf

The accompanying graph shows briefly the status and the late trend of the state's crude petroleum business. With the expansion in area of the known oilfields, the production has increased, with a corresponding increase of consumption. The shipments, which are the basis for defining consumption, include all movements of oil from the fields, as well as the wastage and losses, though probably do not account for the whole of the evaporation and shrinkage losses of the oil in storage, which are known to be heavy.

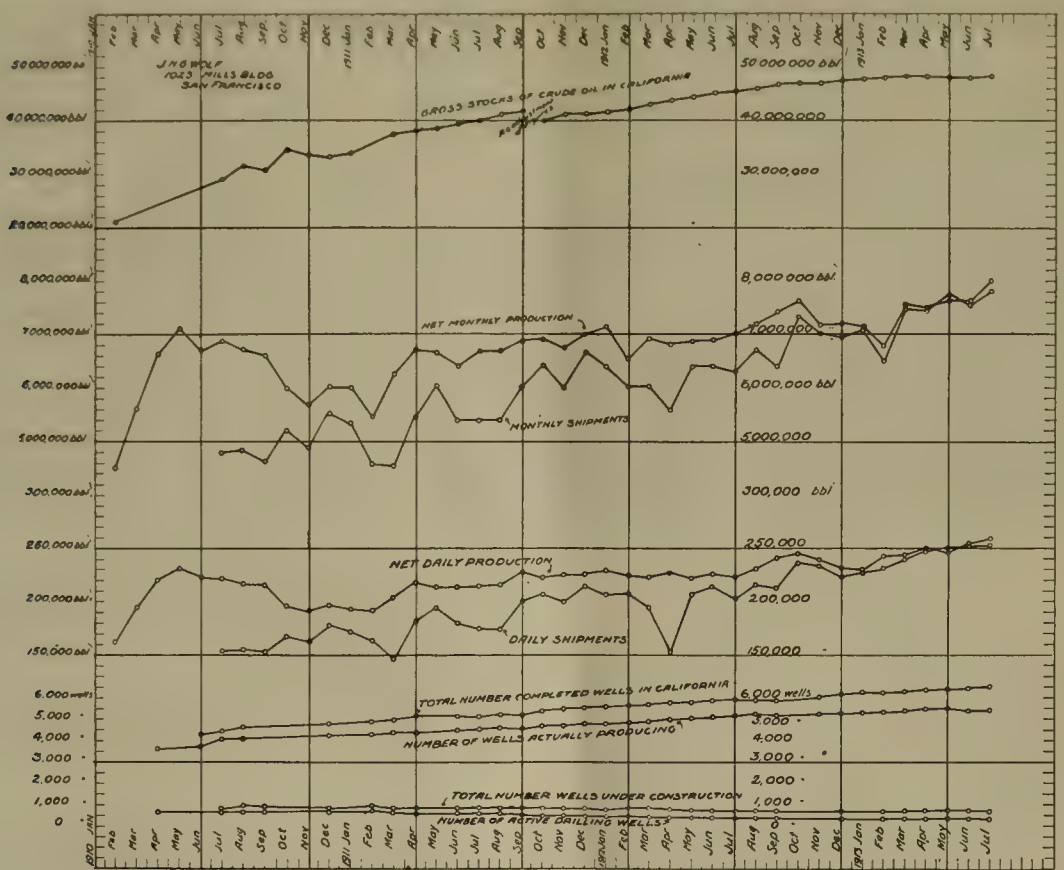


CHART SHOWING PRODUCTION AND STOCKS OF CALIFORNIA OIL.

The features of particular importance are:

1. That the accumulation of oil in storage, or the surplus on hand, has failed to increase sensibly in quantity above 48,000,000 bbl. since about January 1, 1913.

2. That the production in a single month passed 8,000,000 bbl. in July 1913, and the rate of increase in the 24 previous months was practically constant at 54,000 bbl. per month, or 1800 bbl. per day.

3. That the consumption in a single month passed 7,800,000 bbl., in July 1913. The rate of increase in consumption in the 24 previous months was practically constant at 100,000 bbl. per month, or 3290 bbl. per day, or exceeding the gain in production by 46,000 bbl. per month.

While it cannot be denied that the output has been under some restraint, owing to low prices to the producer and other causes, and that the bringing in of occasional heavy-flowing wells is still characteristic of the Midway field, it appears that the production of the fields as a whole has been brought under normal control. The surplus or stock in trade for the conduct of the business is practically constant at 48,000,000 bbl., or a six months supply. The yield for August was greater than for July, owing to the bringing in of an uncontrolled flowing well of 20,000 bbl. in the Midway. September may show some further increase from this cause. With the August yield, California's production is at the rate of 100,000,000 bbl. annually, as compared with the 125,000,000 bbl. produced annually by the remainder of the oilfields of the United States.

An index of the stability of the business in this state can be seen in the uniformity of the rate of increase in both production and consumption. The exploitation of new oilfields in any part of the world is attended usually by violent fluctuations in the output. This is particularly true in districts where the oil is in light and non-important measures, and which are opened and exhausted in a comparatively few years. Such a condition does not exist here.

All the prominent oil-producing fields of California have been under development for twelve years, and none has been exhausted. The gain and yield has been a remarkably uniform one, and the market has expanded correspondingly. It would seem that he who founds an industry upon the expectation of

obtaining a steady and reliable supply of crude petroleum in this state can do so with the reasonable assurance that the supply will not fail him in his generation. In a situation where suitable steaming coal is scarce, as it is on the western coast of America, the market for crude petroleum as liquid fuel is sure to be a broad and an expanding one, and with the steady decline of the Eastern fields which produce the good grades of refining oils, the incentive to prospect more widely in this state, and for years to come, will not be lacking. Of late the proportion of the output that is above 21°B., and classed locally as refining oil, has been brought to above 40%; practically all the 'flush' production of today is from flowing wells of oil above 24°B. It is said that 1½% only of the state's production is above 21° Baumé.

The data on the number of wells completed, active, and idle confirm the statement that the output is under restraint. The number of active producing wells on June 30, 1912 (omitting the 537 wells of the Los Angeles City and the Summerland wells, which for practical purposes can be considered as spent wells) was 5091, whereas on June 30, 1913, it was 5422, or a gain of 331 wells, or 6.5%. If the assumption that in oil production it requires new drilling to the extent of 10% per year to maintain a constant output in the statement of a normal condition, then a gain of 650,000 bbl. in output in one year with but 6.5% added to the number of wells producing, shows unmistakably that the fields are capable of still greater expansion, which is a gratifying situation for the industry, even though it may make hard times for the individual producer for the time being.

Sampling Coal Mines

In taking a sample of coal for analysis a geologist of the U. S. Geol. Survey is instructed to make every endeavor to procure fresh unweathered material. He is supposed to face up the bed in the mine or prospect until fresh material is available, and then to obtain his sample by making a uniform cut across the bed from roof to floor, including all such benches and partings as an experienced and careful miner would include in commercial coal and throwing out such impurities as would certainly be excluded in practical operation. He is supposed to cut sufficient coal to give at least 6 pounds per foot of coal bed sampled. The sample is hastily pulverized in the mine until it will pass through a ½-inch mesh, and then is quartered down until 4 pounds remain. This is placed in a galvanized-iron can, sealed with adhesive tape or paraffin, and mailed to the laboratory for analysis. The sampling is done on the principle that a coal mine should be sampled as carefully as a gold mine, and that the sample should be even more carefully handled after it has been taken. The object of sealing is to prevent change in the moisture content, so that the coal may reach the laboratory in practically the same condition that it exists in the mine.

The Minerals Separation & De Bavay's Processes Australia Proprietary, Ltd., has declared an interim dividend at the rate of 10% per annum.

Tube-Mill Calculations

The rate of revolution most satisfactory in practice is found to be 200 divided by the square root of D, where D = diameter in inches. Thus, a 4 ft. 1 in. mill should revolve at 200 ÷ 7 (square root of 49 is 7) = 29 = the correct number of revolutions per minute (Davidsen).

The correct change of flints is found to be W = 44 × N, where W = weight of flints required and N = the number of cubic feet contained in cylinder of tube-mill; but West Australian wet-grinding practice takes nearly 50% more flints than these figures, and South African practice is even higher.

Ball's investigation shows that most efficient pebble load is about seven-sixteenths of the volume of the tube-mill. The most effectual crushing load is three-fifths of the volume, which corresponds to Rand practice, but this is gained at too great an expense for power.

Ball's tests indicate the most efficient figure to be 30 tons per one ton of pebble charge; output 10 tons of ground sand per ton of pebble charge, or 1½ tons per horsepower (African practice at 90-mesh). El Oro output shows 1.2 tons per horsepower at 150 to 200-mesh. Various observers show that the percentage of moisture should not exceed 38.5 to 39 per cent.

Nothing has yet been published which would prove that it is economical to feed particles coarser than 10 to 14 mesh. Three-mesh has been much used in South Africa, but the investigations of the introducers of the tube-mill are not in favor of such coarse feed.

For wet crushing, large pebbles of 3 to 4 inches in diameter are employed, but some of the most accurate observers prefer a rather smaller pebble than this, as in dry crushing.

In testing efficiencies and outputs of tube-mills, samples obtained during the first hour after an adjustment should be regarded as abnormal.

The value of the gold and silver bullion production in Salvador, Central America, in 1912 amounted to $1,396,730, as compared with $1,525,998 for the previous year. The Butters Salvador Mines Co. continued to be the most important producer. A new company, known as the Monte Mayor Gold & Silver Mining Co., started operations during the year. The Comaracan Gold Mining Co., at one time a large producer and at present not running at full capacity, intends to install new equipment soon. The other mines now in active operation are Los Encuentros and El Tobanco. Practically all the bullion and ore are shipped to the United States.

The Spassky and Atbasar copper properties, in Siberia, are to be operated by one company, although they are 300 miles apart. The ore reserves in the Atbasar are 517,909 tons of 10.25% copper, and a smelter is to be erected. The Spassky produces over 400 tons of copper monthly, while the company owns a coal mine with large quantities of good coal. The capital of the Spassky Copper Co. is to be increased to £1,250,000.

Russian Platinum

Owing to the steady advance in the price of platinum which has been taking place for a number of years, and the new uses which are being found for the metal, the platinum industry of the Urals, which is the most important producing district of the world, is experiencing an awakening both as to methods and scope of operation. An imperial law was passed some time ago whereby the exportation of crude platinum, after a date to be fixed by the Minister of Trade and Industry, would be prohibited. The object of such a measure was evidently that the government might exercise, in part, a control of the industry. The reasons for the government exercising this limited control appear more sentimental than material, in that the small plant that will be necessary for handling the entire output will add but a few thousand rubles to the income of the Russian workmen, and the possible lack of efficiency in refining might well counterbalance the capital which will be kept in the country by this measure. However, with a general supervision exercised by the government and advances being made to the producers from the Imperial Bank, it is expected that the violent fluctuations of the market will be materially decreased. In that the consumption is almost wholly without the country and is largely controlled by syndicated interests, it is reasonable to suppose that the government may find it difficult to exert a control of the industry. Whether it will ever suit the convenience of the foreign syndicate to run the price down again will depend upon the firmness with which the government proceeds with its new policy of holding the platinum industry both as a producing and manufacturing industry in the country itself.

Expansion of Mining Operations

At the present time the high price of platinum is attracting labor from the goldfields of Russia and every piece of available ground is being worked according to the means of the operator. The tendency toward the industry coming into the hands of companies capable of operating on a large scale, and the business is gradually passing into the hands of the large operators. Among these companies may be mentioned the Ovsyankin company, which is a purely Russian organization controlling 109 placers in the Orenburg government. Councellor Ratkoff-Rashnoff has formed a company with a capital of 10,000,000 rubles, known as the Lower Tagil Platinum and Mining Company, which will operate in the Perm government. Another company has been formed to work platinum deposits in the Lower Tagil district belonging to the Demidoff successors and Prince San Donato. The passing of the control of the platinum fields into the hands of the larger operators is the natural sequence, in that the deposits have become of lower grade and it has become necessary to handle large quantities of material, requiring more expensive equipment and larger capital to work them.

The illustration presents a type of the mill which is gradually becoming extinct. It is from such plants that the bulk of the world's output has been produced in the past. On the right of the picture is shown the 'stirrer' and trommel into which the gravel is dumped and screened, from which it passes to the tables, which are housed in the low shed in the centre of the illustration. In this particular mill there are three tables. The tailing is removed through the revolving cylinder, shown at the left of the illustration. This cylinder is fitted with an archimedean screw which acts as an elevator and dumps and stacks the tailing. The platinum is recovered in the form of small nuggets, scales, and rounded or irregular grains. The specific gravity of this concentrate is from 14 to 19 and the percentage of metal varies from 70 to 85. The method of working the platinum alluvial deposits was described in the *Mining and Scientific Press* of June 22, 1912.

PLATINUM MILL IN THE URALS.

The scope of the industry in the Perm government may be had from a recent report of the Perm Government Gold and Platinum Council. It is stated in this report that the average annual production of platinum from 1903 to 1912 amounted to 330 poods and 29 funts (191,254 oz.) Just at the present time the market at Ekaterinburg is reported as weaker. The price which has obtained for a long time of 9 rubles 90 kopeks ($5.04) per zolotnik (0.13715 Troy oz.) has declined to 9 rubles 40 kopeks ($4.80). As a result little if any business is being done at the price named and the stock of platinum has increased somewhat. At the present time the output is being consumed largely in the manufacture of laboratory equipment, the sulphuric acid industry, photography, dentistry, electrical apparatus, jewelry, and in the manufacture of lamps.

Gold production of British Guiana in July was valued at $739,780, and 2558 carats of diamonds $13,983 were won. July output of gold in West Africa was 32,345 oz., Rhodesia £249,302, and Queensland £107,050. In August the Transvaal produced 728,096 oz., Western Australia 110,169 oz., Victoria £175,100, New South Wales £156,348, and New Zealand £156,348.

Tin-concentrate output of Nigeria in August was 390 tons from 31 companies.

Discussion

Readers of the MINING AND SCIENTIFIC PRESS are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment. Insertion of any contribution is determined by its probable interest to the readers of this journal.

Solution Control in Cyanidation

The Editor:

Sir—A. W. Allens' article in your issue of September 20 calls for a protest, in as much as it implies that cyanide operators in general have been working in the dark as regards free cyanide content of working solutions. I admit that such conditions do exist, but they are by no means general. Most working solutions permit of the simple determination of free cyanide by direct titration with silver nitrate regardless of the alkalinity, a method, I believe, in general use. This method depends on the presence of zinc, which acts as an indicator, and in addition the solution must be perfectly clear, as well as the flask in which the titration is made. The end point is indicated by a very delicate opalescence best seen in strong reflected light.

The above method will indicate regeneration of free cyanide by addition of lime under certain conditions, and will also indicate decrease in free cyanide during precipitation, in contradiction of Mr. Allens' experiences but in accord with the principles of chemistry.

Owing to complexity of working solutions there is room for argument as to what reactions occur under certain conditions, as the chemistry of the cyanide process is anything but an exact science, but it is sufficiently well understood for its intelligent application, so that the well informed operator can usually determine free cyanide with more certainty and almost as simply as one whom I knew to determine alkalinity by feeling with his fingers.

I am inclined to believe that Mr. Allen overrates the evils of zinc in solution. Never in twelve years' operations have I thrown away a ton of solution on account of fouling with zinc, nor have I experienced any difficulty with either solution or precipitation of the precious metals on this account. I refer to zinc entering the solution through precipitation by this element. Such troubles are usually due to insufficient free cyanide, which has been allowed to fall below normal on account of some new condition interfering with standard titrations.

Referring to Mr. Allens' article, page 449, he says: "Routine titrations for cyanide strength had been made regularly and showed no material alteration * * *." Farther on he adds: "The solution was analyzed and was found to contain a high zinc content and also a considerable amount of copper." It is quite evident that free cyanide must have been very low. On the addition of more cyanide to solution entering zinc-boxes "the outgoing solution showed an immediate drop."

I cannot accept Mr. Allens' statement in regard to function of hydrogen in precipitation. The liberation of hydrogen is sometimes incidental to and not the cause of precipitation. Pure zinc dissolves very slowly in a solution of pure cyanide. It however dissolves quite readily in a solution of caustic alkali, and the action often seen in zinc-boxes is due more to alkali than to cyanide. It appears to me that the solutions in question were saturated with zinc to the extent of having all of the cyanide combined, and in this sense only. Free cyanide is the most essential condition for good precipitation. I have seen violent action in boxes, due to caustic alkali and poor precipitation resulting; also very good precipitation without any visible liberation of hydrogen.

JAMES S. COLBATH.

Los Angeles, September 30, 1913.

Prospecting by the Government

The Editor:

Sir—Mr. Albert Burch's recent suggestion for government aided prospecting was read by me with much interest, and I must say with as much trepidation as interest, for Mr. Burch's commanding position in the mining world gives to his conclusions a force that makes such socialistic suggestions the more to be feared. To Mr. Burch's invitation for criticism I was glad to see that the first response—that of Mr. R. P. McLaughlin—took the individualistic standpoint.

Mr. Burch's argument in brief is that the easy mines have been found, and that prospecting, through a continually lessening likelihood of reward, seems in danger of being abandoned as an occupation unless stimulated by the certainty of a salary, and this he would have the government pay.

Theoretically Mr. Burch's assumption of lessening likelihood of reward seems to be true: for by just the number of mines discovered in the last forty years there are so many deposits eliminated from the possibility of discovery. But this is offset in a great measure by the constantly increasing factors which redound to the prospector's advantage. Among them, security from Indian attacks, greater and quicker facilities for transportation, supplies comparatively near at hand, perfection of metallurgical processes which make refractory and low-grade ores—valueless in the past—of great value now, readily obtainable geological reports eliminating at once vast areas which have no possibility of bearing precious minerals, and the unquestionably greater ease with which capital can be obtained for the development or purchase of a promising prospect.

When Scheffelin packed his burros and started across Arizona on the trip which was to end in the discovery of Tombstone he, like Theseus who faced the whole world armed only with his club, trusted to his valor. The factors for failure confronting him were greater, I think, than those confronting the prospector of today. He faced the very great danger of death from Indians; he was cut off from the possibility of supplies; and he traversed an uncharted desert where now every water-hole is mapped and known. He also crossed areas of country whose mineral possibilities, or lack of possibilities, he himself had to determine, instead of being able to go through a process of elimination by consulting the geological reports which now are to be had by anyone for the asking.

Yet in spite of all these obstacles Scheffelin succeeded. He was only one out of many men of his time to do so, however. The great majority of his contemporaries did not succeed. It is inherent in the nature of the game then as now that no matter how many are called but few are chosen. But there were then, and there are now, and always will be, men whose psychology is such that they will bet their lives on a big reward but find it impossible to play them for the smaller, if more certain, gains of plodding industry.

That heretofore prospected regions even though mined in for years still offer chances for the careful or lucky prospector is seen from the comparatively recent discoveries of Tonopah and Goldfield in sight of the old camps of Montezuma and Candeleria. And there are numerous such instances.

The prospector of the future must be a more painstaking and a more scientifically trained man. He must rake the region he prospects with a fine-toothed comb instead of running over it. But at bottom he will still be the man who prefers the great gamble to the drudgery of detail. A few will achieve glittering success, while the majority will eke out a living one way or another, which is what the majority in every pursuit has always done and always will do whether aided by government or not.

If unaided I believe a keener and more efficient man will result. But supposing that Mr. Burch's suggestion is carried into effect and every western state sees its government prospectors take the field, who will profit by it? Undoubtedly a large number of men will become pensioners and sure of a livelihood whether they honestly try, or fortunately succeed, or not, and another bureaucracy of politicians will have been installed to administer this function of government and deal out the plums.

The ultimate and great reward will go to the capitalists, then as now, who have the means to develop and equip the properties. It will not result even in so democratizing mining that all capitalists will have a chance at the government paid for discoveries, but only a small group of capitalists—those who know the mining game. That is as it is now.

Mr. McLaughlin has, to my mind, clearly and completely defined the kind of work that should be undertaken by the federal government: "that which is so large or upon which returns will be so long delayed that private enterprise can not well embark; or work which so intimately affects the common welfare that private enterprise can not be entrusted to do it."

It is not the function of a government like ours to subsidize or bolster up an industry in its time of depression. And if it is asked to extend a paternal hand to one wailing child it must be equally considerate of all others who complain.

A few years ago a considerable number of citizens were crying "we must do something for silver." Tomorrow it is the prospector who must be assisted; and the day after the cowboy, and grain grower, the horse breeder, and all through the list until it may be there would be no limit to those looking for assistance.

Before giving our support to government aided prospecting let us pause long enough to carefully consider what is being proposed. It is well to get clearly in our minds who and what government is in this country, since it is becoming so common to call upon it for and expect its assistance. This government is not an omnipotent entity with unlimited means to do. It is, to quote a well known economist, merely "all of us." And to ask the government to assist an industry or pension a class it is but demanding to know "what shall all of us do for some of us." This is not the fundamental of Anglo-Saxon genius; it is not that which has made this country great.

MARSHALL BOND.

Seattle, Wash., Sept. 27.

Mining Experts and 'Practical' Men

The Editor:

Sir—It seems that one should always be prepared for surprises in mining. New modes of occurrence of the various metals are continually described, and the wisest old prospector will shake his head and say: "You never can tell nowadays; you find valuable metals most anywhere." In the course of my travels through Arizona, I met with a rather pathetic case, which I think illustrates this point. An old Comstock miner had located a group of claims and for a number of years had quite religiously done the required assessment work. I was induced to visit his ground, as I was given to understand there were some very good copper showings. Upon arriving at the property, I found the old prospector a very entertaining and cordial fellow, and after a little visit started with him over the property. I could see at the outset that it meant some pretty stiff climbing, and I had some misgivings as to the ability of my companion to hold out. Later in the day I was quite disabused of this opinion, and, indeed, I was more than surprised to see the agility and ease with which this man of 65 could get over the ground. A wonderful commentary on the healthfulness of outdoor life. But, to go back to the point: I had walked some distance, and as yet had seen no favorable outcrop, and was beginning to get a little anxious, though I said nothing. Finally, my companion stopped and, picking up some rock, said: "There, don't you think that looks pretty good for copper?" To say that I was surprised is putting it mildly. I did not know how to answer. To be sure, the rock was green, but I did not suppose anyone would call it copper. If it had been anyone else I would have laughed outright and considered it a joke, but instead I looked wise and deliberately taking out my glass, examined the rock closely. I found it to be a dioritic type, containing considerable chlorite. "You do not expect to find copper in this rock, do you?" I said. "Well," he answered, "I sent a specimen away to a university, and they told me it contained copper." I do not know what kind of an analysis they could have given the old man, but evidently it was so involved in technicalities that it led him to believe that this rock should contain disseminated copper. It only goes to show that a little expert opinion couched in technical language is often a dangerous thing. Just a plain, straightforward statement would have given

no misunderstanding of the rock's composition.

I found the old gentleman had driven a 530-ft. adit, almost unaided. The only indication of mineralization was the occurrence in a few seams and small fissures, of primary chalcopyrite. I found certain places where, for a considerable distance, the whole rock would average about 0.5% copper. However, there was no evidence of leaching or secondary enrichment. In other words, there was absolutely nothing to warrant exploitation. The peculiar thing about this experience was that I found some adjoining ground (to which he took me last, and which he did not consider important) that contained some excellent surface showings. The rock was soft and well leached, and in certain places I found rich masses of copper carbonates and oxides. As you will imagine, I could not understand why the work had not been done in this locality. I was decidedly reluctant to criticize, but I made quite plain my opinion of the situation, and I hope it did some good.

Another experience of quite a different sort illustrates how people will take liberties with nature in exploiting properties. My attention was called to certain clay deposits in Texas, which were said to be rich in copper. The matter was put up in such a way that it seemed worthy of investigation, so accordingly I made a trip to the locality. I found a region occupied by red sandstones and red and blue clay, interstratified in certain places with gypsum and salt. A number of shallow pits had been dug, none of them deeper than 15 ft., and in most of these I could find concretions of copper. In some instances the surface leaching had given a perceptible copper color to the banks, the whole constituting a rather interesting occurrence of copper, but decidedly discouraging from a commercial standpoint.

With no attending circumstances this might be passed off as one of those useless but entertaining side trips which frequently find their way into the itinerary, but the locality had been 'wildly' exploited by a Dr. ———, who (as he told the local people) had had years of experience in mining in Colorado. He led them to believe that they had here a wonderful deposit of copper which only needed capital for development. He promised them big profits if they would only back his plans. In consequence the neighborhood was much excited. In support of his position he had written a very elaborate report, which had gained a wide local circulation and evidently made a deep impression. In fact, I was reminded a number of times of the "scientific standing" of the doctor. I was really very glad to obtain a copy of this report, as it has the advantage over so many of being decidedly entertaining and amusing. There are no tedious or involved sentences to wade through. I take the liberty to give a few excerpts:

"This clay formation, running in depth from 3 to 50 ft., carries from 3⅝ to 66% of copper, with a uniform amount of from $4 to $5 in gold and silver. It is self-fluxing, being easily run in a blacksmith's forge, as the many tests have proved made here in the shop of Mr. P., who was very accommodating in the matter, being willing to interrupt his business for the sake of science and the general enlightenment of the people, for which we are very thankful. The copper in the clay goes into solutions in 1 in 100% bath, going easily. The clay contains small flakes of chalcocite all through. When air touches it it turns characteristically blue and green. The chalcocite is heavy, and concentrates well with small amounts of water. The best plan would be to crush the low-grade clay in an ordinary clay crusher, concentrate and leach the rest. Experimentally, this is working satisfactorily. * * * The immense area of the field, nature being so lavish in her gifts, and the uniformity of deposit, will justify a ten-ton smelter plant to commence with. * * * The sulphide chalcocite seems the first mineral formed from the copper solution, and the azurite next, or, rather, the azurite is first step of decomposition of the chalcocite. Over 150 distinct occurrences have so far been examined, and I have been able to draw some very keen inferences. Some of the clay gives averages of from 3.5 to 30% copper, by actual smelter tests. * * * There is no doubt but that what is already exposed would run a smelter the size we propose to build, for many months, and I predict a brilliant future for all those who take advantage in time. Another matter of easy solution would be the building of the long contemplated dam across Cottonwood, with the slag and gang from the smelter, and reduction plants, not only building the dam without any expense, but furnishing a dump for the waste material from the plant."

Evidently these experiences teach a moral, but I hardly think it necessary for me to point it. Perhaps these occurrences will help to justify the position of the much abused and criticised expert and consulting engineer. I hope, Mr. Prospector and Mr. Practical Superintendent, that you will concede that there is a legitimate place for us in the general scheme of things.

FRED B. ELY.

Salt Lake City, Sept. 13.

Mineral Production of Northern Russia

In the Murman district of northern Russia are considerable mineral deposits, particularly on the coast line, but few mining men have done any exploration there. Gold placers have been found on the Rinbach peninsula, and gold-bearing veins on the River Titovka; but Russians have evidently not bothered with them. An engineer named Popovitch did some prospecting at Murman in the lead deposits, but these are now abandoned. Coal has been found and there are said to be large deposits of manganese.

Gold production of the mines at Kolar, India, during August, was as follows:

	Tons.	Value.
Balaghat	3,600	$ 25,200
Champion Reef	18,575	200,000
Mysore	25,767	345,000
Nundydroog	7,500	120,000
Ooregum	12,892	144,000

The Colorado State Geological Survey at Denver has for sale at low prices interesting reports, bulletins, and topographic geologic maps of various districts of the state.

Special Correspondence

LONDON

COPPER IN CENTRAL AFRICA, AND THE BWANA M'KUBWA MINES.

The development of copper deposits in Central Africa has provided much scope for speculation on the London Stock Exchange. The enterprise of Robert Williams in connection with the Katanga copper ores is already well known to your readers, as several American engineers have been on the spot and have published their impressions. Another deposit not far south, just over the border in Northern Rhodesia, has attracted nearly as much attention in England. This is the Bwana M'Kubwa, a property owned by a company belonging to Edmund Davis' group. Mr. Davis is at present the leading 'promoter' in London. You never know where he will break out next, and you do not always know that he is at the bottom of some of his promotions. It is not surprising, therefore, that the chief attention in connection with Bwana M'Kubwa has been centred on Stock Exchange operations and not on the development of the deposit and the study of the metallurgical problem. Shareholders and the public were kept in the dark, and a technical journalist like myself could never elicit any information or induce an answer to specific questions, if a visit of inquiry was made to the office. S. J. Speak, of the firm of Hooper, Speak & Co., has recently made an examination, and his report has been published. This report contains the first intelligible account of the ore deposit, but unfortunately it leaves us 'no forrader', as the Yorkshireman says, as regards the method of treatment of the ore. I quote briefly some of the facts to be extracted from Mr. Speak's report.

The mine is 491 miles by rail north of the Victoria Falls. At present the nearest port is Beira, 1448 miles away. The railway connection is circuitous, and economic conditions would be improved if a connecting railway could be built from Rhodesia Broken Hill to join the Lomagundi railway at the Eldorado mine and thus give a more direct access to Salisbury and the Beira railway. A stony ridge or *kopje*, 2400 ft. long, rising from a level plain, marks the outcrop. The deposit consists of a central rich orebody dipping nearly vertically, 1800 ft. long at the 100-ft. level and averaging 4 ft. thick, and orebodies on each side of lower grade and measuring 30 to 60 ft. thick. Five vertical shafts have been commenced in the hanging wall of the central orebody; one of them was sunk to 528 ft. when excessive water prevented further exploration at depth. The 100 and 250-ft. levels are about 1800 ft. long, the 350-ft. level 357 ft. long, and the 450-ft. level 95 ft. long. Cross-cuts have been driven into the hanging wall and foot-wall at intervals. The central orebody is friable and porous, and consists largely of silica and carbonate of copper. Its specific gravity in place is only 1.25, and this unusually low figure accounts for previous errors in the estimates of tonnage. Below the 350-ft. level it changes abruptly into silicious dolomite, and the copper content diminishes, occurring then partly as carbonate and partly as bornite and chalcocite. The amount of rich ore is estimated at approximately 50,000 tons, averaging 12% copper. The carbonate is not evenly distributed, but occurs as small bands up to 4 in. thick. The hanging wall consists of quartzite and the average thickness is 35 ft. assaying 4% copper. There is no true foot-wall. The orebody merges into 4 to 10 ft. of decomposed rock carrying little copper, and beyond this is quartzite averaging 60 ft. thick and 4% copper. These two quartzite orebodies are extensive, and 800,000 tons is proved above the No. 2 level. The copper minerals in the quartzite are two-thirds bornite and chalcocite, and the other third carbonate. Mr. Speak is of opinion that the central orebody was originally a bed of dolomite, and that the copper was introduced from the surrounding quartzite by surface waters, the acid of which removed most of the lime and magnesia. An examination of the quartzite without the microscope indicates that the quartzites were sedimentary rocks, probably dolomitic sandstone, which were silicified at the time their copper content was introduced. Very little iron is present in the ore. No granite or other igneous rock has as yet been discovered in the neighborhood. The surface of the country is so thickly covered with soil that geological study is difficult.

The report is a satisfactory one from the engineer's point of view, but the part dealing with the metallurgical problem is not so convincing. Up to the present, the only work done has been to produce a concentrate on jigs and tables from the carbonate ore and to leach this by the Siemens-Halske process, which involves dissolution in sulphuric acid and the precipitation of copper electrolytically. In practice, a concentrate averaging 37% copper was obtained, and this concentrate contained about 40% of the copper in the ore. The leaching process was supposed to be a success in London on a small lot of ore, but it has not been put into action at the mine. Mr. Speak says that the quartzite ore presents a difficulty in water-concentration and talks of flotation processes. He is unable to provide the directors with their chief requirement, namely, a process that will give immediate profits. The board has decided to send Thomas Huntington, one of their number, to the mine to see if he can evolve a suitable treatment. Mr. Huntington is known for his work in conjunction with Ferdinand Heberlein in connection with the sintering of lead ores. He is an American and has spent most of his active life in Italy. At present he is an adviser to the Metallurgische Gesellschaft. For myself I should recommend the directors to secure the services of an engineer acquainted with old Arizona practice and with the concentration of disseminated copper ores.

MAP OF BELGIAN CONGO, WEST AFRICA, SHOWING MINES AND TRANSPORTATION LINES.

NEW YORK

THE AJO COPPER PROPERTY IN ARIZONA.—MINING IN ONTARIO.—STEWART AND OHIO MINES.—LAKE SUPERIOR STRIKE SITUATION.

The most important news of the week was the announcement that the Calumet & Arizona had taken up its option on the New Cornelia property at Ajo, Arizona. All sorts of statements have been made regarding the property, and as the management usually neither confirmed nor denied them, there was ample scope for rumor. The property was under option by the General Development Co. some time ago, but after exploration by diamond-drilling the options were allowed to lapse. In 1911 the Calumet & Arizona company became interested, and has done much more diamond-drilling. It is reported that 29,000,000 tons of ore, ranging from 1.7 to 2.2% copper, has been proved, but no official statement has yet appeared. The property is about 40 miles south of Gila, on the Southern Pacific railway, and surveys will be made for a branch line, but it is much more probable that the El Paso & Southwestern will be extended from Tucson 80 miles west to Ajo. The El Paso & Southwestern, which is owned by the Phelps-Dodge interests, now has its western terminus at

Tucson, and it can readily be imagined that not much through freight from and to Pacific Coast points now gets routed over the line. With a western terminus at San Diego, or some similar point in southern California, the road would be in a much better position. But to return to the Ajo property, it is also of interest because it is proposed to extract the copper from the ore by hydrometallurgical processes, and Stuart Croasdale, with a corps of assistants, has been at work developing a satisfactory process. The original ideas, which have been widely discussed, have evidently been considerably modified in the course of experimental work. The ore occurs at the surface and will be mined by steam-shovels in the way that is now becoming common practice. The ore for 50 to 75 ft. in depth is oxidized and well adapted to leaching. At greater depth it is succeeded by sulphide ore, and the method of treatment for that will be solved later.

Ontario is making a better showing each year in its returns of mineral output. The total for the first half of 1913 was $18,598,000, an increase of 20% over the first half of 1912. Silver alone showed a slight falling off, while gold was responsible for one-half of the increase. Nickel production amounted to 12,104 tons, valued at $2,514,414. A new producer in a new district is the Alexo mine, near Porcupine, which is shipping to the Mond smelter at Coniston. The big new nickel company is temporarily held up to wait more auspicious money markets before attempting to finance its operations. The iron industry of the province is showing a gratifying growth, having quadrupled in the past decade. In this connection, it may be remarked that T. J. Drummond has resigned the presidency of the Lake Superior corporation and was succeeded by J. F. Taylor, of Sault Ste. Marie. In reporting on the operations of the Algoma Steel Corporation, its most important subsidiary, Mr. Taylor announced that over $26,000,000 has been spent in extensions and improvements in the past four years. The rail mills have been increased to 1200 tons daily capacity, the blast-furnace plant has been enlarged, coke-ovens have been built, and new open-hearth furnaces as well. The Company has an exceptionally good power-plant.

Much has been made over the loss of control which F. Augustus Heinze suffered at the meeting of the Stewart Mining Co., held in Kellogg, on September 29. Mr. Beaudry is the superintendent of the mine, and is regarded as Mr. Heinze's representative. However, the board represents the John W. McKinnon interests, and as McKinnon and Heinze are friendly, the latter is only removed from the active headship and not from practical control. John W. McKinnon is vice-president of the Assets Realization Co., which was formed to clean-up the wreck of the United Copper Co. Now that he is out of the control of Ohio Copper, Mr. Heinze is practically divorced from the mining field, but he is still supposed to have large land holdings in British Columbia. The management of the Ohio Copper Co. is struggling with the problem of how to make the mine pay. The ore only runs about 1% copper, so that even if the present poor recovery is improved by the flotation experiments, there is still not much margin to work on. Much has been said about the charge of 15c. per ton for transportation of the ore to the mill through the Mascot adit. In proportion to the cost of mining, this is undoubtedly high, but the company which owns the adit protests that it cannot meet its operating costs at a less figure. Under the circumstances, the natural thing to do would be to merge the two companies, since neither can make any money unless the other operates.

Some well known names have been figuring in print recently. A suit is pending in the Supreme Court of New York against Will S. Tevis, involving a payment of $150,000 made on promissory notes to Charles W. French, in connection with surveys made for a railway from Bakersfield to the California seacoast in order to transport iron ore from mines which it was hoped to develop into big producers. Will S. Tevis, who is prominent in the Bay Cities Water Co. and a large group of affiliated Pacific Coast enterprises, is the son of Lloyd Tevis, who was an associate of J. B. Haggin, Clarence Mackay, and the group of men who were the leading figures in mining in the '70s. The Homestake mine, in South Dakota, is still owned by the Tevis and Hearst estates. J. B. Haggin is the only one of the group still alive, and when it was reported recently that he was seriously ill at his Kentucky farm, there was great regret. Fortunately, the report proved untrue. Although over 90 years of age, Mr. Haggin is still vigorous and directs his Peruvian enterprises with keen insight.

The Lake Superior strike situation is apparently making progress toward settlement. All but two of the mines are taking out some ore, and the Calumet & Hecla is said to have 1200 men at work. However, most of the companies were short of trammers before the strike was called, and not much output can be hoped for while the strike is on. The companies absolutely refuse to have any dealings with the Western Federation, and the only possible conclusion of the difficulty involves non-recognition. When the strike was first called, the best miners largely emigrated to Butte and the iron mines, but they are reported to be coming back, so that a better grade of labor is becoming available. The strike leader on the South Range is reported to have left, and local business people are optimistic. But not much copper can be expected from the Lake country during October, and with the Washoe smelter shut down for a week, the October output promises to be small. If business generally improves, now that the tariff is finally settled, and buying of copper for domestic consumption is resumed in much volume, there can be no doubt that a sharp rise in the price of copper will result.

ST. LOUIS, MISSOURI

CONSOLIDATION OF DOE RUN AND ST. JOSEPH.—ENORMOUS CAPACITY OF NEW CONCERN.—LITIGATION SETTLED.—ST. FRANCIS LEAD COMPANY.

Announcement of the agreed plan of consolidation of the St. Joseph Lead Co. and the Doe Run Lead Co. was made October 4. Negotiations looking toward such a union of the two companies and settlement of other outstanding problems have been under way for months. The plan now put before the stockholders was formulated by a committee consisting of John F. Shepley, F. N. B. Close, C. M. Chapin, C. H. Crane, M. Kotany, E. C. Smith, and M. F. Watts, acting on the advice of J. W. Kendrick as railroad expert, and J. R. Finlay as mining engineer. Consolidation is to be effected by exchange of $5,000,000 new stock in the St. Joseph company for the entire outstanding $6,500,000 of Doe Run stock. As the St. Joseph company has issued $10,000,000 in shares to its existing stockholders, this practically results in consolidation on the basis of the Doe Run owners taking one-third of the amalgamated properties. In fixing this ratio, Mr. Finlay considers that the St. Joseph Lead Co. has 6444 acres of land of the first class, that is, lands either known to contain ore or geologically so favorably situated as to carry the presumption of containing ore; and 2810 acres of the second class, that is, lands which may carry ore, but in which its occurrence is doubtful and rather improbable. The Doe Run Lead Co. has 3103 acres of first-class and 1337 acres of second-class lands, he finds, so that the St. Joseph Lead Co. has a little more than twice as much as the Doe Run of each class. He also finds that the amount of ore in sight in the lands of the St. Joseph Lead Co. may be estimated at 11,200,000 tons; that of the Doe Run Lead Co. at 8,250,000 tons. Promising and partly developed lead lands should add 11,075,000 tons to the estimate of the St. Joseph and 4,450,000 tons to the estimate of the Doe Run company, bringing the grand total for comparison up to 22,275,000 for the St. Joseph and 12,700,000 tons for the Doe Run company. The new concern will, it is evident, at once become the largest lead-mining company in existence, with an annual capacity of 70,000 to 80,000 tons of pig lead. Mr. Finlay has already been engaged as consulting engineer and will be in charge of operations. It is understood that $1,000,000 per year of the earnings is to be devoted to extinguishment of the floating debts which led to reorganization of the companies, and that, as part of the settlement, Robert Holmes' suits against the companies and

their officers are to be dropped. Other minor points are covered by the agreement, but the essential point is that these magnificent properties are to be managed hereafter as one unit and that new men join in the management. The St. Joseph properties have not been previously valued, but Mr. Finlay's appraisal of the Doe Run is said to check closely with that made 18 months ago by Philip N. Moore and C. P. Perrin. The Doe Run, while it has less reserve land than the St. Joe, has excellent earning capacity. Additions to new mills just about ready to operate give a crushing capacity of 900,000 to 1,000,000 tons. It may be noted for comparison that the Homestake and Treadwell groups each crush about 1,500,000 tons per year. The new St. Joseph company will be prepared to handle more than 2,000,000 tons per year. Costs have not been made public, but are, presumably, about $1 per ton, while the average grade is perhaps a little above 3 per cent.

Another of the local lead companies is threatened with litigation. S. F. Beals has applied for a receiver for the St. Francis Lead Co., the Potosi Lead Barytes & Mercantile Co., and the Potosi Miners Co., alleging juggling of stock to the disadvantage of minor shareholders. The St. Francis Lead Co. is a new concern, which, after exchange of stock in the practically bankrupt concerns that had preceded it, purchased the Jake Day tract between Flat River and Leadwood. The Company made one or two payments and then was unable to go ahead. It borrowed money from the St. Louis Smelting & Refining Co. to make one payment and so got into debt. A shaft has been sunk, a run of ore found, and about 300 tons per day, said to contain 5 or 6% lead, is being shipped to the St. Louis mill, where the ore is being treated on contract. If the ore holds out, it should be possible to complete payments, extinguish the debt, and pay dividends; but if the Company must waste money in litigation, the prospect is not hopeful. Fortunately, it is not anticipated that the action brought by Mr. Beals will prove serious.

PLATTEVILLE, WISCONSIN

SUMMARY OF THE DISTRICT'S OPERATIONS.—ZINC ORE PRICES AND PRODUCTION.—MINES AND EQUIPMENT.

September, usually depended upon to produce record-breaking results in the Wisconsin zinc-lead field, this year fell below a normal output, although conditions generally were favorable to a large yield of mine product. Only large operating concerns, notably the New Jersey Zinc Co., Vinegar Hill Mining Co., Wisconsin Zinc Co., and Frontier & Cleveland Mining Co. did especially well. They were responsible mainly for the yield reported. Prospecting has reached a low point all over the field, which augurs disastrously for the industry as a whole, because the average zinc mine is shortlived, and unless new ground is opened for development and production, the area available for ore diminishes.

The level of ore prices was fairly well maintained throughout the month, the average for standard grades being close to $46 per ton, basis of 60% ore. Mifflin reported sales of 55% ore at $42 per ton; Benton, Galena, and Cuba, sales of 45% ore at $32 per ton; Platteville, Cuba, and Galena, roasted ores at $46 per ton; with low grades, 30 and 35% zinc ore, $16 and $21 per ton, respectively. Lead ore was in better demand, quotations being made freely at $58 per ton, but shipments for the entire month were light. Shipments of sulphur ore also fell below the production reported in August, the Wilkinson mine delivering the bulk of the production shown in the table following. Production of carbonate of zinc ore received impetus by the New Jersey Zinc Co. coming into the market late in the month and bidding the ore up lively, $21 per ton being reported on choice grades. As this commodity is mined exclusively in the upper horizons, in the dry, where pumping is obviated and little blasting is called for, the profit is greater than on the other ores. A heavy tonnage is sure to be produced this winter from the northern camps, where there is a good deal of this ore.

Sales of zinc ore during September were distributed among the following buying concerns: Mineral Point Zinc Co., 4212 tons; Grasselli Chemical Co., Cleveland, 1398 tons; Empire Roasters, Platteville, 946 tons; National Separating Co., Cuba, 877 tons; Matthiessen & Hegeler Zinc Co., 686 tons; Illinois Zinc Co., Peru, 777 tons; American Zinc Co., 384 tons; Linden Zinc Co., 275 tons; and Joplin Separating Works, Galena, 119 tons; a total of 9674 tons. The Mineral Point Zinc Co. set the pace in bids all the month and secured almost half of the total production.

Lead shipments were made by H. Lewis, Highland, 50,000 lb.; Ross mine, Linden, 59,630 lb.; Kennedy mine, Hazel Green, 60,000 lb.; Federal mine, Day Siding, 82,000 lb.; Fox mine, Benton, 53,600 lb.; Calvert, Benton, 50,000 lb.; East End, Platteville, 60,000 lb.; Wilkinson, Benton, 81,000 lb.; Vinegar Hill, Galena, 82,000 lb.; and Northwestern, Buncombe, 64,700 lb.; a total of 642,930 lb. Shipments of sulphur ores were about evenly divided between the Grasselli Chemical Co., East Chicago, Indiana, and General Chemical Co., Hegewisch, Illinois; the former securing 2,249,640 lb. and the latter 1,948,260 lb. The Wilkinson mine at Benton was the chief contributor, with the National Separating Co. and the Linden Zinc Co. offering the remainder. Gross production of zinc concentrate from mines during the month aggregated 17,394,640 lb., and refined ores net to smelters, 12,409,440 lb. The Mineral Point Zinc Co. delivered 32 cars of roasted zinc ore to its smelters at DePue, Illinois. Less than half a million pounds of carbonate of zinc ore was shipped, although another million pounds remained in bins on a portion of which bids had been accepted.

Deliveries from the various districts were made in September as follows:

Name.	Zinc, pounds.	Lead, pounds.	Sulphur, pounds.
Benton	3,552,000	184,600	3,032,300
Platteville	2,614,000	60,000	.....
Livingston	2,536,000	.....	.....
Hazel Green	2,532,000	142,000	.....
Cuba	1,748,000	.....	744,760
Shullsburg	1,736,000	.....	.....
Linden	1,552,000	59,630	345,780
Galena	1,470,000	146,700	.....
Highland	496,000	.....	.....
Harker	296,000	.....	.....
Rewey	228,000	.....	.....
Mineral Point (local)	224,000	.....	.....
Montfort	184,000	.....	.....
Dodgeville	180,000	.....	.....
Mineral Point Zinc Co.	2,311,300*	.....	.....
Total	21,559,300	642,930	4,222,840

*Roasted ore.

The more important developments transpiring in the field in September are as follows: At Highland the New Jersey Zinc Co. remodeled its central power and milling plant and got up steam ready for double-shift service. The Mineral Point & Northern railway, feeding the northern mining camps, spent $65,000 in track improvement, steel bridges, and concrete culverts. The Weigle mine, at Linden, became a new and steady producer; the Gribble Mining Co. developed a new zinc orebody showing a 'facing' 90 ft. wide and flat sheets a foot thick; the Mineral Point installed new boilers and engines furnishing electric power for its mines; Mifflin finished three new shafts on new ore deposits and was in the market for heavy equipment. The Klar-Piquette mine, at Platteville, paying 325% annual dividends during the past three years, and absent from the shipping list for three months, again began regular weekly deliveries; Cuba developed the Midway and Little Dick allotments, the latter taking over the mine and equipment of the Board of Trade Mining Co. Benton has three new producers, the Martin at Strawbridge for the Vinegar Hill Mining Co., Longhenry Bros., on the Spenseley, and the DuVall-Piquette by local people. From Hazel Green is reported a new discovery on Scrabble creek, and the completion of a 125-ton power and milling plant on the Lawrence, owned by the Cleveland Mining Co., which also purchased the Square Deal mining allotment of 160 acres.

General Mining News

ALASKA

Nome

Telegrams received in San Francisco from Nome state that, on October 5, a violent storm struck the town, demolishing about 500 houses, the wireless station, telegraph system, power-plant, and houses for two miles adjacent, after which a fire broke out, threatening to destroy the whole town. Damages are estimated at $1,000,000. Winter is now setting in, and the inhabitants will be considerably inconvenienced. Supplies of fuel and food are being sent by steamer from Seattle.

NOME.

Valdez

The Fidalgo-Alaska Copper Co. resumed operations during the last week in September, under the management of C. W. Harrington; having been shut down since last May. A stope is to be opened from the middle adit to develop a large orebody at a depth of 140 ft. The ore averages 7% copper. A shoot has been cut in another adit 127 ft. below the middle adit. The ore-bins have a capacity of 1200 tons.

ARIZONA

Cochise County

The Commonwealth mill at Pearce started work on October 5. A stope 90 ft. wide has been opened on one level of the mine.

Gila County

Concrete pouring on the ore-bin foundations at the main east and west shafts of the Inspiration Consolidated has been completed. More than half the forms have been peeled off. Steel is being rapidly unloaded, and the steel workers will soon be at work erecting the bins. All form work is completed for the retaining wall at the coarse-crushing plant at the main shafts, and all machinery and tools have been moved to the crusher site. This work will progress rapidly, as the concrete-mixer will be placed between the main east and west shafts in the centre of the face of the wall and the concrete delivered by gravity. This face will be a solid concrete wall about 150 ft. long with a drop of 22 ft. The distributing tower now in use at the bins will not be necessary in pouring concrete for the wall, but it will probably be moved later to help in building some of the machinery foundations. Rapid concrete pouring continues on the retaining walls of the concentrator. Work is still under way on the crusher near the Scorpion shaft, and already work is being done on the foundations for the conveyor belt that will carry the ore from the collar of the shaft to the bin. The belt will have a drop of 1¼ in. per foot. Six hundred tons of ore will be handled at this point per day, to supply the 600 ton flotation test mill. About 200 tons of rock is being broken at the rock quarry and crushed daily.

The Old Dominion and Burro Mountain copper mining companies have signed contracts with the Minerals Separation, Ltd., and are to build test plants with a view to developing flow-sheets for flotation plants.

Mohave County

The Telluride Mining Co. has resumed development on its claims on the Tom Reed vein. The Black Eagle claim, in which the Tom Reed company recently opened a 12-ft. vein, mostly of high-grade ore, adjoins the Telluride claims. On the Blue Ridge claim, owned by the Telluride company, the veins form a junction with the Tom Reed vein, and Mr. McDonald, the superintendent, figures that at this point will be found a large and rich orebody. The Telluride main shaft is down 200 ft., and the work of sinking is being continued to the 300-ft. level. The shaft at the Lucknow, on Music mountain, is down 250 ft., and ore is worth $20 per ton. Drilling is to be commenced at the Bi-metal mines, near Kingman.

Yavapai County

The Consolidated Arizona Smelting Co., at Humboldt, has secured a license from the Minerals Separation, Ltd., for the use of flotation, and is planning a mill. The present capacity of the plant is about 300 tons per day.

Yuma County

With the coming of cool weather, many companies and private owners of mines in the vicinity of Parker are preparing to resume operations. This is probably the hottest mining district in the world during the summer, and there is little activity during that season. All indications are that the coming winter will be the busiest in the history of this area. The better known properties in this district are the Roberts-Allen-Mavis group, Carnation, Osborne, Eagle, and O'Mara.

CALIFORNIA

Butte County

Three dredges at the Oroville Dredging Co.'s property at Oroville produced $5870 during the week ended September 6. The Company's dredge at Pato, Colombia, recovered $7350 from 14,550 cu. yd. during the second week in September.

Nevada County

A lease has been secured on the old Blue Banks placer property at Moore's Flat by Coughlan Bros. This mine has been idle for 25 years, but produced a good deal of gold when operated. An old adit, about 1½ miles long, is being reopened, and the Northern Water & Power Co. will probably reconstruct the old ditch which was destroyed three years ago.

Placer County

(Special Correspondence.)—The Pacific Gold Dredging Co. has completed a 7-ft. Bucyrus-type dredge on its property near Auburn on the American river. The dredge commenced work on September 30. It is constructed along the latest and most approved lines and will have a capacity of 120,000 cu. yd. per month. A time record was made in the construction of this dredge which has never been equaled in California. The first load of lumber arrived at Auburn on July 17. The dredge was operating just 73 days later. The hull is 105 ft. long, 40 ft. wide, and 8 ft. 4 in. deep. H. C. Perring, who was for five years assistant superintendent of the dredging department of the Yukon Gold Co. at Dawson, was in charge of the construction work, with Oscar Wicks as foreman. The Pacific company is a subsidiary organization of the Yukon Gold Co., which is operating a large fleet of dredges at Dawson, Yukon Territory.

Auburn, October 1.

Siskiyou County

(Special Correspondence.)—Several small shipments of specimen ore have been made during the past month to this city from the Homestake mine, in the Salmon River district. The quartz is free milling and comes from a shoot several inches wide. Ore of milling grade accompanies the richer material. The Homestake is chiefly owned by R. S. Taylor, of Yreka. The owners of the Osgood quartz mine, one mile west of Yreka, have purchased a 5-stamp mill and plan to have the plant in action within a few weeks. The sinking of a main shaft is under consideration. Developments have been under way for about three years, and a large reserve of milling ore is stated to be developed. William Beal is superintendent. C. L. Harris, of San Francisco, and T. T. Calvert, of Portland, Oregon, have completed arrangements for the operation of their mill on Badger creek. The mine comprises six claims, and a number of promising shoots have been opened during the four years of development. Shipments of coal from the mines near Ager are finding a ready market in Yreka, Montague, and other towns. The product is stated to be excellent for domestic purposes, and is being used in preference to wood. Several distinct seams of coal are reported in the mine. The new owners are sinking deeper and mining a better grade product than formerly. It is reported that outside capitalists have acquired the mines of the Salmon River Mining Co. Florian Le May and George Tebbe have arranged to resume work on the Sunnyside mine, in the Greenhorn creek district. A long drift will be extended to tap the back channel. The gravel was profitable when last worked.

Yreka, September 28.

Trinity County

The auriferous gravels and gold lodes of the Weaverville quadrangle are described, respectively, by J. S. Diller and H. G. Ferguson in *Bulletin* 540-A, issued by the U. S. Geological Survey. The district studied embraces part of Shasta and Trinity counties and has an area of 26 by 34 miles. Redding, 52 miles from Weaverville, is the main distributing point. The La Grange and Trinity River Consolidated are the most important hydraulic properties in the Weaverville basin. The outlook for future placer mining in the region is encouraging.

Lode mining began in the quadrangle in 1852, and the total output of gold to the end of 1911 was about $15,000,000. In that year there were 49 producing mines in the Shasta portion and 24 in the Trinity portion of the area, producing 38,193 and 14,411 oz. of gold, respectively. The principal gold deposits are fissure veins, as a rule narrow with steep dips. They are most numerous in slate, while another type exists which cuts the quartz-diorite and alaskite-porphyry, especially near Whiskeytown. Basic dikes occur near them.

Tuolumne County

Development work at the old North Star and Black Warrior mines on Moccasin creek is being conducted uninterruptedly by the Fayalense Mining & Milling Co. The famous Eureka and Dead Horse group of mines, which of late years has been operated in a desultory way and frequently levied upon by miners for their wages, was sold recently at sheriff's sale to satisfy two judgments aggregating $697. The sale price was $1298, which sum included the cost. The property was bid in by the judgment holders. Besides the Eureka and Dead Horse, the Lady Washington, Golden West, Grizzly, and New Albany mines were included in the sale.

COLORADO

Clear Creek County

J. W. Ballantine, engineer for the Edison milling process, has ten or twelve men at work installing the equipment at the Burleigh mill at Silver Plume.

Gunnison County

J. L. McGruder, who has been experimenting for several years for a cheap method of reducing the complex zinc-lead ores of the Crested Butte district, has completed a small experimental plant in which he made a preliminary test last week with satisfactory results. The plant consists of a furnace in which the crude ore is placed and subjected to sufficient heat to volatilize the lead and zinc contained therein, and the fumes are carried off into condensers.

Lake County (Leadville)

The district enters the last three months of the year in first-class physical condition, and the outlook for a brisk winter campaign is exceedingly bright. Several causes lead to this. The unwatering of the mines of Fryer hill now seems to be assured, as it is learned that fully 75% of the owners of ground have signed, and it is said the others will also help. It is understood that when the others come in there will be no difficulty in getting the necessary capital to carry the project to a successful issue. The unwatering of the upper Carbonate hill mines also looks encouraging, and those interested state that they expect to have the matter definitely settled within a few weeks.

The new company that has taken hold of the properties of the Big Four Mining Co., on Breece hill, intends to push development work 300 ft. below the present depth of the shaft, 750 ft. A large tonnage of ore continues to be sent from the Yak tunnel. The Western Mining Co. is shipping 400 tons of ore per day, which includes a fair tonnage of zinc carbonate ore. At Iron Hill, the Iron Silver, Louisville, and Belgian are making regular shipments; also from the Penn, Garbutt, and Little Jonny properties on Breece hill. Snow has fallen in the district recently.

Las Animas County

A battle was fought between coal-mine strike sympathizers and mine guards at the tent colony at Ludlow in which one guard was shot through the leg, two horses killed from under mine guards, and many houses riddled with bullets, on October 8.

Ouray County

Shipments during September from the Ouray mines were as follows: Wanakah, 580 tons; Camp Bird, 585; Atlas, 200; Barstow, 21; and Bachelor, 41 tons.

San Miguel County

The Weller Mining & Milling Co. is planning to start its mill on October 15 at its new site. The aerial tramway is also nearly completed. The Liberty Bell company is planning to construct a spur line to decrease haulage costs. The Ida Gold Mining Co. is extending the Carribean tramway about 1500 ft. The Standard Chemical Co. is said to be mining 150 tons of carnotite ore per month in the west end of the county. The Primos Chemical Co., at Vanadium, is operating at full capacity. There is said to be great activity in mining vanadium ores in this district.

Teller County (Cripple Creek)

The reported production of the district during September was as follows:

	Tonnage.	Av. val.	Gross val.
Golden Cycle, Colorado City	33,000	$20.00	$ 660,000
Portland, Colorado City	10,500	22.00	231,000
Mills and smelters, Pueblo and Denver	3,865	65.00	251,225
Portland, Cripple Creek district	14,600	2.96	43,216
Stratton's Independence	11,375	2.67	30,271
Colburn-Ajax	5,285	3.25	18,931
Gaylord-Dante	1,200	3.50	4,200
Kavanaugh-Jo Dandy	1,500	2.10	3,150
Rex M. & M. Co	700	1.40	980
Wild Horse	900	4.40	3,960
Isabella	925	3.20	2,960
Total	84,390		$1,249,893

Details of September ore production from the various groups are approximately as follows: Gold Sovereign on Bull hill, 350 to 400 tons of $10 to $30 ore; Ajax property, on Battle mountain, 6811 tons, worth $38,060; El Paso, on Beacon hill, 2600 tons; C. K. & N., on Beacon hill, 400 tons of $20 ore; Granite property, on Battle mountain, 2250 tons; Cresson Consolidated, 5000 tons; lessees at the

United Gold property, 750 tons; and Vindicator, on Bull hill, 3250 tons, including lessees. Measurements of the flow from the Roosevelt drainage tunnel show 6280 gal. per minute. The report of the Isabella Mines Co. shows that during the past year, exclusive of lessees' work, development covered 3438 ft. Ore sales realized $181,692; payments to lessees, freight, and transport, $159,403; net receipts, from ore sales, $22,288. With other revenue the total was $26,772. Company expenditure, including mine development, was $18,490, leaving a profit of $8490.

IDAHO

Boise and Cassia Counties

Coal and lignite deposits in these counties are described by C. F. Bowen in *Bulletin* 531-H, issued by the U. S. Geological Survey. The coal at Horseshoe Bend, in the first county, is 20 miles north of Boise, on the Payette river. The total area is about 23 square miles. Both igneous and sedimentary rocks occur in the district. At most exposures the beds of coal are less than 14 in. thick, and on account of the unconsolidated character of the inclosing strata, they disintegrate rapidly. No definite statement regarding the extent of the deposits can be made, but in two places they are worthy of development. Samples from the Henry mine show 36 to 40% fixed carbon, 38 to 42% volatile matter, and 15 to 17% ash. The Goose Creek lignite deposits have an area of about 156 square miles in Cassia county, and the mineral occurs associated with the lower division of the Tertiary of the Goose Creek district in two principal beds and a number of small unimportant ones. The lower bed is the most important because of the better quality of the lignite, is from 3 to 5 ft. thick, and has been worked at the Worthington mine principally. The upper bed is from 14 in. to 9 ft. thick, but is dirty and impure. Analyses show from 21 to 32% fixed carbon, 26 to 40% volatile matter, 34% (as received from mine) moisture, and 18 to 27% sulphur.

Shoshone County

The Stewart mine has the third largest payroll of any of the properties operating in the Coeur d'Alene district, between 350 and 400 men being employed in the mine and mill. The adjourned annual meeting of the Stewart Mining Co. was held at Kellogg on September 28, and although not open to the press, it is stated that a compromise had been agreed to between F. A. Heinze and associates and the opposition interests. The directors elected were: F. S. Crosley, William A. Gallagher, A. D. Ormsbee, and Nash Rockwood, all of New York, and William Beaudry, of Kellogg, superintendent of the Stewart mine, who is the only one of the old directors to secure a place on the new board. Organization was affected with Crosley, president; Campbell Carrington, New York, treasurer and assistant secretary; and William M. Bacon, Butte, Montana, was continued in office as general manager. It is said that two of the directors, including Mr. Ormsbee, will immediately resign from the directorate, as they were only representing New York stockholders unable to be present. The next meeting of the board will be held in New York on October 7.

MICHIGAN

Houghton County

It is estimated that the following daily tonnage of ore is being produced from the copper mines, in spite of the strike:

Mine.	Present output.	Normal.
Calumet & Hecla	3600	9,000
Quincy	600	3,500
Victoria	600	500
Champion	500	3,000
Superior	350	600
Baltic	300	2,800
Trimountain	300	2,200
Osceola	300	3,000
Isle Royale	250	1,800
Total	6800	26,400

The Copper Range Consolidated mills, the Baltic, Champion, and Trimountain, are being overhauled, advantage being taken of enforced idleness to do this work. The regrinding plants being installed will save from 1½ to 2 lb. of copper per ton of ore stamped. The annual supply of coal for these properties, 122,000 tons, has been nearly all delivered. The Calumet & Hecla Mining Co. has received the hull for its new dredge to be used in digging the conglomerate sand from Torch lake for the regrinding plant. It will weigh 450 tons when complete, and will handle 10,000 tons per day. The machine was made by the Bucyrus company.

James Pollack, a deputy sheriff, was killed on October 8 by copper mine strike sympathizers at the Isle Royale mine, near Houghton. The State Supreme Court issued an order requiring Judge O'Brien, of the Houghton County Circuit Court, to immediately renew and place in force his injunction of September 20 restraining picketing, which he recently dissolved.

MONTANA

Broadwater County

(Special Correspondence.)—The Boston & Idaho Mining Co., operating dredges in Boise basin, Idaho, has a drilling crew at work on Crow creek, near Radersburg, testing the gravels with a view to erecting a dredge. The Ohio mine at Radersburg is shipping about 600 tons per month to the Anaconda smelter.

Radersburg, September 30.

Lewis and Clark County

(Special Correspondence.)—The Stemwinder property, in the Grass Valley range, is under option, and is being prospected by a shaft. The Rock Rose shaft, in the same district, is being unwatered.

Helena, September 30.

Madison County

(Special Correspondence.)—The success of the dredges of the Conrey Placer Co., in which Harvard College people are interested, has led to the investigation of similar ground farther down from Ruby gulch. Options are being secured and drilling will be undertaken. The Missouri Mining Co. has recently purchased the Elling mining property, on North Meadow creek, near McAllister, and is preparing to develop and operate the property.

McAllister, September 30.

NEVADA

Esmeralda County

The estimated September production of the Goldfield Consolidated Mines Co. is as follows: Ore treated, 27,965 tons; gross value recovered, $338,000; operating expenses, $186,000; net realization, $152,000.

Active mining operations, with ample financial backing, and with what are regarded locally by the best authorities as excellent prospects for success, are being conducted on a number of properties in the Goldfield district, including the Goldfield Consolidated, Merger Mines, Florence Goldfield, Jumbo Extension, Goldfield Oro, Blue Bull, Booth, Silver Pick Consolidated, Sandstorm-Kendall, C. O. D. Consolidated, Lone Star, Goldfield Vernal, Nevada Eagle, Nancy Donaldson, Diamondfield Black Butte, Goldfield Belmont, Diamondfield Daisy, Great Bend, Crackerjack, Yellow Tiger, and New Jersey Mines Co.'s properties, and within a short time work will be in progress at a number of other properties.

Nye County

The quarterly statement of the Belmont company shows that receipts from ore and bullion were $940,521, and net earnings $543,584. The available cash resources on August 31 were $1,466,919. The shaft vein is opening in a splendid way, especially on the 1166-ft. level. A raise from the drift under the Murray vein on the 850-ft. level of the Extension has opened the shoot, which contains some good ore. The Jim Butler winze, below No. 6 level, is down 26 ft. in rich sulphide ore. On the 1000-ft. level of the Halifax there is profitable ore in three faces. The winze below the 600-ft. level of the West End is down 30 ft. On the 1170-ft. level of the Merger the orebody has proved

to be wider than expected. There has been a general change of officials at the North Star mine, J. W. Chandler being the new manager. Active development is under way at the 1200-ft. level of the Buckeye-Belmont. During the week ended October 4, the mines at Tonopah produced 11,927 tons of ore valued at $281,170.

Storey County

A new 1000-gal. per minute capacity Starrett pump is being fitted ready for work at the 2500-ft. level of the C. & C. pumping shaft, to lower the water to the 2700-ft. point. Bronze working parts are being substituted in the pump where necessary. There will be two of similar capacity for this work. It is stated that San Diego people have secured control of certain holdings on the Carson river which contain the tailing discharged from old mills crushing Comstock ores years ago. There is estimated to be great quantities of quicksilver and silver in the tailing, and operations are to be started at an early date.

White Pine County

The Ely Consolidated has shipped its third car of copper and silver ore to Salt Lake, Utah, smelters. Development in the Copper Queen on Lode B has opened 18 in. of 20.83% copper and 32.4 oz. of silver ore. The Morgan group is opening well, and on one drift is 30 in. of 2.73% copper, 15% lead, and 30.28 oz. silver ore.

UTAH

Summit County

Ore production of the Park City district in September totaled 7701 tons, divided among the different mines as follows: Silver King Coalition, 4004 tons; Daly-Judge, 1404; Daly West, 1338; Ontario Silver Mining Co., 407; creek jigger, 104; Grasselli Zinc Co., 96; Beggs and Miller, 45; Frank Daley, 34; Thompson-Quincy, 76; American Exploration Co., 166; Summit Leasing Co., 96; and Mines Operating Co., 34 tons.

WASHINGTON

Ferry County

(Special Correspondence.)—W. R. Foley, of Denver, Colorado, has bonded and leased the Phil Sheridan group of three claims, and the Stemwinder claim, in Sheridan camp, about 14 miles northwest of Republic. A 5 to 6-ft. vein on the Phil Sheridan has been partly developed, and the ore-shoot opened assays about $75 per ton, mainly in silver.

Republic, October 3.

The Republic district is quite active at present. The Imperator-Quilp company, having a bond on the Quilp mine, has leased the workings, and the lessees are shipping their first car of ore. The Knob Hill company is shipping 55 tons per day to the San Poil Consolidated mill. The Ben Hur Leasing Co. is employing 46 men and will soon increase the number. During August the Company shipped about $24,000 worth of ore to the smelters. In September the Company sunk the main shaft on the Ben Hur mine, from the 500-ft. toward the 600-ft. level; shipped a considerable quantity of ore and broke down about 1500 tons ready for shipment.

Boyle Bros. are operating a diamond-drilling plant on the Lame Foot group of claims and another on the Oversight group for the Granby Consolidated Mining, Power & Smelting Co. (British Columbia), having bonds on these and adjacent mines.

The Hall Creek Mining & Milling Co., owning mines in Meteor camp, in the southeastern part of the county, is installing a power-plant and concentrator to handle 75 tons of ore per day. The power will be developed from Hall creek, which will generate 270 horse-power. At the Surprise, the 700-ft. level is opening in a promising manner. This property has produced a total of $1,434,000 from above the 700-ft. level.

Plans for the rehabilitation of the North Washington Power & Reduction Co., which has an ore-treatment plant at Republic, are beginning to take definite form. About $10,000 was subscribed at a recent meeting to pay labor expenses, while $15,000 will be necessary to overhaul the mill, as estimated by Harry W. Newton, the superintendent.

Stevens County

(Special Correspondence.)—Development work has been resumed on the Butte and Washington mine, near Orient. C. H. Walters, the manager, reports that the last sample from the International vein assayed $7.22 in gold and 2.5 oz. in silver per ton. The sample was taken for 35 ft. across the vein. A shaft has been sunk 25 ft. on a cross-vein on the Audrey mine, on Toulou mountain; the vein is 30 in. wide and is reported to be rich. In the Chewelah district, the Butte-Chewelah Copper Co. has opened rich ore and is installing an engine and compressor to help development. The Copper King mine has completed a raise which connects the lower with the upper levels and gives air circulation sufficient to ventilate all of the stoping ground on the 500-ft. level. The Company will now ship a carload of ore per week.

Chewelah, October 2.

Electric power is now used at the United Copper mine, and the new concentrating plant will soon be in full operation.

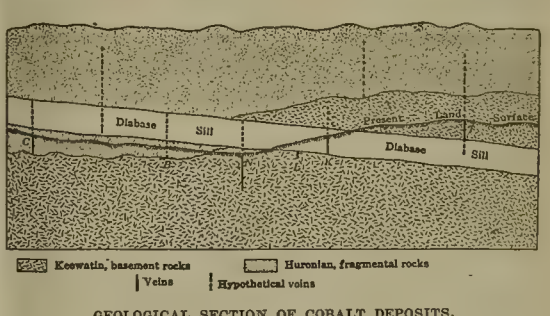
CANADA

British Columbia

In a report issued by the officers of the British Columbia Copper Co., Ltd., it is estimated that the production for August 1913 was 700,000 lb. of fine copper, 2400 oz. of gold, and about 12,500 oz. of silver. The report for eight months, including August, shows 5,590,624 lb. of fine copper, 16,103 oz. of gold, and 81,023 oz. of silver. During the first half of the year, $120,000 was spent on examining new properties. Last month a blast was fired on the Mother Lode mine which is said to be one of the greatest in the history of mining. Twenty-five tons of 40% giant powder was used, and there were 4123 holes drilled, each 15 ft. deep. This blast brought down 45,000 tons of ore and was completely successful. This is estimated to be about a year's supply of ore.

Ontario

At Porcupine, the concrete work for the additions to the Dome mill is almost finished. The main shaft of the mine is down 425 ft. Early in the current month the



GEOLOGICAL SECTION OF COBALT DEPOSITS.

directors will visit the property. The 10-stamp mill at the Three Nations is crushing from 40 to 45 tons per day, but the tube-mill has not been installed yet. A new tube-mill has been installed at the Porcupine Crown mill, and the stamp-mill will then have a capacity of 100 tons per day. A winze, in the mine, is down 30 ft. below the 400-ft. level, and shows ore for the full width. The south drift on the 300-ft. level has opened the rich shoot in the two upper levels. One hundred and fifty shareholders of the Three Nations Mining Co. visited the property of the Company on October 6 and 7. A new shoot, worth $12 per ton, has been opened on the 390-ft. level of the McIntyre. During September the mill treated nearly 200 tons of ore per day.

Ore shipments from nine Cobalt mines during the week ended September 26 totaled 434 tons, and the Nipissing sent 118,321 oz. of silver to London. On October 20 this company will pay a dividend of $450,000, making a total of $10,890,000 to date. At the Cobalt Lake No. 6 shaft, No. 2 cross-cut has opened a 2-in. vein of cobalt and silver assaying from 1000 to 1500 oz. per ton. It is evidently parallel to No. 2 vein. A cross-cut is being driven

toward the north end of the lake on the 225-ft. level from No. 4 shaft.

As the Kerr Lake, Crown Reserve, and Cobalt Comet (Drummond) mines are dependent for their water-supply on Kerr lake, which is now being drained, a pumping plant has been installed on Giroux lake to supply them with water for all purposes. This plant consists of two motor-driven turbine pumps, each with a capacity of 500 gal. per minute, taking water from a well sunk in rock at the lakeside, and connected to it by a blasted-out passage. The water is pumped through an 8-in. pipe against 125-ft. head to a 46,000-gal. receiving tank, whence it is piped to the different mines.

MEXICO

SONORA

During September 350 cars of ore, concentrate, and bullion, valued at ₱3,305,100, were exported from this state through the port of Agua Prieta. The Nacozari mine shipped 11,985 tons, and El Tigre 72 bars of bullion and 40 cans of precipitate.

The Moctezuma-Arizpe Development Co. is installing oil-engines and a new air-compressor at the mill, which is about 18 miles southeast of Cananea.

Mineral Production of California

The following is advance data from the 1912 annual statistical report of the State Mining Bureau.

Substance.	Amount.	Value.
Asbestos, tons	90	$ 2,700
Asphalt, tons	250,000	[illegible]
Barytes, tons	564	2,512
Bituminous rock, tons	44,072	87,467
Borax, tons	42,035	1,122,712
Brick, M	207,233	[illegible]
Cement, bbl.	6,199,634	6,074,661
Chrome, tons	1,570	11,269
Clay, tons	199,605	215,682
Coal, tons	14,848	29,992
Copper, lb.	24,169,997	5,638,049
Crushed rock	[illegible]	2,691,010
Feldspar, tons	1,252	6,180
Fuller's earth, tons	[illegible]	6,500
Gems	[illegible]	20,150
Gold	[illegible]	19,713,475
Granite, tons	[illegible]	362,975
Gypsum, tons	37,529	117,368
Infusorial earth, tons	4,129	17,074
Iron ore, tons	2,508	2,508
Lead, lb.	1,370,067	61,653
Lime, bbl.	522,116	464,440
Limestone, tons	610,075	570,248
Magnesite, tons	10,512	105,120
Manganese, tons	22	400
Marble, cu. ft.	27,620	74,120
Mineral paint, tons	300	1,500
Mineral water, gal.	2,497,794	529,384
Natural gas	[illegible]	94[illegible]76
Paving blocks, M.	11,015	574,365
Petroleum, bbl.	89,689,250	41,968,344
*Platinum, oz.	603	19,731
Pumice, tons	100	2,500
Pyrite, tons	69,972	203,470
Quicksilver, flasks	29,600	866,024
Salt, tons	*165,721	383,870
Sand and gravel, tons	2,657,685	841,588
Sand-glass, tons	13,075	15,404
Sandstone, cubic feet	66,487	22,574
*Silver	[illegible]	799,584
Soapstone, tons	1,750	7,350
Soda, tons	7,000	37,094
Tungsten ore, tons	[illegible]042	206,000
Zinc, pounds	4,331,091	299,666
Total		$91,472,385

*Figures compiled by the U. S. Geological Survey.

Personal

Professional men are invited to send news of their engagements and travels. Such news is interesting to friends.

C. S. HERZIG has gone to Butte.

HOWARD D. SMITH has gone to London.

F. W. BRADLEY has returned from Alaska.

H. V. WINCHELL has gone to Cripple Creek.

THOMAS CHARLTON has gone to Northern Nigeria.

C. H. MONRO has returned from British Columbia.

F. C. ALSDORF has opened an office at San Francisco.

F. G. COTTRELL has returned from Butte and the East.

A. R. CANNING has returned to England from West Africa.

W. F. STEVENS, recently of Arequipa, Peru, is in London.

ALLEN BARCLAY has gone to Burma on a professional visit.

P. D. BURTT has returned from Shushana and southwestern Alaska.

W. A. PRICHARD has gone to Colombia, to examine a placer property.

J. G. MCMILLAN has been appointed mining inspector for Northern Ontario.

SEELEY W. MUDD was in San Francisco over Sunday, returning from Denver.

CHARLES C. SELBIE has returned from Korea and is now at Pasadena, California.

C. M. EYE is superintendent for the Imperial Reduction Co. at Ogilby, California.

WARREN A. LESTER, of Las Vegas, Nevada, is in San Francisco on mining business.

J. A. HOLMES has left Valdez for Seattle. He will be in San Francisco about October 16.

RALPH S. G. STOKES is making examinations in the Stewart district of British Columbia.

W. B. TUCKER, recently with the Calera Mining Co. of Chihuahua, has returned to San Francisco.

E. Z. BURNS of the firm of Simonds and Burns, New York City, is in Colorado on professional business.

E. J. WAGOR has been appointed superintendent of the melting and refining departments of the San Francisco mint.

CHARLES A. BANKS, manager of the Jewel-Denero Mines at Greenwood, B. C., is examining properties in the Province of Quebec.

C. K. LEITH and G. P. CROSBY were in New York last week to testify in the dissolution suit against the U. S. Steel Corporation.

FREDERICK G. CLAPP has returned to Pittsburgh and will devote the next few months to the preparation of reports on foreign oil and gas fields.

HALL MACLAY CROSMAN, until recently with the American Smelting & Refining Co. at Charcas, San Luis Potosi, Mexico, is at New Rochelle, New York.

R. T. MISHLER, of the Tigre Mining Co., and JAMES W. MALCOLMSON have completed an examination of the Little Charlie mine at Mogollon, New Mexico.

D. C. JACKLING, C. M. MCNEIL, CHARLES HAYDEN, and K. H. BABBIT are making a tour of inspection of the properties of which Mr. Jackling is the general manager.

JOHN M. BOUTWELL, consulting geologist for Phelps, Dodge & Co., having finished his report of the property of the Detroit Copper M. Co., has left Santa Barbara for Globe, where he will make an examination of the property of the Old Dominion Copper M. & S. Company.

Among the geologists composing the excursion party to Alaska are H. ABLT, A. SCHENCK, L. DE BUGGENOM, F. VON GROTE, J. MOREL, H. HAUSEN, J. MCLEISH, E. MAIER, E. DE MARGERIE, E. S. MOORE, W. K. TEISSEYRE, A. W. C. WILSON, F. BASCOM, H. RIES, JAMES M. WOODIE, B. R. MURRAY, AUGUSTINE BAKER, PAUL ZOUDE, E. STOLLEY, T. F. WOLFF, C. KIDO, F. R. VAN HORNE, E. ROMER, and H. LUCK.

The Metal Markets

LOCAL METAL PRICES

San Francisco, October 9.

Antimony	12—12½c	Quicksilver (flask)	$39.50
Electrolytic Copper	17½—17¾c	Tin	44—46½c
Pig Lead	4.75—5.70c	Spelter	7—7½c

Zinc dust, 1400 lb. casks, per 100 lb., small lots $9.50—9.75; large $7.50—8.50

EASTERN METAL MARKETS.

(By wire from New York.)

NEW YORK, October 9.—The copper market is easier, with no demand. The London market closed steady with spot at £73 2s.6d. and futures at £73. A slight decline is to be noted in the price of copper, the average wholesale quotations of the New York market declining to 16.27. Despite the recent report of the Copper Producers' Association, very little support is being given to the copper stocks. The weak feature of the report was in the domestic demand, which shows a decrease of 6,800,000 lb., and the total deliveries both domestic and foreign showed a decrease of almost 7,000,000 lb. Lead and spelter are weak. Their sale is being pressed.

SILVER

Below are given the average New York quotations, in cents per ounce, of fine silver.

Date.		Average week ending	
Oct.	2 — 61.50	Aug.	27 — 59.46
"	3 — 61.62	Sept.	3 — 59.60
"	4 — 61.37	"	10 — 59.58
"	5 Sunday	"	17 — 60.20
"	6 — 61.00	"	24 — 61.59
"	7 — 61.25	Oct.	1 — 61.68
"	8 — 60.87	"	8 — 61.27

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	56.25	63.01	July	60.67	58.70
Feb.	59.06	61.25	Aug.	61.32	59.32
Mch.	58.37	57.87	Sept.	62.95	60.53
Apr.	59.20	59.36	Oct.	63.16	....
May	60.88	60.21	Nov.	62.73	....
June	61.29	59.03	Dec.	63.38	....

The falling off in American supplies, so far this year, is reflected in the total amount of the imports of silver bullion from the United States, Canada, and Mexico for the first eight months of the year. The figures are given below, together with those for the corresponding periods in 1912 and 1911.

	1911.	1912.	1913.
Ounces	86,098,660	78,187,081	74,071,113

It is worthy of note that the total imports from Australia and New Zealand for the same periods were:

	1911.	1912.	1913.
Ounces	422,875	547,006	1,215,335

Recent figures from Japan, relating to the silver movement in that country, show to what extent the metal is being parted with. Exports of 7,133,304 yen are offset by imports of 1,163,755 yen, leaving net exports of 5,959,549 yen. The net exports of 1911 were 1,369,126 yen, and for 1910 were 2,430,268 yen. Japan's production of silver is usually somewhat less than 5,000,000 yen, according to Pixley & Abell's circular.

COPPER

Quotations on copper as published in this column represent average wholesale transactions on the New York market and refer to electrolytic copper. Lake copper commands normally from 1-5 to 1-4c. per lb. more. Prices are in cents per pound.

Date.		Average week ending	
Oct.	2 — 16.30	Aug.	27 — 15.51
"	3 — 16.30	Sept.	3 — 15.69
"	4 — 16.30	"	10 — 16.32
"	5 Sunday	"	17 — 16.44
"	6 — 16.25	"	24 — 16.41
"	7 — 16.25	Oct.	1 — 16.29
"	8 — 16.25	"	8 — 16.27

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	14.09	16.54	July	17.19	14.21
Feb.	14.08	14.93	Aug.	17.49	15.42
Mch.	14.68	14.72	Sept.	17.56	16.23
Apr.	15.74	15.22	Oct.	17.32	....
May	16.03	15.42	Nov.	17.31	....
June	17.23	14.71	Dec.	17.37	....

On the whole the market was dull last week. Week before last the market weakened and sales in small lots were made at about 16½c., while the producers' figure declined from 17 to 16⅞c. per pound. On Monday, September 29, there were sales of small lots around 16½c., and the market was unchanged. On Tuesday, light sales at 16⅞c. were made for December delivery by the large sellers. This was reflected the next day in higher prices asked by the small dealers. On Thursday a fair amount of copper was sold to European buyers, and the producers exhibited more optimism. No sales of importance were recorded on Friday, and the week closed with both sides awaiting the report of the Copper Producers' Association on Wednesday. Exports of copper for the week ended October 2 totaled 10,174 tons. Foreign fortnightly statistics were reported on October 2 and revealed a further shrinkage in the stocks and visible supply of the metal abroad. Stocks decreased 1513 tons, and the visible supply in England and France and afloat on October 1 was 32,553 tons, a falling off of 3488 tons in the fortnight. The visible supply at Rotterdam, Hamburg, and Bremen on October 1 was 5295 tons, a decrease of 631 tons. Rotterdam stocks decreased 400 tons, Hamburg fell off 261 tons, and at Bremen a small increase was noted. The total of exports of copper from the United States during September was 77,000,000 lb., as compared with 51,144,000 lb. last September.

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.		Average week ending	
Oct.	2 — 4.40	Aug.	27 — 4.75
"	3 — 4.38	Sept.	3 — 4.75
"	4 — 4.33	"	10 — 4.73
"	5 Sunday	"	17 — 4.73
"	6 — 4.30	"	24 — 4.69
"	7 — 4.30	Oct.	1 — 4.61
"	8 — 4.30	"	8 — 4.33

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	4.43	4.28	July	4.71	4.35
Feb.	4.03	4.33	Aug.	4.54	4.60
Mch.	4.07	4.32	Sept.	5.00	4.70
Apr.	4.20	4.36	Oct.	5.08	....
May	4.20	4.34	Nov.	4.91	....
June	4.40	4.33	Dec.	4.20	....

ZINC

Zinc is quoted as spelter, standard Western brands, St. Louis delivery, in cents per pound.

Date.		Average week ending	
Oct.	2 — 5.25	Aug.	27 — 5.60
"	3 — 5.25	Sept.	3 — 5.63
"	4 — 5.25	"	10 — 5.65
"	5 Sunday	"	17 — 5.59
"	6 — 5.23	"	24 — 5.50
"	7 — 5.23	Oct.	1 — 5.39
"	8 — 8.23	"	8 — 5.24

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	6.42	6.88	July	7.12	5.11
Feb.	6.50	6.13	Aug.	6.96	5.51
Mch.	6.57	5.94	Sept.	7.45	5.55
Apr.	6.63	5.52	Oct.	7.36	....
May	6.68	5.23	Nov.	7.22	....
June	5.88	5.00	Dec.	7.09	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California, being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending			
Sept.	10 — 40.00	Sept.	24 — 39.50
"	17 — 39.50	Oct.	1 — 39.50
		"	8 — 39.50

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	43.75	39.37	July	43.00	41.00
Feb.	46.00	41.00	Aug.	42.50	40.50
Mch.	46.00	40.20	Sept.	42.12	39.70
Apr.	42.25	41.00	Oct.	41.50	....
May	41.75	40.25	Nov.	41.50	....
June	41.30	41.00	Dec.	39.75	....

TIN

New York prices control in the American market for tin, since the metal is almost entirely imported. San Francisco quotations average about 5c. per lb. higher. Below are given average monthly New York quotations, in cents per pound:

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	42.53	50.45	July	44.25	40.70
Feb.	42.96	49.07	Aug.	45.80	41.75
Mch.	42.58	46.95	Sept.	48.64	42.45
Apr.	43.92	49.00	Oct.	50.01	....
May	46.05	49.10	Nov.	49.92	....
June	45.76	45.10	Dec.	49.80	....

The Stock Markets

SAN FRANCISCO STOCKS AND BONDS

(San Francisco Stock and Bond Exchange.)

BONDS

October 8.

Listed.	Bid	Ask	Unlisted.	Bid	Ask
Associated Oil 5s	$ 99	100½	General Petroleum 6s	$—	54½
E. I. du Pont 4½s	88½	85½	Natomas Dev. 6s	98½	—
Natomas Con. 6s	—	75	Pac. Port. Cement 6s	99½	—
Unlisted.			Standard Cement 4s	90	—
Am. Oil 5s	76½	—	Santa Cruz Cement 6s	83	—

STOCKS

Listed.	Bid	Ask	Unlisted.	Bid	Ask
Amalgamated Oil	75	78	Mascot Copper	—	2½
Associated Oil	39½	—	Noble Electric Steel	2½	—
E. I. du Pont pfd	86	92½	Natomas Consol	9	12
Pac. Cst Borax, com	—	100	Pacific Port. Cement	63	75
Pacific Crude Oil		35c	Riverside Cement	45	—
Sterling O. & D.	65c	1.10	Santa Cruz Cement	45	[illegible]

NEVADA STOCKS

(By courtesy of San Francisco Stock Exchange.)

San Francisco, October 8.

Atlanta	$ .14	Mizpah Extension	$ .35
Belcher	.40	Montana-Tonopah	1.15
Belmont	7.10	Nevada Hills	.86
Big Four	.20	North Star	.38
Cash Boy	.07	Ophir	.22
Florence	.20	Pittsburg Silver Peak	.37
Goldfield Con.	1.42	Round Mountain	.40
Goldfield Oro	.08	Sierra Nevada	.11
Halifax	1.40	Tonopah Extension	1.87
Jim Butler	.65	Tonopah Merger	.66
Jumbo Extension	.12	Tonopah of Nevada	4.00
MacNamara	.10	Union	.10
Mexican	1.12	West End	1.52
Midway	.40	Yellow Jacket	.45

COPPER SHARES—BOSTON

(By courtesy of J. C. Wilson, Mills Building.)

October 9.

	Bid	Ask		Bid	Ask
Adventure	$ 1½	—	Mohawk	$ 40½	41
Allouez	33½	34	North Butte	25½	26
Calumet & Arizona	63½	64	Old Dominion	50½	51½
Calumet & Hecla	420	425	Osceola	76	78
Centennial	13½	14	Quincy	[illegible]	59
Copper Range	39	39½	Shannon	6½	7
East Butte	12	12½	Superior & Boston	2½	2¾
Franklin	3½	3½	Tamarack	[illegible]	30
Granby	72½	72¾	U. S. Smelting	39	39½
Greene Cananea	30	[illegible]	Utah Con.	8½	9
Hancock	16½	17	Victoria	1½	1½
Isle-Royale	18½	19	Winona	1½	2½
Mass Copper	2	2½	Wolverine	41	42½

NEW YORK QUOTATIONS

(By courtesy of E. F. Hutton & Co., Kohl Building.)

October 9.

	Bid	Ask		Bid	Ask
Braden Copper	7¼	7⅜	McKinley-Dar.	1½	1⅝
B. C. Copper	3	3⅛	Mines Co. Am.	2⅛	2⅜
Davis-Daly	1⅝	1¾	Nipissing	8⅜	8½
Dolores	1	2	Ohio Copper	⅜	½
El Rayo	2	4	San Toy	18	22
Ely Con.	5	7	Sioux Con.	1	2
First Nat.	3	3⅜	So. Utah	⅛	¼
Giroux	1⅛	1½	S. O. Calif.	181	184
Greene Can.	6	7	Tri Bullion	⅛	[illegible]
Hollinger	17	17¾	Tuolumne	2½	2⅝
Iron Blossom	120	130	United Copper	¼	⅜
Kerr Lake	3⅞	4	Wettlaufer	12	14
La Rose	2	2⅛	Yukon Gold	3	3¼
Mason Valley	3½	3¾			

LONDON QUOTATIONS

(By cable, through the courtesy of Catlin & Powell Co., New York.)

October 9.

	£	s.	d.		£	s.	d.
Alaska Mexican	1	17	6	Kern River Oilfields	0	7	6
Alaska Treadwell	8	5	0	Mexico Mines	6		0
Alaska United	4	0	0	Messina	1	10	0
Arizona	2	0	0	Oroville	0	6	3
California Amalg.	0	2	6	Pacific Oilfields	0	2	6
California Oilfields	6	5	0	Rio Tinto	78	2	6
Camp Bird	0	16		Santa Gertrudis	0	17	6
El Oro	0	15	0	Stratton's	0	2	6
Esperanza	0	18	9	Tanganyika	2	8	9
Granville	0	11	3	Tomboy	1	5	0

AUSTRALASIAN

October 9.

	£	s.	d.		£	s.	d.
British Broken Hill	1	18	9	Mount Boppy	0	15	[illegible]
Broken Hill Prop.	1	16	9	Mount Elliott	4	17	6
Golden Horse-Shoe	2	16	9	Mount Lyell	2	0	0
Great Boulder Prop.	0	18	9	Mount Morgan	3	3	9
Ivanhoe	3	0	0	Waihi	2	7	6
Kalgurli	2	1	3	Waihi Grand Junc.	1	1	[illegible]

COPPER PRODUCERS' ASSOCIATION REPORT

The Copper Producers' Association statement, October 8, shows a decreased surplus. The details are as follows:

	Pounds.
Stock of marketable copper of all kinds on hand at all points in the United States, September 1, 1913	38,314,137
Production of marketable copper in the United States from all domestic and foreign sources during September	131,401,229
Deliveries for consumption, September	66,836,897
Deliveries for export, September	73,685,275
Stock of marketable copper of all kinds on hand and at all points in the U. S., October 1	29,793,094

Recent changes in surplus have been as follows, in pounds:

	Increase.	Decrease.
September 1912	16,364,213	.....
October	13,679,380	.....
November	9,419,095	.....
December	19,148,523	.....
January 1913	17,885,770	.....
February	.....	896,134
March	.....	18,032,928
April	.....	28,720,162
May	.....	8,074,883
June	.....	14,569,619
July	690,339	.....
August	.....	15,280,908
September	.....	8,531,043

GOLD PRODUCTION IN WESTERN AUSTRALIA

The July yield for the state was worth $2,310,680, and from the principal mines as follows:

Name.	Tonnage.	Value.	Profit.	Dividend.
Great Boulder	18,788	$241,600	$122,260	.....
Ivanhoe	20,607	199,900	70,000	$175,000
Kalgurli	10,985	110,500	47,000	120,000
Bullfinch	4,806	72,090	44,200	.....
Yuanmi	10,600	89,600	22,700	.....
Fenian	2,800	41,500	20,500	.....
Sons of Gwalia	13,510	104,700	19,600	.....
Lake View & Star	18,694	107,400	18,100	.....
Golden Horse-Shoe	29,030	184,600	12,600	.....
Sand Queen	1,600	28,400	12,500	11,250
Oroya Links	12,500	66,300	8,900	.....
Ida H.	1,426	24,000	8,100	.....
Mararoa	2,730	24,900	7,900	.....
Queen of the Hills	4,082	37,900	7,800	.....
Ingliston Consols	1,900	22,500	7,700	.....
Mountain Queen	4,166	26,200	7,300	.....
Kyarra	1,040	13,100	6,900	.....
Black Range	3,076	31,600	5,200	.....
Associated	11,435	67,400	5,000	61,900
Golden Ridge	2,950	23,300	4,900	.....
Boulder Perseverance	21,550	108,200	4,900	.....
Boulder No. 1	2,234	6,000	2,200	.....
Edna May	1,140	20,300	1,700	.....
Victorious	8,573	38,800	1,600	.....
Lake View Consols	8,064	7,500	1,500	90,200
Marvel Loch	1,700	13,200	1,000	.....
Burbank's Main Lode	2,047	22,000	700	.....
Golden Butterfly	1,215	6,500	500	.....
			Loss.	
Great Fingall Consols	5,361	55,300	[illegible]	.....
Menzies Consols	2,169	17,800	[illegible]	.....
South Kalgurli Consols	9,666	51,300	1,800	.....
Lady Miller	1,705	7,700	2,200	.....
Commodore	880	4,700	1,000	.....

Company Reports

TROITZK GOLDFIELDS, LIMITED

The Company was registered in 1906 to acquire from the Siberian Proprietary Mines, Ltd., the Preobragensk and Alexendrosk, Andreyevsky, and Vawarensky gold mines in the northwest part of the Kotchkar goldfields, province of Orenburg, southeast European Russia, and 49 miles south-southeast of Bishkil station on the main Siberian railway. The property is held on perpetual lease from the Russian Government and was taken over as a going concern, having been worked by former owners for several years, and equipped with milling, cyaniding, and a chlorination plant. The capital is £625,000 in 124,993 priority, and 500,007 ordinary shares of £1 each; 105,488 priority and all the ordinary shares are issued and fully paid. The report for the year ended January 13, 1913, states that the trial run of the mill and cyanide plant extensions commenced in July, and by August the installation was running normally. The new slime plant also came into operation in July, and during the few months the plants were in operation 23,793 tons of ore was milled, with the following results:

Ore milled, tons	23,793
Gold by amalgamation, ounces	4,662
Cyanide plant operation:	
Sand leached, tons	11,755
Slime filtered, tons	9,205
Concentrate produced, tons	150
Gold from cyanidation, ounces	1,486
Total extraction, per cent	82.95
Value of yield	R.*246,135
Total expenditure	252,983

*1 ruble = 51.5 cents.

There is an increase of R. 1.032 per ton in operating costs as compared with the previous year, chiefly due to the abnormally high cost of cyaniding. The value of the ore milled is 1.8 dwt. per ton less than that milled during 1911, due to the larger amount of waste broken, and to a faulted zone met with at the 680-ft. level. The ore reserves were estimated at 26,270 tons of a value of 7 dwt. (R. 14) per ton, besides which there was 1,199 tons of broken ore at surface, produced by mining operations during the year. In addition there is 1,950 tons of ore as pillars and arches, not available until the 500-ft. level is abandoned. The output from all sources was valued at £26,000, against which the total expenditure in Russia amounted to £26,608, thereby showing a working loss of £599. The net result for the year is a loss of £14,028.

THE OFFIN RIVER GOLD ESTATES.

The company was registered in 1900 to adopt an agreement with the Offin Syndicate Ltd. and to acquire a property of about 40 sq. miles, including the right to dredge the river Offin and its tributaries, in the Gold Coast Colony. Additional property has since been acquired, making 100 sq. miles now held and 158 miles of river. Four dredges are at work. The Offin Rubber Plantations Ltd. has been formed to develop a portion of the property for the cultivation of rubber. During 1910 an exclusive property license was acquired over 2½ sq. miles of tin-mining property, about 20 miles southeast of Naraguta, in Northern Nigeria. A mining lease has been secured over 720 acres, of which 81 acres have been proved and are estimated to contain 1,717 tons black tin. An exclusive prospecting license over 3¾ sq. miles situated to the northwest of the before mentioned property has been acquired and an application has been made for two square miles adjoining. Tin concentrate is recovered by means of calabashing. The capital is £300,000, in 45,000 7% preference and 252,920 ordinary shares of £1 each; 30,000 preference and 252,920 ordinary shares are issued and fully paid. The active profit for 1912 was £3,888. One dredge was laid up for the year, and the operations of the other three machines seriously hampered by light rains and the consequent low state of the river, yet the value of the gold output was only £1,156 15s 3d less than in 1911. The expenditure on the Nigerian tin properties amounted to £4,709, but tin concentrate was recovered to the amount of £1,854. The proceeds of the bullion recovered by the dredges was £22,184.

ABBONTIAKOON MINES, LIMITED.

The company was registered in 1909 and is an amalgamation of the Abbontiakoon Mines Ltd. and Abbontiakoon Block 1 Ltd. The property consists of leases for 99 years from December 1880, of the mining, surface, timber, and rubber rights over the Abbontiakoon concession, near the town of Saskeva, Nassaw district, Gold Coast Colony. It is connected with Seccondee, a distance of 40 miles, by the Gold Coast government railway. Ball-mills and cyanide plant were erected but were subsequently dismantled and a new mill of 25 stamps (1,680 lb. each), two tube-mills and sand and slime plant have been erected, with a capacity of 11,000 tons monthly. The capital is £625,457 in 1,250,915 shares, 221,285 shares are under option at par, leaving 127,800 shares in reserve. There is a loan of £140,000 from the Fanti Consolidated Mines Limited, and the Gold Coast Amalgamated Mines Ltd., $55,000 have been repaid since the beginning of this year, leaving £85,000 outstanding. The mine has been running in a normal condition since October. Surface construction work was completed in June, and the mill started regular crushing in July. Since that date 46,415 tons of ore has been crushed and £78,841 worth of gold produced, giving a profit of £8,432 or 3s 7.59d per ton. The average working costs from July until December were 30s 4.07d per ton. It was necessary to recruit raw natives from Nigeria and the northern territories, but given a sufficient supply of native labor so that 11,000 tons of ore could be crushed monthly, there should be no difficulty in reducing working costs to 25s per ton. The total ore developed during the year was 24,958 tons. The cost of 21,555 tons exposed during the December quarter was 1s 2.52d per ton. At December 31 629,942 tons, of 10 dwt. gold content, and 309,012 tons, of 3.5 dwt., was developed or exposed, calculated over a minimum stoping width of 48 inches. The total receipts for the year were £79,440, leaving a debit balance for the year of £2,462.

CENTRAL ZINC COMPANY, LIMITED.

The company was registered in 1906 to acquire zinc distilling works in England, and has entered into a contract with the Sulphide Corporation, Ltd., whereby the latter undertake to supply from the Central mine, Broken Hill, N. S. W., for 10 years from January, 1907, zincblende up to 50,000 tons per annum. Smelting works have been erected at Seaton Carew, near the mouth of the Tees river, Durham, capable of treating 40,000 tons per year. The capital is £150,000 in 150,000 shares of £1 each; all the shares are issued and fully paid. The report for the year ending March 31,1913, states that operations were not resumed for a month at the beginning of that period, on account of the then-existing coal strike. The influence of the strike, in the increased price of coal, was felt for a long period. The year closed with the best results yet achieved in the history of the company, however. The roasting plant proved ample for all purposes and 7,608.54 dry tons of ore was roasted. The number of retorts made totalled 11,952, together with 25,076 condensers. The distilling furnaces handled 8,972.55 tons of ore, producing 3,066.14 tons of spelter, 23.42 tons blue powder, and 41.51 tons metallic lead. The argentiferous leady residue totalled 6,270.82 tons. The concentrating plant treated 6,270.82 tons of residue yielding 3,229.64 tons of concentrate. The total expenditure for the year was £35,071. The profit for the year was £9,146, of which £2,788 is due to the Sulphide Corporation, Ltd., as their share under arrangement for joint account working, leaving a balance of £6,368, which is applied in reductions in the amount of expenditure to be written off, as per balance sheet of March 31, 1912.

THE production of lead ores in 1912 increased about 500,000 tons compared with 1911. The yield of lead concentrates from the Central States (mainly from Missouri) was 256,838 short tons. Idaho, the largest producer in the Western States, contributed 176,704 tons.

Book Reviews

THE DAWSON NEWS. Discovery Day Edition, August 17, 1913. P. 74. Ill. The Dawson News Publishing Co., Dawson, Yukon Territory.

This is an interesting publication covering the discovery of gold in 1896 by Robert Henderson, the gold output to date approximating $175,000,000, work of the Yukon Gold Co., dredging and hydraulic work, gold quartz and copper mines in the territory, climate, transportation, wild animals, and other details concerning a generally little known country.

FUR-FARMING IN CANADA. By J. Walter Jones. Commission on Conservation, Canada, publication. P. 166. Ill., maps, index. The Mortimer Co., Ltd., Ottawa, 1913.

The ruthless slaughter of fur-bearing animals in the world in past years and at present, which amounts to from 400 sea-otters to 71,500,000 rabbits per annum, with no provision made for keeping up the supply of the more valuable animals, has reduced the supply to a low point. The raising of these animals and their regular killing for furs is a comparatively new industry in Canada, and is a move in the right direction. The book under review is full of interest as to the habits and value of certain animals now being raised on these farms.

ENGINEERING AS A PROFESSION. By A. P. M. Fleming and R. W. Bailey. P. 286. John Long, Ltd., London. For sale by the *Mining and Scientific Press*. Price, $1.

In this book the attempt is made to give a concise view of the scope of training necessary for an engineer and of the opportunities for advancement. Mr. Bailey's experience as principal of the Technical Institute at Crewe gives weight to what is said as to the training of engineers. The bulk of the book, filled with matter relating to the cost of training methods, of obtaining appointments, and schedules of civil service examination, is based almost entirely upon conditions in Great Britain and is therefore of little direct use elsewhere.

INTRODUCTION TO THE STUDY OF IGNEOUS ROCKS. By G. J. Finlay. P. 228, index, Ill., tables. McGraw-Hill Book Co., New York, 1913. For sale by the *Mining and Scientific Press*. Price, $2.

This is an excellent little book of pocket size, with flexible backs, and contains in convenient form the essential facts necessary to determination of igneous rocks likely to be met by mining engineers. The different chapters cover 'Qualitative Classification of Igneous Rocks,' 'Determination of Igneous Rocks in Hand Specimens,' 'Movement of Light in Crystals,' 'Identification of the Essential Minerals of Igneous Rocks,' 'Description of the Accessory Minerals of Igneous Rocks,' 'Igneous Type Rocks,' 'Varietal Rocks Related to Type Rocks,' 'Method of Describing Rocks,' 'Outline of the Quantitative Classification.' Mr. Finlay is a competent petrographer, has made an excellent selection from the material available, and has written a highly useful book.

THE GEOLOGY OF KALGOORLIE. By C. O. G. Larcombe. P. 315. Ill., maps, plans, index. Australasian Institute of Mining Engineers. Melbourne, Victoria, 1913. For sale by the *Mining and Scientific Press*. Price, $4.

This valuable work has been printed and in circulation among members of the Australasian Institute of Mining Engineers since 1911 and is now for sale to the public. The volume is the outcome of three years' study, and has been written, not only as a scientific exposition of the geology and occurrence of the ore deposits of Kalgoorlie, but, at the request of various mining people, with the object of initiating those interested into some of the more important places connected with the mining geology of the district. In this respect the work must of necessity differ from a purely technical monograph. When first published we commented on Mr. Larcombe's work, and we have made short extracts since from time to time, so there is no need here to cover the same ground again. The book is well arranged, excellently illustrated, and the printing and binding is also good. It bids fair to become a standard text-book of reference on the geology of this important district.

CYANIDE PRACTICE, 1910 TO 1913. Edited by M. W. von Bernewitz. P. 732. Ill., index. San Francisco, 1913. Published and for sale by the *Mining and Scientific Press*. Price, $3.

This book forms the third in the series of reprints from the MINING AND SCIENTIFIC PRESS of articles on cyanidation that was begun by T. A. Rickard in 1907, and it is of the same general character as the preceding volumes, 'Recent Cyanide Practice,' and 'More Recent Cyanide Practice.' The name is indicative of the scope of the work, and the volume consists of a wide variety of individual papers on cyanidation, all having in common the trait of centring interest on practice. Collectively they afford an unexampled picture of the state of the art at the beginning of the year, and individually they throw light upon nearly every phase of the work of the present-day cyanidationist. The book brings together and preserves in permanent form the experience and observations of nearly 200 men engaged in the actual operation of cyanide mills in the United States, Canada, Mexico, Central America, Korea, Australia, South Africa, and, indeed, wherever potassium cyanide is used to dissolve gold. The list of authors includes E. M. Hamilton, A. W. Allen, S. J. Truscott, H. Stadler, F. C. Brown, Noel Cunningham, W. P. Lass, J. W. Hutchinson, A. J. Yeager, A. Grothe, E. L. Oliver, W. J. Sharwood, W. A. Caldecott, Philip Argall, F. C. Landguth, A. E. Drucker, Alfred James, and many others too numerous to mention, who are widely known for their excellent work. A not unimportant portion of the book was written by its editor, who from extended operating experience in New Zealand and Australia, supplemented by wide reading and study in the United States, has brought to the task of compiling this volume especial competence as well as enthusiasm. Mr. von Bernewitz has arranged the abundant material under the following heads: Historical; Chemistry of Cyanidation; Special Problems; Crushing; Concentration and Treatment of Concentrates; Roasting; Agitation; Decantation; Filtration; Precipitation and Clean-up; Disposal of Residue; Measurement and Estimation of Tonnages; Recent Cyanide Practice by Districts; Description of Notable Mills; Review of Progress by Years.

The book is a sifted compendium of facts that will promptly take rank as one of the indispensable handbooks of the cyaniders. H. F. B.

Recent Publications

PREVENTION OF ACCIDENTS. General rules issued by the Safety Department of the Copper Queen Consolidated Mining Co., Bisbee, Arizona. P. 23. This department of the well known copper mining company was formed to try and reduce the number of serious and minor accidents occurring at the mines and smelters, which, besides injuring employees and incapacitating them from work, is a source of worry and expense to everybody concerned. The prevention of accidents by all possible means is a personal duty which everyone owes not only to himself, but also to his fellow workmen. This little pamphlet deals with 87 different subjects, and should be secured by miners and millmen alike.

MINING MAP OF SONORA, MEXICO. Compiled by S. M. Greenidge, Douglas, Arizona. Size, 36⅜ by 49¼ inches. Scale, one inch to 11.8 miles. For sale by the *Mining and Scientific Press*. Price, in folder for pocket use or on rollers, $2.

Sonora is one of the most important mining states in Mexico, and the map under review has been executed with care, to show every mining centre of the state. While this state is somewhat disturbed at present, there is sure to be a large return of mining men when affairs are settled, necessitating the use of a reliable map.

Concentrates

Most of these are in reply to questions received by mail. Our readers are invited to ask questions and give information dealing with the practice of mining, milling, and smelting.

APPLICATION for patent should, when possible, be made in the spring rather than fall, since, in case examination of the claim becomes necessary, delay may ensue by reason of the impossibility of making examinations at high altitudes in the winter.

THE QUESTION as to real or personal property in respect to mining equipment is often the subject of great difference of opinion when it comes to deciding the question of ownership. A track laid in an adit in a more or less permanent manner is a fixture and passes with the real property, regardless of change of ownership, unless some special provision in the lease gave the lessee the right to remove the equipment. A mine-car is personal property and may be recovered by its owner at any time prior to the lapse of the three-year period of limitation.

ROTARY ROASTING FURNACES give satisfaction in treating zinc and other ores and in calcining cement-making materials. In Mexico there are two 4 ft. 8 in. by 40-ft. furnaces roasting zinc ores, and the Power & Mining Machinery Co. has made one 10 by 150 ft. The lining is usually of fire brick, 4 in. thick for small machines, and up to 12 in. for the firing zone of the larger ones. They are mounted on rollers, and inclined from ⅜ to ¾ in. per foot. Speed varies from 1 to ⅛ r.p.m., fuel consumption ranges from 250 to 750 lb. per ton of ore being roasted, and, according to size, the machines could handle from 36 to 600 tons per day.

DISCOVERY is a prerequisite to the patenting of mineral land in the United States, and the Supreme Court has said: "While the statute does not prescribe what is necessary to constitute a discovery under the mining laws of the United States, it is essential that it give reasonable evidence of the fact either that there is a vein or lode carrying precious minerals, or if it be claimed as placer ground, that it is valuable for such mining, and where there is not enough in what the locator claims to have seen to justify a prudent person in the expenditure of money and labor in exploitation, this court will not overthrow a finding of the lower court that there was no discovery. It is the policy of the Government to favor the development of mines of gold and silver and other minerals, and every facility is afforded for that purpose, but it exacts a faithful compliance with the conditions required. There must be a discovery of mineral and a sufficient exploration of the ground to show this fact beyond question. If the lands contain gold or other valuable deposits in loose earth, sand or gravel, which can be secured with profit, that fact will satisfy the demand of the Government as to the character of the land as placer ground."

ELECTRICITY was used in the Butte district, Montana, prior to 1902, only for lighting, tramming of ore on the surface, and electrolytic refining of copper, according to John Gillie. It is now used for every purpose. The Anaconda Copper Mining Co. operates 10 main hoisting engines and 10 auxiliary hoists by compressed air, which is generated by six 7500 cu. ft. of free air each per minute air-compressors, driven by 1200-hp. synchronous motors. The air in rock-drilling operations is used at 85 lb. pressure, and for the large operations is usually furnished from three or four central plants, the smaller mines using individual machines. A total of 13,455 e.hp. is used for this purpose, and the voltage used is from 440 to 2200 volts. In draining the mines, electrically driven pumps are generally used, and a total of 4780 e.hp. is required. The large pumps are quintuplex vertical-plunger type, with a capacity of 600 gal. against a head of 1200 ft. The smaller units are of various types. Centrifugal pumps are not used on account of the acid nature of the mine waters. The mines of the Butte district are warm, due to the oxidizing of the sulphide minerals, and forced ventilation is largely resorted to. Twenty-five hundred electric horse-power is used for driving ventilating fans. In addition to fans and blowers, compressed air is used after blasting to clear the mines of powder gases and foul air. Underground, the stations, main cross-cuts, and drifts are electrically lighted, as well as the surface plants and property. A total of about 1300 hp. is used for this purpose. Electric locomotives are being introduced in all tramming, both underground and surface, and this work requires 1860 e.hp. At Butte, Anaconda, and Great Falls, all the Butte ores are treated. In these ore-reducing plants, 24,177 hp. is used in driving concentrators and blowing engines, and in operating cranes, shops, and the different power machinery in connection therewith.

IN MANY REGIONS the settling of ground above extensive mine workings is of common occurrence and leads to serious damage to property on the surface, not only immediately above the mines, but often at considerable distances away, according to Ernest Howe. The force of gravity, exerted vertically downward, that tends to overcome equilibrium in a partly supported mass of rock or earth may be resolved into two components, one of which is in the direction of least resistance to movement; the angle that this component makes with the vertical has been called the 'angle of pull.' The surface area subject to disturbance depends upon the various angles of pull of the unstable ground, and a determination of these angles may sometimes be a matter of considerable importance. In a study made some years ago in the mountains of southwest Colorado, the causes that were believed to have been responsible for the numerous landslides were summarized as follows: Internal causes: (1) physical condition of the rocks: cohesion, jointing, presence of soft or incompetent layers; (2) structural conditions: folding, faulting; and (3) topographic conditions: oversteep hillsides or cliffs. External causes: (1) earthquakes; (2) readjustment of stresses within the mountains; (3) saturation of the ground by water; and (4) frost. Probably the commonest of the external causes of landslides is saturation of the ground by water.

THE ore reserves of the Central Mining & Investment Co.'s properties, as calculated at the close of the financial year, are summarized as follows:

	Tons.	Value per ton.
1. Ore blocked out and available for stoping (This represents an average of 3.20 years' supply for the mills.)	32,512,087	31.3s.
2. Ore in sight which will be rendered available for stoping by current development operations (This represents an average of 0.32 year's supply for the mills.)	3,290,168	25.2s.
Total	35,802,255	30.8s.

This represents an average of 3.52 years' supply for the mills on measured ore reserves alone.

3. Ore contained in shaft, safety and boundary pillars is given in a subjoined detailed statement for each company.

In addition to these reserves, a further supply amounting on the average to about 15% of the total output, is obtained from development rock and reclamation work. Close attention has been given on the mines of the group during the year to mining as little waste rock as possible, to confining the stope widths as nearly as is practicable to the actual widths of the profitable orebodies. This enables the proper inclusion in profitable reserves of bodies of ore which with less careful mining would remain below the profit limit.

The average rate of sorting for 1912 was 14.08% of the total tons mined. The ore reserves in classes 1 and 2 therefore represent 30,761,298 milling tons of a calculated gold content of 35.2s. per ton.

Production Statistics

SMELTER AND REFINERY PRODUCTS IN 1912.

The value of the metals produced from domestic ores, foreign ores, matte, and unrefined bullion smelted or refined in the United States in 1912, according to a report by J. P. Dunlop of the U. S. Geol. Survey, was $995,798,618, compared with $787,727,776 in 1911. The figures are approximate, as the value given for aluminum is that for consumption and includes the imported metal in addition to the production from domestic ores.

The quantity and value of the metals are given for both domestic and foreign sources, but it is necessary to add the value of the secondary metals recovered in 1912 in order to show the vast extent of the refinery and smelting industry in the United States. As the value of these secondary metals, which is exclusive of gold, silver, platinum, iron, and aluminum, amounted to over $77,000,000 in 1912, it is reasonable to assume that the total value of the metals derived from foreign and domestic sources by the smelters and refineries in the United States amounted to over $1,100,000,000. A portion of the increased value in 1912 was due to the much higher average prices for silver, copper, and zinc, but the production of all metals other than gold and antimonial lead increased in 1912.

The extremes in output are shown by the fact that 1.3 tons of platinum, 188.1 tons of gold, and 4,471.4 tons of silver were recovered from domestic and foreign ores and from foreign matte and unrefined bullion, while the production of pig iron, the largest output of pig recorded in the United States, amounted to 33,802,685 short tons. The yields of refined copper, 734,052 tons, and of spelter, 338,806 tons, were also the largest ever made. The consumption of aluminum in 1912 was 32,803 short tons, an increase of nearly 10,000 tons over that of 1911. Pig iron production increased over 7,750,000 short tons in quantity and over $93,000,000 in value. Of the pig iron about 4 per cent was smelted from foreign ores. The quantity of spiegeleisen, ferro-manganese and other ferro-alloys marketed in 1912 amounted to 368,126 short tons, of which 39% was derived from foreign ores.

The gold from domestic ores amounted to $93,451,500 and that from foreign ores, matte, and bullion to $19,964,010. The value of the silver in 1912 from domestic sources was $39,197,500 and that from foreign sources $40,989,817, a total of $80,187,317, or nearly $11,000,000 more than in 1911. The output of nickel and of platinum, valued at $17,936,800 and $1,732,221, respectively, was derived almost wholly from foreign ores, matte, and bullion. The small yield of tin was derived from foreign ore, as the domestic ore, which came entirely from Alaska, was shipped to Great Britain for smelting. The value of the copper from all sources amounted to $242,237,160, an increase of over $63,000,000. The production of copper from domestic ores increased over 65,000 tons, while that from foreign ores and matte declined 48,000 tons. The lead from all sources was 6,000 tons less in quantity and $540,000 less in value in 1912 than in 1911, the decline being due almost entirely to a lower smelter recovery from foreign ores, matte, and bullion. There was an increase of over 62,000 tons of spelter made from domestic ores, while that from foreign ores was about the same in 1912 as in 1911. The total value of the spelter increased from $32,663,964 in 1911 to $46,755,228 in 1912.

The largest increase was that of iron ores, which amounted to 46,023,540 short tons in 1911 and 63,859,728 short tons in 1912, an increase of over 38%. Most of the ore shipped was hematite ore from the Lake Superior region. Brown ore furnished only about 3% and magnetite less than 4% of the ore shipments. Manganese ores of high grade came mainly from Virginia and the rich manganiferous iron ores mainly from Arkansas and Virginia, while all the chromium ore shipped in 1912 was mined in California. The figures for aluminum ore given in the table represent the domestic output of bauxite, mainly from Arkansas, Alabama, and Georgia. The figures given for gold ore include silicious, pyritic, and other alloys in which the predominant value is gold.

The following table shows the production of crude metallic ores supplied from domestic mines to gold and silver mills, concentrating plants, and smelters in 1911 and 1912, in short tons:

Ores.	1911.	1912.
Iron	46,023,540	63,859,728
Manganese	2,752	1,864
Manganiferous iron	3,006	3,247
Chromium	134	225
Tungsten	16,500	34,000
Titanium	.....	6,900
Aluminum	174,292	179,040
Gold	9,884,684	9,736,203
Silver	739,200	848,574
Quicksilver	138,525	155,694
Tin	42,200	3,000
Vanadium and uranium	8,468	18,000
Copper:		
Western States	18,207,566	23,431,301
Central States	10,978,827	11,411,941
Eastern States	801,842	830,089
Total	29,988,235	35,673,331
Copper-lead	6,923	14,614
Lead:		
Western States	2,157,817	2,388,598
Central States	3,794,712	4,064,366
Total	5,952,529	6,452,964
Zinc and zinc-lead:		
Western States	1,356,781	1,344,222
Central States	10,629,269	11,899,185
Eastern States	413,332	497,832
Total	12,399,382	13,741,239
Grand total, tons	105,380,370	130,728,622

The table conveys in a striking manner the prominence of the mining industry in the United States. The total quantity of crude metallic ore from domestic mines in 1912 increased over 25,000,000 short tons compared with that of 1911. The output of nearly every kind of ore increased and all parts of the country shared in the prosperous conditions.

The production of silver ore given is mainly that of silver-gold ores in which the value of the silver exceeds that of the gold. Pure silver ore is rare in the United States. Of the 1912 production, Nevada (mainly Tonopah) is credited with 476,725 short tons, Colorado with 158,429 tons, New Mexico with 110,127 tons, Utah with 81,234 tons, and Texas with 20,375 tons. The Colorado output is largely iron-manganese-silver ore used as flux in lead furnaces.

No quicksilver ores were imported and of the domestic ore treated 130,926 tons was the output of California mines.

The production of copper ores increased 5,700,000 tons in 1912. The increases from the Lake Superior mines and from Tennessee, while substantial, were relatively small compared with the largely increased tonnage of copper ores treated in the Western States, amounting to over 5,200,000 tons. New Mexico, Arizona, and Nevada contributed the bulk of this increase, which consisted mainly of concentrating ores. The quantity of copper concentrate produced in 1911 was 2,202,590 tons; in 1912 it was 2,734,065 tons. The average content of copper in crude ore concentrated in 1912 was 1.26 per cent.

The production of zinc concentrate in the Central States amounted to 424,337 short tons in 1912, which came mainly from ores mined in Missouri, Wisconsin, Kansas, and Oklahoma. New Jersey was the largest producer of zinc ores in the Eastern States, and Colorado, Nevada, Utah, Montana, and New Mexico in the Western States.

The Survey report entitled 'The Production of Metals and Metallic Ores' is now in press. When issued, copies may be obtained upon application to the Director of the United States Geological Survey, Washington, D. C.

The report shows a general increase in production and expansion of the industry with special regard to the copper, lead, and zinc.

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EDITORIAL

COAL MINING in Western Canada is showing a healthy growth, the shipments from the mines during a recent week being given as 69,000 tons, as compared with 59,000 for the same period last year.

THE decision of the Supreme Court of the State of Michigan, reinstating the injunction against the Western Federation of Miners and others, which prohibits picketing with its attendant disorder, comes as a timely relief to that district.

IF President Huerta's recent *coup d'etat* is to stand as a precedent for future Mexican executives, the relations between the executive and legislative branches of that government will never be other than harmonious. However, the element of personal risk that will be connected with the office of deputy, and the duties of this body, which will consist solely of putting the legislative O. K. on the dicta of the President, will not tend to make this a much sought after office.

RESULTS attained under the operation of the British Workmen's Compensation and Employers' Liability Acts during 1912 are of much interest to operators in this country. The general terms of these laws are too well known to need repetition. During the past year 424,406 cases of injury and 3599 death cases were compensated; the statistics covering 7,500,000 employes engaged in 136,279 industries. Two-thirds of the employes are factory workers, and the average annual charge for compensation there amounted to only $1.25 per person employed. In mines the charge was $5.35, the average for all industries being $2.10. A most gratifying feature of the law is the small number of claims taken into the courts, only 5858 having been settled judicially, and of these, 76 per cent were awarded in favor of the workman.

THE colliery disaster at Cardiff, Wales, marks another of those seemingly unavoidable tragedies of mining which have marred the history of the industry since its beginning and which with each reoccurrence causes us to pause and consider whether the humane side of the industry is keeping pace with the technical. It is to be regretted that accidents and the loss of life have been and always will be associated with mining; but it only remains within the power of the operator to reduce such hazards to the minimum by fostering the 'safety first' movement and making use of every available means for the protection of life in the conduct of mining operations. To our Welch friends, we ex-

tend our deepest sympathy and will hope that this calamity may be a stimulus to the work which is being done for the humanitarian side of mining.

THE adventures of a mine promoter, whose unavailing efforts to discover valuable mineral deposits were finally crowned with success through selling the mine water as mineral water, not long ago formed the subject of an amusing short story. The fiction is recalled by the suit of the Archipelago Islands, Ltd., to recover the value of 1000 shares of the United States Cobalt Company, which it had traded with a wine broker for an equivalent value in champagne. The perfidious broker sold the shares but failed to deliver the champagne, hence the suit. The incident not inaptly characterizes the effervescent quality of some kinds of mining finance.

Mining Law Revision Again

In reprinting this week the article opposing revision of the mining law from the *Bisbee Daily Review*, we give our readers the strongest and best statement we have seen on behalf of those who would let well enough alone in this case. We are confident that our contemporary under-estimates the amount of demand for change that comes from the mining people. Aside from other opportunities for judging, we have served on several occasions upon the resolutions committee of the American Mining Congress, and we speak from positive knowledge when we say that there is more than a vague unrest among mining men. There is indeed a fixed idea that the safeguards enumerated by the writer in the *Review* have not served to meet the needs of the situation and that some change is imperative. It is impracticable at this time to take up and discuss seriatim the points raised in the article, but as to one or two we wish to speak in some detail.

In practice it is not true that the mining law secures exclusive occupancy to a placer claimant prior to discovery, and this fact is the basis of great dissatisfaction in the oilfields. Under the United States mining law a mere locator of placer ground is unknown to its officers and prior to discovery has no rights. There is in fact no legal reason why the withdrawal act should not have been retroactive as regards locators. The state courts protect such a one merely as an incident to preservation of the peace. He is not permitted to fence the land claimed, because it is public land, and unless it be fenced it is difficult to prove trespass and so get the protection of the state courts. If without act of violence another can gain access to the land and first complete discovery, the title belongs to this second man and the first claimant loses everything, regardless of the fact that he may have been the first, by geological surveys or other means, to have determined the probable presence of oil, and regardless of his good faith and possibly heavy expenditure. The result of all this is the system of plowed furrows and shot-gun guards that anyone traveling through a new oilfield on public land must have seen. No one familiar with the fact may deny that among oilmen there is extreme dissatisfaction with the law. This is just one instance; others may be easily cited.

Another cause of great dissatisfaction is that while the people of the community may, it is true, reduce the size of claims in a district, they are not permitted to enlarge them, and under existing conditions the maximum claim is too small for many purposes. Out of this has grown a system of dummy and power of attorney locations and a whole tissue of fraud. The miner is naturally honest and straightforward. He wants to get away from this system. It is probably true that as a whole the miners are not asking for a leasing system, but it is also true, if we correctly judge current opinion, that the miners will consent to a modified leasing system, if thereby the area needed for economic operation may be honestly claimed and taken, and other defects in the law may be cured. At the same time he is but a poor judge of Eastern opinion, and in the end the majority must at least consent to any new law, who sees probability of getting changes in the mining law, without introduction of leasing, at least to some extent and to apply to some of the minerals mined.

Government Control of Strikes

New Zealand, through her Arbitration Court, has always held a unique position in the settlement of labor disputes, and up to last year adequate means were available through this court for the adjustment of these difficulties. However, after a great amount of hair-splitting it was decided that a strike is not a strike when it is a conference, and the five and six months conferences of last year resulted in a complete suspension of operations at Waihi and Reefton during these periods. The Government is about to undertake the solution of the conference difficulties whereby such conferences or strikes with their attending hardships to both labor and operator may be avoided. Surely this is a most laudable purpose for the government to undertake, and if the enactment of a law, equitable to both operator and miner, can rectify existing conditions, it might well serve as a pattern to be emulated by other nations. The bill, which is about to be presented to the New Zealand parliament provides *inter alia*, for a board representing both employer and employes, which will investigate all labor grievances and make such recommendations as seem advisable for settlement. If an agreement cannot be reached a vote will be taken and a bare majority will suffice to decide the issue submitted. Another provision in the bill is that if a union has voluntarily or penally had its privileges cancelled and a new union has been formed, the new union may not include in its membership any who have taken part in an unlawful strike. By this law all differences will be adjudicated by this commission and every worker and employe who, being bound by an award of the court, shall take part in a strike will be liable to a penalty up to £10 and a union which promotes it to a penalty up to £1000, and anyone who aids in a strike, even by contributing to strike funds, will be penalized. The stand being taken by the government against lawlessness and mob violence would indicate that this element in the conduct of strikes must be obliterated and a speedy, peaceful, and sane means substituted.

Revision of the Mining Law — A Protest

*With a profound appreciation of the study given by the committee on mining law of the Mining and Metallurgical Society of America to the question of revision of the present mining statutes of the United States, the writer is by no means prepared to admit that a revision of these statutes is necessary or even expedient. Further, the writer is very much disinclined to attach any weight whatever in this matter to opinions of mining congresses, recommendations of Directors of Geological Survey, of Secretaries of the Interior, and such. Mining congresses' opinions are influenced altogether by interested suggestions from without the mining industry. A properly conducted U. S. Geological Survey has nothing to do with the practical side of mining, its proper function being the conduct of accurate surveys of the surface structure of the country, that is to say of the topography and geology, and the publication of general maps of the surveys including the mining districts. The principal qualification of Secretaries of the Interior is that they shall have absolutely no practical acquaintance with mining. Why then should the opinions of these organizations and persons be considered seriously on this subject? The fact is that their opinions in the matter should not be considered at all.

Relation of New Laws to the Present Laws

It is a mistake to assume that "in many parts of the country the general inadequacy and many absurdities of our present system have become so irksome as to create a widespread demand for an entire new law." There is, indeed, a general feeling that something is wrong, and consequent on this that something should be done about it. But when investigations are carried beyond these two general conclusions, very little is found that is concrete and definite in statement as to what is wrong, and many loose-jointed ideas of the cure for the assumed wrong are put forward. The demand for an entirely new law is quite understandable under the circumstances. It is the easy political first-aid device of the politically shiftless proposed for any industrial ill. An entirely new law is popularly assumed entirely to obliterate the old law by putting it out of sight, and thus to save the effort required to understand the cause of the trouble from it. As a fact, the new law does nothing of the kind. The old law is not obliterated. The entirely new law ultimately appears in its true relation as an addition to the old, thus making more laws where less have been hoped for. Suppose, then, before academically discussing the comparative merits of so-called new entire mining laws proposed, that the existing United States mining statutes be reconsidered in search of what is wrong about them or through them.

The present mining statutes of the United States make an unconditional grant to citizens, or to persons who have declared their intention of becoming citizens, of the valuable minerals which may be found by them in unappropriated public land. The grant is free. You find valuable minerals in the public land. You take possession of them as personal property. They forthwith become yours absolutely. There is no tax to pay. There is no paper to be signed. No claim of right to the possession of the land has to be made by locating it. This unconditional grant of valuable minerals free to the taker from unappropriated public land—that is from public land to which there is no claim—has been part of the statute law for 47 years. Do miners want this unconditional grant of free minerals withdrawn from them now? Are miners asking that they be compelled by law to pay for the valuable minerals which the law gives them free now? Well hardly. Then who are they that ask that all valuable minerals be sold by the United States to miners hereafter through leases under a leasing law? Why, the people who will be the collectors and spenders of the lease rent money—call it graft money for the sake of clarity.

Exclusive Occupancy of Public Land

The present United States statutes grant a conditional right of exclusive occupancy of public land for purposes of exploration for minerals. The right itself is free like the minerals when found. There is no fee or charge of any kind imposed by the United States statutes. There is no regulation for the occupancy of the land or of exploration in it which is provided for by the statutes. The conditional feature of the grant of exclusive occupancy of public land for mining purpose is that the law of such exclusive occupancy shall be the rules, customs, and regulations of miners which they themselves create for definite territories in the public land described as mining districts, with these limitations of authority that the miners could not make lawful any rules, customs, and regulations, under which (1) exclusive occupancy could be had of any land for exploration for minerals in rock in place without a precedent discovery of the lode or vein of the rock in place which might contain the valuable mineral, or could be had of a greater extent of land in a single claim than 1500 ft. along the supposed strike of the ledge or vein together with no more than 300 ft., and no less than 25 ft., width on each side of the lode line, making parallel end lines; (2) under which exclusive occupancy for exploration for minerals outside of veins or lodes of rock in place, as the statute expresses it, "of claims usually termed placers," could be had for more than 20 acres in a single claim by a single person, or for more than 160 acres in a single claim by eight persons, conforming in boundary to subdivisions of the public land survey where practicable; and (3) under which exclusive occupancy could be maintained by less than $100 expenditure in labor and improvements annually on each claim or for its benefit. The United States statutes also enlarge the grant of free occupancy of the public land by grants of free timber from unappropriated public land for use in exploration and recovery of minerals, and free rights of way over the public land for mining ditches and waterways.

*From the *Bisbee Daily Review.*

Efficiency of the Present Laws

The writer confesses inability to understand how these provisions of the present mining statutes by themselves are inadequate or absurd. They confer the real law-making power over mining of the public land on the people interested locally in the mining. Within the limits set by the statutes the people have power to make the rules, customs, and regulations of the free occupancy of the public land for exploration for minerals, what they please. The courts enforce the rules, customs, and regulations when created by the people interested. If the people of a mining district or locality consider that lode claims in that locality or district should not be more than 1000 ft. along the vein and not more than 100 ft. wide on each side of it, they can adopt rules and regulations fixing these maximum dimensions for the location of claims in the district thereafter, and thereby make them the law of the district which the courts will enforce. If the people in the mining territory consider that 20 acres is too much to be embraced in a single placer claim occupancy, they may make rules and regulations limiting the extent of the claims to 10 acres, to 250 ft. sq., or to any other dimensions they elect as most likely to provide for the best interests of people in that district. The people may make rules and regulations for their district requiring $200 value of work on each claim annually or requiring a still larger sum, or requiring continuous work, and the rules and regulations they made would be the law of assessment work for all mining claims in the district beginning with the next succeeding January 1, whether claims were located before or after the adoption of the rules and regulations. If the people consider that it is to their best interests that lode claims in their district should not have extralateral rights, they may make rules and regulations of lode mining claims which limit them to their side boundary lines. Such rules and regulations would not affect the extralateral rights attached to claims located prior to the adoption of the rules and regulations. These would be vested and existing rights which would be recognized. But locations made subsequent would not carry extralateral rights, and that is all the substantial difference which would be made by a change in the present United States statutes.

Rules and Regulations v. Custom

What has happened, however, is that the people have permitted a miners' custom to take the place of their miners' rules and regulations. It has become the very general custom of miners in all the mining districts to initiate exclusive occupancy of the land and to maintain it under the express limitations made in the statute. Locations of mining claims are made in extent up to the maximum permitted by the statutes and are held by performance of the minimum value of annual work, $100, named in the statutes. It has been very generally forgotten that the acceptance of these respectively maximum and minimum statutory limits for location and holding of mining claims are mining customs, and that they have force as law because they are the mining custom of the people of the several districts, and not because they are mandatory requirements by reason of being made so by express statutory provision. It will suggest itself at once in confirmation of this statement that it is the fact that for many years up to a maximum of 18 years before there were United States mining statutes, there were many different district rules and regulations, all of which were law, and that in some of the older districts the rules and regulations were already beginning to be replaced by mining customs. The enactment of the statutes did not destroy the force of the district rules and regulations, or the mining customs where they were within the limits made by the statutes. The statutes neither enlarged or cut down the extent of claims existing when they were enacted. They did not reduce the requirement of annual work where it was more by the rules and regulations than the $100 minimum named in the statute, but increased it to $100 where rules and regulations or custom exacted less. It would be difficult to find among the thousands of mining districts any in which the rules and regulations were regularly amended to conform to the provisions of the statutes. The miners' rules and regulations gradually faded away into the miners' customs and the latter, developing on the line of least economic resistance, became identical in requirements with the United States statutes.

Right of the People to Make Rules

A custom can always be changed. The lawful right of the people of a mining district to change their mining customs by substituting mining rules and regulations which suit their circumstances better, is still theirs. No amendment of the United States statutes has been made taking this vital law-making right away from the people. And, in this connection, it should not be overlooked that it is the people—all the people—of a mining district, who make its rules and regulations, and not the lesser number who are the claim owners. The people of a mining district have the power to make rules and regulations for assessment work which will compel claim owners to work their claims or abandon them to new owners who will work them. It is impossible for claim owners to 'hog' possession of mining ground without doing any work on it, if the people want to prevent them from doing it.

What is there really wrong in the conditions of occupancy of public land for exploration of minerals under the provisions of the existing statutes, which has suggested the need of their revision as the means of righting the wrong? If the people of the mining districts have the full legislative power to make the mining law of occupancy of the public land between themselves, what seems best for themselves what more can be wanted by them and why? The answers to these questions develop the real trouble of the mining industry on the public land. Considering the matter historically, it will be found that, prior to the middle nineties, while questions growing out of extralateral rights and the amount of annual assessment work were more or less disturbing locally in the mining districts and among people interested in the mining industry, there was no outside interference with the law of occupancy of the public land for purposes of exploration for minerals. The free mining in the public land was let alone by people not

engaged or directly interested in it. None of the particular questions concerning mining in the public land which are now subjects of general political discussion were mentioned during the nearly fifty years of mining which preceded the middle nineties. They came afterward and from the outside.

Rent of Mineral Land

The proposition that rent should be paid the federal government for the exclusive occupancy of public land for purposes of exploration for minerals comes from outside the people of the mining industry. But why should the federal government collect rent from miners more than from farmers who settle on the public land to homestead it into a free fee title? Why should there be discrimination? And why should anybody pay rent at all to the federal government? The people are sovereign and as sovereign own the soil of the public land. The federal government is simply the general agent of all of the people. The idea of all of the people paying rent to themselves is absurd. If paid only by miners to the agent of all the people as compensation for the agent's services to all the people, the rent unquestionably becomes an unequal and unlawful tax. Calling the money which would be paid by some other name does not change its essential nature as rent for occupancy of public land, whether the occupancy be by miners or by farmers. It is, no matter how named, a federal tax which is both unfair as between fellow citizens and unconstitutional under our mode of government.

In one of the disguises of another name which the rent-payment proposition has taken, it is proposed that instead of a minimum requirement of $100 annual assessment work to hold exclusive occupancy of a mining claim, that the $100 shall be paid to the federal government as a license fee for the occupancy, on the ground that the $100 annual assessment work is usually wasted in digging a hole in the ground, or in other ways, producing nothing in return for the expenditure. The conclusive answer to this is that the $100 expended in the assessment work, no matter what it does to the claim or for the claim owner, contributes to support a free working man and to maintain a population in the district where the claim is situated, while $100 rent paid the federal government only contributes to support one more politician in idleness in some great centre of population and pleasure.

Discovery Rights

Another trouble with occupancy of the public land for purposes of exploration for free minerals has been a supposed requirement of the statutes that a discovery of the mineral was requisite to make an exclusive occupancy for purchase or exploration for minerals lawful. As a fact, the United States statutes make no such requirement. The requirement made by the statutes is that the discovery of the 'ledge' or vein of quartz, that is to say, of the lode, must be made before a claim is made by location to exclusive occupancy of public land for exploration for minerals in a lode. The reasons for this requirement is very plain. Such occupancies are granted extralateral rights for the lode, and the width of the land occupied is measured from the line of the lode. Obviously without the lode being discovered there is nothing to measure width from, and nothing to which to attach extralateral rights. The requirement of the statute that there shall be a lode discovered before location does not mean that mineral shall be discovered in the lode before a lawful location could be initiated. Lodes are located on the assumption that exploration in them will discover mineral even where there is none in sight. On the other hand, the mineral from a lode is frequently found in the 'float' or loose surface rock and earth without the lode itself being found, yet, while the mineral is certainly lode mineral, no lode location can be lawfully made. There is no requirement in the statutes that there shall be a precedent discovery to make a lawful claim of occupancy of public land as placer. The location of a placer claim is primarily made to obtain an exclusive occupancy before spending time and money in exploring in the land to make a discovery of the mineral. This condition of placer location was well understood by the old miners and was everywhere recognized by the rules and regulations which they made for locating placer claims. It is invariably the custom now when a new mining district is developed for locations of claims of exclusive occupancy to be made first, exploration in them to discover the mineral coming afterward.

Exclusive Occupancy Under Miners' Rules

The statutes not only in express terms confirm and recognize the practice or custom of the miners in this matter of establishing an exclusive occupancy of the public land under miners' rules and regulations before they undertook to explore and make discovery of the minerals, but the provisions of the statutes themselves relate to locations of claims of exclusive occupancy of public land for mining purposes, and do not relate to the making of discoveries of minerals. The statutory provisions are consistent without extending them by implication of anything not expressed in direct words. The statutes grant free minerals to the finder, and grant free occupancy for the purpose of finding the minerals. It is only occasionally that the minerals are discovered without digging into the surface of the earth to find them. The proposition that the free minerals must be discovered before there can be a right to free exclusive occupancy has no basis in public interest—in fact, it is the other way. The requirement of prior discovery before a right of occupancy can be initiated works out practically to limit and discourage exploration by making its reward uncertain. The proposition that a discovery of minerals was a necessary precedent to a lawful mining claim did not originate with miners' rules and regulations, nor from courts deciding controversies between rival claims of miners. Some recent decisions of the courts where the good faith of the mining location was questioned have indicated that a discovery of the mineral was necessary to make a location lawful, but the great mass of court decisions, where the good faith of the location was not in issue, are in line with the letter of the statutes in confirming rights of exclusive occupancy for purposes of exploration without there being a precedent discovery of the mineral.

The Rand Banket and Its Gold Content—II

By C. B. Horwood

Today the quartzites and conglomerates of the Witwatersrand beds form an almost impervious mass,[41] owing to the action of dynamic metamorphism and the deposition of secondary silica and, to a less extent of pyrite and other secondary products in the interstices of the original sandstones and conglomerates. Pressure exerted in a north and south direction has bent and folded the beds into their present position. The main structural features of the district indicate that this pressure was due to the intrusion of enormous masses of Ventersdorp diabase, accompanied by considerable fracturing, faulting, and consequent intrusions of diabase dikes.[42] Thus, deep-seated communications were established; and solutions, ascending from great depth through fractures and along lines of weakness marked by the intrusion of dikes, would at the time have encountered the beds in a sufficiently pervious condition to penetrate them. The conglomerate beds naturally formed lines of least resistance to the passage of solutions; and thus some of them became channels of maximum circulation. Along the Crown Reef dike, the evidence indicates that the mineralizing solutions, which deposited the iron bi-sulphide and gold, ascended along the line of fracture and weakness produced by the intrusion of the dike, and spread out laterally near the surface, choosing one or more of the conglomerates as offering the easiest channels.[43] Combined with their lateral motion they would also have had a downward component due to gravity. As previously mentioned, the Main Reef Leader here immediately overlies a band of shale. The latter is fine and close-grained, with laminae parallel to the dip of the conglomerate. It thus forms an almost impervious layer; and so it is an easy matter to understand how mineralizing solutions would have become concentrated above this layer, and have precipitated some of their contents along its junction with the overlying and more porous conglomerate, especially as here the rate of flow would have been lessened owing to the fact that the downward component of motion would have been checked. (This explains why a thin film of pyrite or of gold is frequently found on the upper surface of the foot-wall of a rich leader, when this foot-wall consists of shale, or is talcose, or has suffered much sericitization.) If this actually happened, one would expect to find the majority of the pyrite 'pebbles' along a definite horizon[44] at or near the immediate contact of the conglomerate with the underlying shale, and if there were any above this, that they would be less in number. This is how they actually did occur; and no pyrite 'pebbles' were found below this shale band. Also, one would expect to find that here this banket layer was rich in gold; and it was, as this stope was one of the richest places in the mine;[45] and nearly all the gold was contained in that narrow band of conglomerate in which the pyrite 'pebbles' occurred.

Association of Pyrite 'Pebbles' with Dike Intrusion

Thus the association of pyrite 'pebbles' with dike intrusion and rich ore[46] was one of the most notable features of this occurrence at the Crown Reef mine.

As a result of examining numerous slides of the pyrite from this occurrence, the writer found that while some of the 'pebbles' certainly have replaced real quartz pebbles, others have replaced the quartzite matrix of the banket. Fig. 5 and 6 are microphotographs of sections cut through pyrite pseudo-

[41] This is evident from the fact that while the original shallow outcrop mines of the Rand are wet, the deep-level mines are dry and dusty, the dryness increasing with depth.

[42] C. B. Horwood (1905, *loc. cit.*, p. 35; and (1910) *loc cit.*, p. 76; and 'Notes and Analyses of Typical Transvaal Rocks,' by C. B. Horwood, *Trans.* Geol. Soc. So. Af., Vol. XIII (1910), pp. 42 and 43.

[43] The fact that some of the conglomerate beds contain gold in sufficient quantity while others contain little or none seems to be considered by many a serious difficulty in explaining the genesis of the Rand gold. Apparently, they forget that, although often far more difficult to explain, it is quite usual to find poor or barren, quartz, veins in the neighborhood of, and often parallel to, rich ones. So that this is merely a still further analogy between the Rand bankets and ordinary gold-quartz veins.

[44] The flint nodules in the chalk beds of England usually occur along horizons coinciding with the bedding-planes of the chalk, these having formed the easiest channels for the circulation of the silicious solutions. But it is only fair to remark that, probably, in some cases the explanation is also partly due to certain layers in the chalk having originally contained more silicious organisms, such as sponge spicules. In the case under discussion the horizon was fixed by the presence of an underlying, almost impervious, band of shale. There is distinct evidence all along the Rand of secondary enrichment, both in and below the oxidized zone, due to the action of meteoric waters. As there is, however, in this case at this depth no evidence of such secondary gold and sulphide enrichment, the latter is evidently entirely due to the causes above explained. (For treatises on the subject of secondary enrichment, the reader is especially referred to 'The Secondary Enrichment of Ore Deposits,' by S. F. Emmons, and 'The Formation of Bonanzas in the Upper Portion of Gold-Veins,' by T. A. Rickard, both in 'The Genesis of Ore Deposits,' 2nd Ed. (1902), published by the Am. Inst. Min. Engineers.)

[45] For the last nine months of 1905, the value of this stope averaged 22.8 dwt. over about 21.25 in. of reef, or 12.4 dwt. over a stoping width of about 39 in., and for the first six months of 1906 it averaged 20 dwt. over 22.5 in. of reef, or 10.7 dwt. over a stoping width of about 42 in. These values were nearly all obtained in the narrow band of Main Reef Leader conglomerate in which the pyrite 'pebbles' occurred; for example, during the first six months of 1906 the Main Reef Leader averaged 41.6 dwt. over 9 in., while that portion of the underlying Main Reef which was stoped, and which was separated from the Main Reef Leader by a narrow, almost impervious, band of shale, only averaged 5.4 dwt. over 13.4 in., the two together thus averaging 20 dwt. over 22.3 in. of reef. The average stope assay for the period was 10.7 dwt. over 42 inches.

[46] Rand ore, or, in other words, the auriferous conglomerate of the Rand, is relatively poor compared with the ore of other goldfields; but this is compensated by the comparative uniformity of its yield over big areas. Speaking generally, assays of 8 dwt. and upward, over say 36 in., would on the Rand be considered good.

morphs after quartz pebbles. (As the slides were photographed by transmitted light, the pyrite comes out black in the photographs.) In the former, the large 'pebble', extending from the centre to the top of the photograph, is composed of iron pyrite; and in the slide the mosaic crystalline structure, so char-

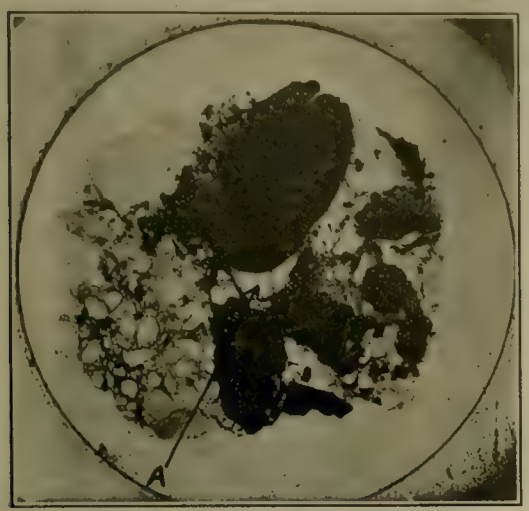

FIG. 5. SLIDE 63.

acteristic of the quartz pebbles of the Rand banket, has not been obliterated, but is clearly discernible with a 2-in. objective. The retention of this original structure by the replacing of material is clear evidence that it has replaced one of the quartz pebbles of the banket.[47] The 'pebble' has a smooth and well defined outline, with the exception of that portion extending from about one-third of the way up the left side to the small slit at the top. This latter portion, stretching inward for about ¼ in. as measured on the photograph, consists of pyrite that has evidently replaced the quartzite matrix, as the granular structure of the latter can be clearly seen under the microscope. The small round pyrite 'pebble', seen about half way up on the right-hand side of Fig. 5, has been formed by replacement of the matrix of the conglomerate. The outlines of the quartz granules of which the latter was composed can readily be distinguished under the microscope. The white portion, marked A, stretching between the lower end of the pyrite 'pebble' and the partly formed one below it, consists of secondary fibrous quartz, the fibres radiating outward from the circumference. Fig. 6 is also of a pyrite 'pebble' formed by the replacement of a quartz pebble.[48] Again, in this slide, the outline of the individual crystals composing the original quartz pebble have not been obliterated and can be distinctly seen with a low-power objective. Numerous particles of unreplaced quartz are enclosed in the pyrite. The white streaks running through the 'pebble' consist of secondary quartz, with a tendency to fibrous structure, which has been introduced along cracks evidently produced after the pyrite was formed. Fig. 7, 8, and 9 are micro-photographs showing pyritic replacements of the matrix. The first of these shows, not a formed pyrite 'pebble', but merely a mass, or agglomerate, of pyrite, which, from its structure, distribution, shape, and tendency to form crystalline outlines,[49] has apparently replaced the small quartz granules and interstitial matter of the matrix. In one place this mass of pyrite is seen embaying and eating into a rounded quartz pebble, the pyrite apparently replacing matrix and pebble indiscriminately. The white portions seen in the photograph, running through the pyrite, consist of secondary fibrous silica, the length of the fibres being at right angles to its walls; that is, at right angles to the cracks or fissures, or to the bounding edges of the pyrite. As in the case just cited, it undoubtedly fills cracks made in the pyrite 'pebble' after its formation. These cracks, as we shall see later, were due to contraction. The direction of the tensile stresses so produced is doubtless indi-

FIG. 6. SLIDE 59.

FIG. 7. SLIDE 58.

[47]Lindgren has recently remarked on the fact that in metasomatic replacements the "structure and texture are often faithfully preserved." ('The Nature of Replacement,' by W. Lindgren, *loc. cit.*, p. 535.)

[48]The section has been broken in mounting. The pyrite in the two portions should, of course, be continuous in outline.

[49]From macroscopical and microscopical study of the subject, the writer found that pyrite which has partly replaced a pebble metasomatically usually tends to conform to the shape of the latter rather than to assume crystalline outlines; whereas the secondary pyrite, which has replaced a portion of the matrix, is often in the form of either cubes or octahedra.

cated by the direction of the fibres of this secondary silica. Fig. 8 shows three aggregates of pyrite formed by the replacement of the matrix. The outlines of the original quartz granules have not been obliterated, and are distinctly observable in the masses represent a more advanced stage in the formation of 'pebbles' than that shown in the previous photograph; they are more compact and their edges are better rounded and defined. It will also be observed that, in section, they have assumed a cir-

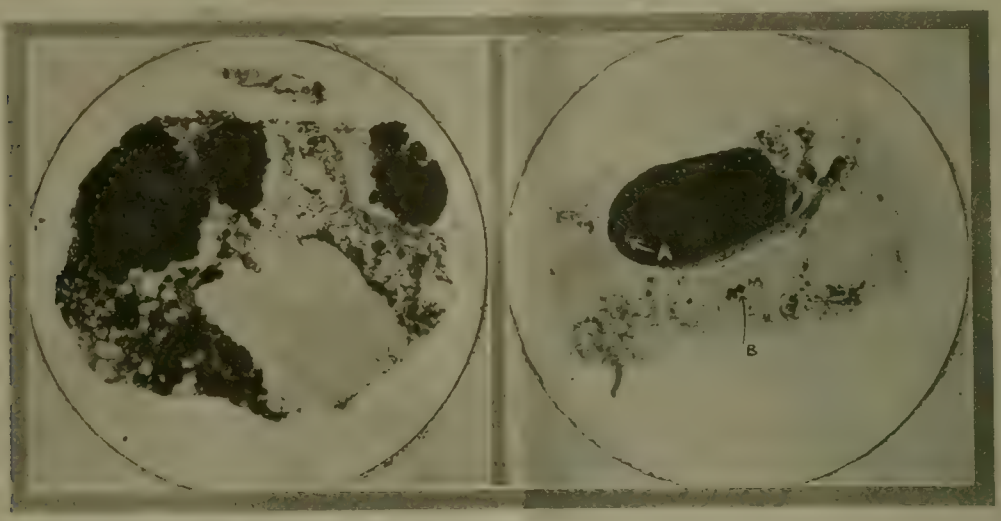

FIG. 8. PYRITE 'PEBBLES' REPLACING QUARTZ AND MATRIX.

FIG. 9. PYRITE 'PEBBLE' THAT HAS REPLACED A PORTION OF THE BANKET MATRIX. SLIDE 61.

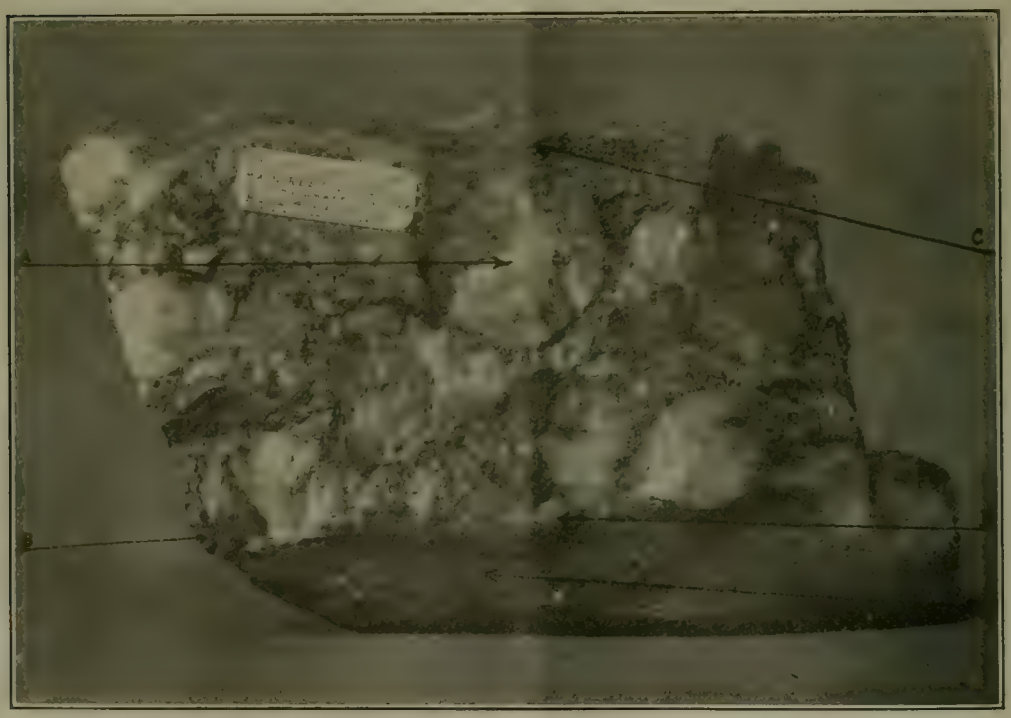

FIG. 10. MAIN REEF LEADER, SHOWING UNDERLYING BLACK SHALE BAND WITH TWO SMALL PYRITIC 'PEBBLES' IMMEDIATELY OVERLYING. FROM THE CROWN REEF MINE. A, THIS AND OTHER BIG PEBBLES ARE COMPOSED OF WHITE QUARTZ. B, SMALL PYRITE PEBBLE. C, HANGING WALL QUARTZITE. D, SMALL PYRITE PEBBLE. E, FOOT-WALL SHALE.

slide, when examined under a low power.[50] Secondary fibrous quartz can be seen along the right edge of the central pyritic mass. These three pyritic cular or oval shape, doubtless due to fairly uniform growth on all sides. It will be noticed that the quartz pebble in the lower right-hand portion of the photograph has its edges embayed, eaten into, fretted, and corroded by pyrite. The top edge of this pebble has been partly dissolved and has been drawn out into wavy streaks; and the portions between the streaks have been filled with secondary

[50]The shape and outlines of the original quartz granules of the matrix are particularly well preserved in the case of the centre one of the three pyrite aggregates. They are best examined by reflected light, either under the microscope or with a powerful pocket lens.

silica and some pyrite. Fig. 9 is a section cut at the contact of the Main Reef Leader with the underlying shale; it shows a well formed oval[51] pyrite 'pebble' with a well defined smooth outline, which one might easily take to be a pseudomorph after a quartz pebble; but when examined in thin section under the microscope, the writer found that outlines of the quartz granules of the matrix could be clearly seen, the original structure having been retained, proving it to be a replacement of the quartzite matrix. The secondary fibrous growth seen around a portion of this pebble appears to be a mixture of chlorite with some quartz and minute specks of pyrite. At A, some unreplaced quartz is seen enclosed in the pyrite 'pebble'. At B, there are some small cubes of pyrite which have replaced a portion of the matrix. Many of the quartz crystals exhibit corroded outlines and slight strain shadows.

Fig. 10 is a photograph of a good typical speci-

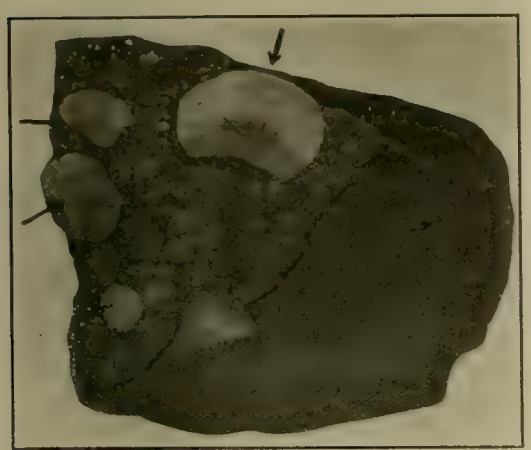

FIG. 11. PYRITE 'PEBBLES' SHOWING RADIATE STRUCTURE, IN MAIN REEF LEADER.

men of Main Reef Leader, about 3 in. wide, resting on a shale foot-wall. It is from the Crown Reef mine, from the stope where the 'pebbles' occurred, and was taken about 100 ft. up the stope, away from the dike contact, where its influence was less, and so the pyrite 'pebbles' are small and scarce, only two tiny ones being seen in the plate.

Fig. 11 shows a polished surface of banket resting on a shale foot-wall, and cut through four pyrite 'pebbles'. Two of the latter exhibit a well marked, internal, radiating structure. Only some of the pyrite in this Crown Reef exhibits this structure, but there can be no doubt that the 'pebbles' have all been formed in the same way. It would seem that it is a later superinduced development. It may be a result of molecular rearrangement, due to gradual contraction. It is certainly, in some way, connected with the origin of the 'pebbles' and is in itself a sufficient indication that they were formed in place, and are not rolled pebbles. This subject will be more fully discussed later.

The Du Preez Series

Perhaps the best known example of the occurrence of pyritic 'pebbles' in the banket is that of the small rounded pellets of pyrite in the Du Preez series at the New Rietfontein Estate mines.[52] These 'pebbles' vary from about $\frac{1}{8}$ up to $\frac{1}{4}$ inch in diameter; occasionally one nearly half an inch can be found. They are almost entirely confined to one particular member of the conglomerate series, which, owing to the supposed resemblance between these pyrite pellets and ordinary buckshot, is known as the Buckshot Reef. This banket has already been described by the author in another place;[53] but, for the purpose of the present paper, a further brief description is necessary. It is a small leader occurring at distances varying from a few inches to more than a foot below the principal gold-carrier or 'pay-reef'[54] of these mines, and is only present in their western portion. As typically developed, it consists of a single-pebbled layer, with white lustrous rounded ellipsoidal quartz pebbles, of which the largest vary from about an inch to an inch and a half in greatest diameter; and fewer and rather smaller black quartz pebbles. These pebbles all lie with their longer axes parallel to the dip of the bedding. Instead of a single-pebbled 'leader,' it is sometimes from two to four inches thick. Again, it may contain no pebbles at all, or only minute ones, and merely be represented by a line, usually of carbon[55] accompanied by visible gold. As in the Crown Reef mine, so here the pyritic 'pebbles' occur most abundantly along the immediate foot-wall portion of the conglomerate, and diminish in number upward as the distance from the foot-wall increases. The reason for this is doubtless the same as that advanced in the previous case, for this bed of conglomerate has a greasy talcose foot-wall, the laminae of which are parallel to the bedding-planes, or dip of the banket, and it would therefore present an impervious layer to solutions circulating above it. On a fractured or polished surface of one of these pyrite 'pebbles' a radiate and fibrous structure can often be seen; sometimes a concentric structure is exhibited; and the author has also noticed a stratified appearance. Carbon is asso-

[51] That is, the section of the pebble is oval shaped. The pebble itself is in the form of an ellipsoid.

[52] As already stated, these mines are situated about nine miles east of Johannesburg, and about four miles north of Germiston.

[53] 'The Mode of Occurrence and Genesis of the Carbon in the Rand Bankets,' by C. B. Horwood, *Trans.* Geol. Soc. So. Af., Vol. XIII (1910).

[54] The Pay Reef is also the name by which this lode is known at the Rietfontein mines.

[55] The carbon usually occurs in small black opaque nodular grains, having a somewhat warty dull surface, and ranging in diameter from 1 mm. downward. 'Further Notes on the Auriferous Conglomerates of the Witwatersrand, etc.,' by R. B. Young, *Trans.* Geol. Soc. So. Af., Vol. XII (1909), p. 86.

Vide, also, C. B. Horwood, *loc. cit.* In this paper the present writer showed that the carbon in the bankets is due to magmatic vapors or solutions derived from the neighboring basic dikes before their final solidification; and he proved by numerous analyses that these dikes contain carbon. It was also shown by him that the occurrence of carbon was so closely associated with that of the pyrite and gold as to leave no doubt that there was a genetic relationship between all three of them; and this relationship was still more fully emphasized in a more recent paper entitled 'Iridosmine from the New Rietfontein Mines; Its Occurrence, Analysis, and Genesis,' *Trans.* Geol. Soc. So. Af., Vol. XV (1912).

ciated with this 'reef' and occurs in tiny specks on the surfaces of the pyrite 'buckshot' and also scattered through the matrix. The Buckshot Reef is characterized by high gold contents. At the surface the pyrite pellets weather to a black oxide, and their usual radiate habit is then well marked; sometimes the black oxide has been dissolved, and only the casts and the internal radiating divisional walls of secondary silica are left. On the inside surfaces of these casts, specks of carbon and free gold are often visible. Fig. 12A, 12B, and 13 are from photographs of two typical hand specimens of this 'reef.'[56] In the case of each of these specimens the surface that showed the 'buckshot' pellets best was ground and polished, in order to obtain a better photograph. On the left-hand and near the top of Fig. 12B, a complete circular section of one of these can be seen, exhibiting radiate structure. To the right of this the pyrite pellets have come out white, owing to the reflection of the light from their polished surfaces, but the annular rings, or partial ones, as the case may be, around some of them, can be detected. These rings, which can be well seen in the hand specimens by the aid of a good magnifying glass, consist of the secondary fibrous silica to which attention has already been directed.

Presence of Gold Around Pyrite Pellets

Fig. 12A is from another photograph, of the same specimen, taken in diffused light, so as to avoid the reflection from the polished pyrite surfaces. In some instances in the hand specimens visible gold can be seen round the circumferences of the pyrite pellets, and specks of carbon occur scattered through this gold ore.

Fig. 14 shows a micro-photograph of a thin section cut from a specimen of the Buckshot 'reef.' The round black spots represent the pyrite 'pebbles', and in this lode their spherical nature and smooth surfaces are particularly characteristic. When examined under the microscope with a 1-in. objective, the quartz pebbles are seen to be embayed in places by pyrite. Numerous minute, sharp, angular fragments of quartz still remain unreplaced here and there in the pebbles. This can be seen in one of the 'pebbles' in the photograph. In some, a radiating structure is apparent under the microscope, the lines radiating outward from the centre of the pebble. They usually have a secondary growth of crystalline fibrous quartz, also radiating outward around portions of the circumferences. Gold is visible in places around the edges of the pebbles. In the particular slide shown in Fig. 14 the process by which these buckshot pebbles were formed in place can be traced. The pyrite replaced some of the quartz of both the coarse and finer particles constituting the matrix of the conglomerate. In some cases not only the dark outlines of the original quartz particles and granules, but also the mosaic structure of the larger quartz particles, the division between individual crystals, and the original dusty-looking lines of inclusions running through the quartz have not been effaced by the replacement of the original substance by the pyrite, and are still quite distinct under a low-power objective. The quartz and pyrite are somtimes agglomerated as a confused mass—the pyrite having so far only replaced a portion of the small quartz granules of the matrix, as at A in Fig. 14. This constitutes one of the transitional forms of the process of replacement. Eventually all, or nearly all, the associated quartz is replaced, and a compact mass of pyrite results. The spherical shape is doubtless due to fairly even growth around a centre; and the particularly spherical nature of the iron bisulphide pellets in this occurrence suggests that there was no rapid lateral circulation of the precipitating solutions. The more ellipsoidal shape of the Crown Reef pyrite 'pebbles', on the other hand, and the fact that their longer axes are parallel to the bedding, shows that deposition has been greater along the direction of the bedding-plane than at right angles to it, and indicates a fairly strong lateral flow of the solutions through the bedding-planes of the banket.[57] This subject will be discussed more fully later. The central portion of the slide (Fig. 14) is cut through a well rounded quartz pebble of about the same size and shape as the pyrite 'pebbles', which suggests that the latter were pseudomorphs after quartz pebbles. Some of them evidently are, as the structure of the original quartz pebbles is, in some instances, still sufficiently discernible under the microscope, but probably the majority represent replacements of the matrix. Secondary pyrite can be seen in the central portion of this particular quartz pebble and also in the irregularly shaped quartz pebble just below it, and may represent the initial stages of replacement. Posepny has already pointed out that many phenomena in the formation of pseudomorphs are hard to explain, and gives as an example the fact that in some minerals the change commences within the mass and progresses outward; and, as he states, where the original substance was expelled there must have first been access for the liquids that began and executed this effect; such may be furnished by original minute rock-cavities, or by secondary cavities.[58] In the case under discussion there appear to be no secondary cavities, or cracks, by which the liquids could have entered, unless, which is probable, they worked their way along the junctions between the individual crystals of which the pebble is composed; also, minute cracks may formerly have existed, as under the microscope the quartz shows undulose extinction, indicating that it has been subjected to strain, and the slide exhibits distinct signs of shearing. The numerous small granules of pyrite seen scattered through the slide have mostly been formed by replacement of

[56] They are best seen with the aid of a good magnifying glass.

[57] This is what one would expect in that particular case, as the 'pebbles' occur so close to the soft decomposed face of an almost vertical dike, that is, near to one of the main channels whence the circulating solutions arose; for, presumably, it was up this plane of contact that some of the mineralizing solutions ascended from great depth, and then spread out laterally. The decomposition of this face of the dike is doubtless due to the action of these same solutions.

[58] 'The Genesis of Ore Deposits,' by F. Posepny, 2nd Ed. (1902), p. 15 (published by the Amer. Inst. Min. Engineers).

quartz granules of the matrix. There appears to have been a distinct tendency for pyrite to form around the edges of the pyritic masses already formed.[59] This can be seen at C (Fig. 14) where four small particles of pyrite have been formed at one end of a larger pyritic mass and two small ones at the other end of it.[60] The frequent growth of secondary fibrous quartz around the edges of the pyrite 'pebbles', as at B, suggests that the pyrite

described a slide of banket from these mines, the section exhibiting an irregular fragment of such striped slate, which has been completely pseudomorphed by pyrite and in which the banding is perfectly preserved. He describes the material of the pebble as banded slate of the Hospital Hill[62] type, and expresses his opinion that the banding is due to minute inclusions in the quartz of the original rock that have remained enclosed without

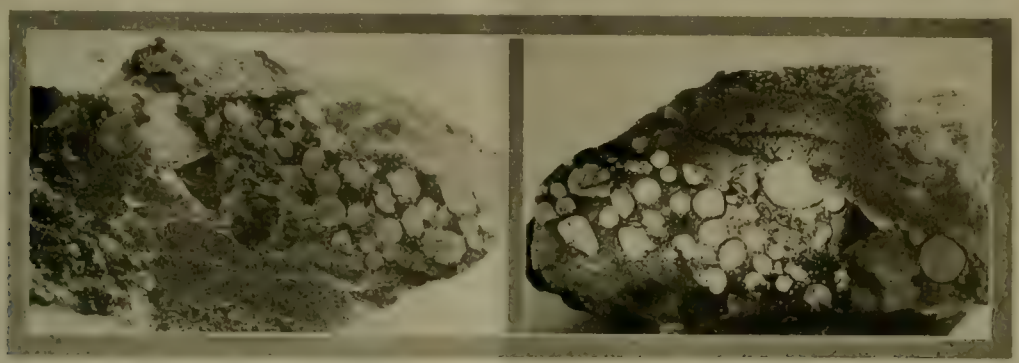

FIG. 12A. BUCKSHOT REEF FROM RIETFONTEIN ESTATE MINES.

FIG. 12B. BUCKSHOT REEF FROM NEW RIETFONTEIN ESTATE MINES.

in such cases now occupies less room than did the quartz it originally replaced.

Angular and Sub-Angular Pebbles

In addition to the 'buckshot', other pyrite 'pebbles' occur at the Rietfontein mines. Angular and sub-angular pebbles of black or dark banded slate, which has been much altered and indurated and is often of cherty appearance, and might perhaps be better described as lydian stone, can frequently be

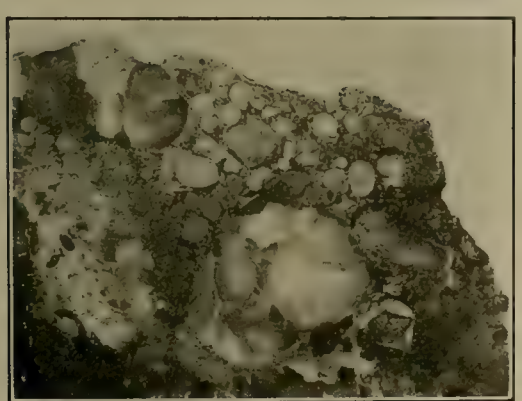

FIG. 13. BUCKSHOT REEF FROM THE NEW RIETFONTEIN ESTATE MINES.

found in almost all stages of replacement by iron bisulphide. In these cases the pyrite has worked in along the original bedding-planes of the slate, of which the pebbles are composed, and in consequence has often produced a banded appearance, or accentuated such if already present. R. B. Young[61] has

change of place in the replacing material. The banded appearance of this particular type of slate has, however, been shown, and generally accepted, to be due to variations in texture and relative proportion of quartz grains, such as might be expected

FIG. 14. SECTION OF BUCKSHOT REEF FROM THE NEW RIETFONTEIN ESTATE MINES, SHOWING PYRITE PEBBLES. SLIDE 57.

to occur under conditions of sedimentation from currents.[63] This so-called slate is more of a quartzite, not only as regards structure, but also in chemical composition, for the proportion of alumina pres-

[59]In an article entitled 'Progress in Chemical Research,' in the *Mining and Scientific Press* for Feb. 15, 1913, the fact was emphasized that crystalline substances have a strong tendency to be deposited on crystals of the same substance if present.

[60]This is best studied by using a magnifying glass.

[61]'Notes on the Auriferous Conglomerates of the Witwatersrand,' by R. B. Young, *loc. cit.* (1907), p. 25.

[62]The Hospital Hill slates form a very well known and conspicuous member of the Lower Witwatersrand beds.

[63]'Notes on the Witwatersrand Gold Deposits and Their Associated Rocks,' by F. H. Hatch, *Jour. Proc.* So. Af. Assn. Eng., Vol. II, No. 1 (1903), pp. 36-37.

'On the Igneous Theory of the Hospital Hill Shales,' by F. H. Hatch, *Jour. Proc.* So. Af. Assn. Eng., Vol. II, No. 4 (1904), pp. 193-194.

C. B. Horwood, *loc. cit.*, 1905, pp. 53-54.

ent is far less than in a true slate.[64] The writer was at one time assistant general manager of these mines and is therefore well acquainted with the occurrence of these pebbles. He particularly noticed the frequency with which they have been replaced by pyrite, whereas pebbles originally of quartz that have been replaced by pyrite are of much rarer occurrence.

Replacement by Pyrite

A splendid example of a hard black cherty-looking pebble partly replaced by pyrite, which has worked in toward the centre from the outside, was found by the writer in 1907 in the Pay Reef in one of the stopes in the western section of the New Rietfontein mines. The portion of the banket in which it occurred consisted of a good specimen of the Pay Reef, and to avoid injury it was carefully chiseled out of the face of the stope. It contained white rounded quartz pebbles up to about 7/8 inch in greatest diameter, and a few small buckshot 'pebbles' up to about 1/8 inch in diameter, which were scattered along, and just above, a sericitic foot-wall. Under a strong magnifying glass the structure of these small 'pebbles' could be seen well. In some of them the process of formation was incomplete; these consisted of heavy rings of pyrite around central cores. The latter were apparently composed of the original banket matrix, which was only partly replaced by pyrite. Presumably, the outer rings of pyrite already formed had effectually closed the pores and prevented the further entry of solutions to the central portions. No free gold or carbon could be discerned. The writer wished to see whether this specimen confirmed his usual practical experience that such 'pebbles', whether wholly or only partly replaced by pyrite, are an indication of good ore. Therefore he had it carefully cut in two by means of a rock-sectioning machine, so as not to run any risk of injuring the portion containing the partly replaced pebble. The larger portion was assayed and found to contain 43 dwt. of fine gold per ton; thus corroborating his former experience. The surface of the smaller portion,[65] which contained the partly replaced pebble, was ground and polished, and is illustrated in Fig. 15, from which it will be seen that the section of the partly-replaced pebble is oval, or rather pear-shaped, and that it has a smooth outline. The portion replaced by pyrite is white in the figure, owing to the reflection of the light, when photographed, from the highly polished surface of the pyrite. The outer edge of the pebble has been replaced by iron bisulphide, and from the inside of this layer, or outer shell, little tongue-like growths of iron pyrite can be seen projecting inward toward the centre of the pebble. This transitional form has been preserved in this stage of development owing, doubtless, as in the cases just cited, to the growth of the pyrite from the outside having been so compact, and also sufficiently soon consolidated, to have entirely closed up all pores or channels by which further pyrite solutions might otherwise have penetrated and replaced the central portion of the pebble.

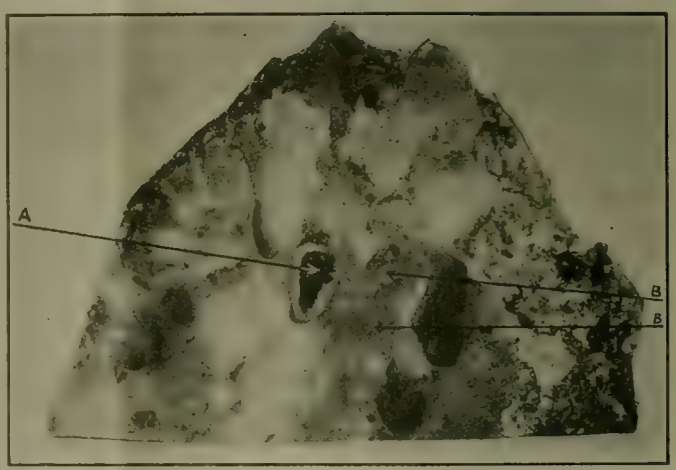

FIG. 15. THE PAY REEF, NEW RIETFONTEIN MINE. SHOWS BLACK PEBBLE BEING REPLACED BY PYRITE. SLIGHTLY ENLARGED. A, BLACK PEBBLE BEING REPLACED BY PYRITE. THE LIGHT-COLORED OUTER PORTION IS PYRITE. B, GLOBULAR AGGREGATE OF PYRITE.

The Crown Reef Mine

At the Crown Reef mine the pyrite 'pebbles' were associated with good ore in the immediate neighborhood of a well defined, persistent, decomposed diabase dike, the formation of the pyrite being evidently associated with the igneous intrusion. At the Rietfontein mines, where the pellets of pyrites are a characteristic feature and are also associated with good ore, and where other pyrite 'pebbles' are also found likewise associated with good ore, there are strong decomposed diabase dikes, 80 to 120 ft. thick, which occur throughout the entire length of the mines, that is, for a distance of nearly two miles. The occurrence of these pyrite pellets is closely associated with the presence of carbon, and it has already been shown that there is a close relationship between the deposition of the latter and the intrusion of these dikes.[66]

When afterward manager of various gold mines at Randfontein,[67] the writer continued his investigations of these replacement 'pebbles.' Fig. 16 shows a typical rich specimen of the Randfontein Leader.[68] The rounded light-colored pebbles consist

[64]For chemical analyses of Hospital Hill slate, see G. Denny, *Jour. Proc.* So. Af. Assn. Eng. (1904), Vol. II, No. 4, p. 142; also, 'Notes on the Chemical Composition of the Hospital Hill Shales,' by H. F. Marriot, *Trans.* Geol. Soc. So. Af., Vol. VII, Part I, p. 27. See, also, for analyses of several slates in the Lower Witwatersrand beds, 'Notes and Analyses of Typical Transvaal Rocks,' by C. B. Horwood, *Trans.* Geol. Soc. So. Af., Vol. XIII (1910).

[65]The larger portion weighed about 612 gm., and the smaller portion about 105 grammes.

[66]'The Mode of Occurrence and Genesis of the Carbon in the Rand Bankets,' C. B. Horwood, *loc. cit.* (1910).

[67]On the Far West Rand, about 27 miles west of Johannesburg.

[68]This corresponds to the South Reef Leader of the

of light-gray quartz. The big angular pebble on the left is one of those compact and indurated cherty pebbles similar to those already described as occurring at the New Rietfontein. They are frequent in the ore of the Rand, and are occasionally partly replaced by iron pyrite, and they are often found in the Randfontein Leader. Only occasionally do they occur in the West Reef,[68] and in this case also they are sometimes partly replaced by iron pyrite. Numerous sections of such pebbles were examined under the microscope by the writer and found to be similar to sections of the so-called slates of the Lower Witwatersrand formation; and to be, as already mentioned, really fine-grained quartzites containing a small proportion of aluminous matter, rather than true slate. About one-half of the angular pebble in Fig. 16 has been replaced by iron pyrite, which has evidently worked its way in along the original lines of stratification, still distinctly visible in the pebble. These pebbles, also, are associated with good ore. In this particular specimen, for example, a heavy line of visible gold occurs along the foot-wall.

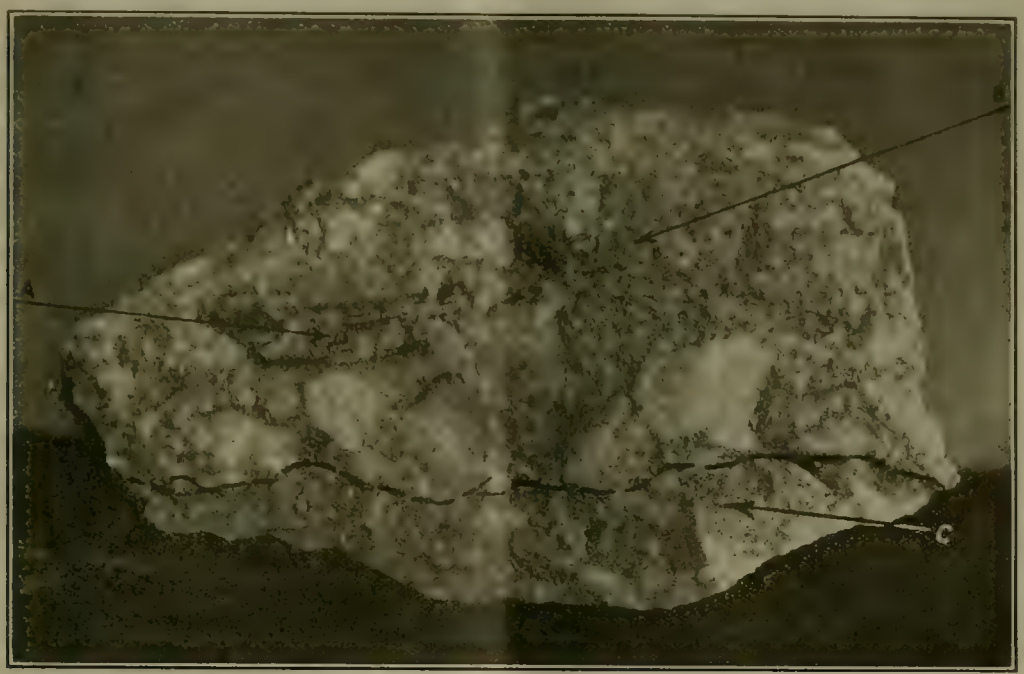

FIG. 16. RANDFONTEIN LEADER, SHOWING ANGULAR BLACK PEBBLE BEING REPLACED BY PYRITE. THE BROKEN BLACK LINE INDICATES A LINE OF VISIBLE GOLD ALONG THE FOOT-WALL. A, ANGULAR BLACK PEBBLE, THE GREATER PORTION OF WHICH HAS BEEN REPLACED BY THE PYRITE (LIGHT COLORED). B, HANGING WALL QUARTZITE. C, FOOT-WALL QUARTZITE.

Fig. 17 is another specimen of Randfontein Leader. It shows two well rounded lustrous black quartz pebbles in different stages of replacement by iron pyrite, which has worked its way from the circumference. The one seen in the centre of the photograph presents an almost perfectly circular section, and around the circumference (with the exception of the top portion) there is a thin ring of pyrite which has replaced the outer portion of the pebble. The one above and a little to the right of this is of oval section; it has a much deeper border of pyrite, which all the way around, has replaced the outer portion of the pebble, the process of replacement in this instance having extended further than in the former case. The crystalline habit of the pyrite and the irregular manner in which the inner margins of the two rings have eaten toward the centres is particularly noticeable. It is perfectly evident that this pyrite was not present originally in the quartz far back in geological time, before it was denuded, transported, worn down into pebbles, and then deposited, with a vast number of others, to constitute those pebble reaches which now form the gold-bearing conglomerates of the Rand. Had it been, it would hardly have formed rings of

Central Rand. As typically developed, the Randfontein Leader series consists of three thin beds of conglomerate. The uppermost, or hanging wall 'reef,' varies from about 8 up to 18 in. thick, and is usually too poor to work. Some 6 to 18 in. below this, and separated from it by quartzite, is the Middle 'reef.' The thickness of this varies from about 4 to 10 in. It frequently contains a profitable amount of gold and is often mined with the Leader, which is the productive member of this series, and is the lowest of the three 'reefs', being separated from the Middle one by some 4 to 10 in. of quartzite. It varies from a mere streak up to 4 to 6 in. thick. Perhaps, as most typically developed, it consists of a single line of pebbles, varying in greatest length or diameter up to about 1¼ to 1½ in. When a mere streak, its position is often fairly well marked by the contrast in color and texture of the hanging and foot-wall quartzite; the latter is softer, less crystalline, and lighter in color; as a general rule, it is sericitic, and white or light gray in color. A thin streak of gold, accompanied by minute specks of carbon, frequently occurs along the contact of the two quartzites.

[68]The West Reef in the Randfontein mines corresponds to the Main Reef series of the Central Rand. It is separated by about 200 ft. of quartzites and a few intervening conglomerates from the overlying Randfontein Leader series. For a detailed description of the Leader and West reefs, with particulars of the pebbles, etc., occurring in them, see C. B. Horwood, *loc cit.* (1910), pp. 70 75.

well defined pyrite crystals in such a manner that they now are coincident with the circumferences of the pebbles. Clearly these rings of pyrite have been formed by active solutions late in the history of the banket, by means of the simultaneous dissolution and replacement of the quartz of the pebbles.

Pyrite Aggregates

The most striking and characteristic replacement products of the Randfontein mines are small globular aggregates of pyrite and quartz granules.[70] They vary in size up to about ⅝ inch in greatest diameter. In these mines the writer has found by experience that they, also, are infallibly accompanied by high gold contents. A good example of one of these globular aggregates is shown in Fig. 18, from a photograph of a specimen illustrating how the

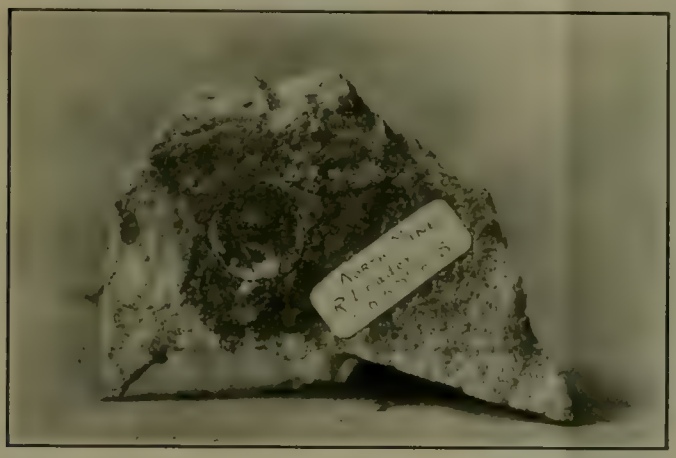

FIG. 17. SPECIMEN SHOWING TWO BLACK PEBBLES IN DIFFERENT STAGES OF REPLACEMENT BY PYRITE. THE PYRITE IS SEEN TO BE PENETRATING FROM THE CIRCUMFERENCE. NATURAL SIZE.

Randfontein Leader sometimes shrinks from a single-pebbled banket into a mere line of visible gold accompanied by minute specks of carbon. In the centre, resting on the foot-wall contact, is one of the small globular aggregates above mentioned. The Leader is represented by this and by the gray quartz pebble to the right. To the left of the former, it is merely represented by the line of contact of foot-wall and hanging wall quartzites,[71] along which gold and carbon are visible. The association of these globular aggregates with good ore is thus demonstrated in this instance by the presence of visible gold, and the latter is accompanied by carbon. Fig. 19 shows another specimen of the Randfontein Leader; it will be noticed that a slide has been cut from it through one of these pyrite aggregates in order to make a section of the latter for examination under the microscope. The pyrite aggregate is seen lying between two light-gray quartz pebbles, and it is embaying the edge of the one on the left. The association of these replacements with good ore is again demonstrated by this specimen, as it contains visible gold, and the latter is again accompanied by carbon. From the section cut through this aggregate, and from other sections of them as examined under the microscope, the writer found that they consist of an intimate intergrowth of iron pyrite with the quartz granules and secondary quartz of the banket matrix, the pyrite having partly eaten into and replaced them in such a manner that a distinct graphic structure is sometimes developed. This structure seems to be due to the great tendency of the pyrite to form crystalline outlines. Fig. 20 is a micro-photograph of a portion of the slide cut from the specimen illustrated in Fig. 19; it exhibits this semi-graphic structure well, and also the strong tendency of the pyrite to form crystalline boundaries. It shows individual crystals of secondary pyrite indiscriminately replacing both the granules of the matrix and the interstitial matter between them. As already pointed out in another place,[72] these granular aggregates of quartz and pyrite evidently represent an intermediate stage in the formation of certain pyrite 'pebbles'; and, from examining sections under the microscope, it is apparent that the complete stages were: (1) The pyrite replaced the interstitial matter between the quartz granules of the banket matrix, and then the quartz granules themselves[73] (these two processes doubtless overlapping), until one of these aggregates had been formed; (2) the enclosed quartz and other matter was then replaced by pyrite, provided passages of entry were still open to the solutions, the pores not having been plugged by the pyrite already deposited; (3) any rough outlines then became toned down and the pyrite aggregate, if not already a spherical body, became so by means of processes hereafter described.

The Randfontein Ore

As in the Crown Reef and Rietfontein occurrences, so also at Randfontein, 'pebbles' and globular aggregates of pyrite are closely associated with good ore and dike intrusions. Thus in the North Randfontein mine, where they are of particularly frequent occurrence, the West Reef is immediately overlain throughout its whole length, that is, for a distance of over 3000 ft., and along its dip for about 2300 ft.,[74] by an intrusive diabase dike.

This dike is known as the West Reef dike, and since it is probably the only one occurring in the mines of the Rand that has been studied in some detail,[75] a short description of it may not be out of place here, especially as, later on, this dike will be

[70] The writer has already described the occurrence and origin of these globular aggregates, and pointed out that, in the Randfontein mines, where they occur, they are an infallible indication of good ore. *Loc. cit.*, pp. 73-75.

[71] Contrary to the general rule, the foot-wall quartzite is, in this particular instance, darker than the hanging wall quartzite.

[72] C. B. Horwood, *loc. cit.*, p. 75.

[73] From several points of attack.

[74] As far as what was then (in 1910) the bottom of the mine.

[75] 'The Mode of Occurrence and Genesis of the Carbon in the Rand Bankets,' by C. B. Horwood, *Trans.* Geol. Soc. So. Af., Vol. XIII, pp. 71-72.

again mentioned and it will be shown that these strike-dikes have an intimate and important bearing on the genesis of the gold in the banket. It is of a dull dark-gray color, and in the lower levels of the mine is fine grained, exceedingly hard, and dense. Numerous minute crystals of pyrite can be seen scattered through it in places, and it is traversed in all directions by cracks, presumably due to contraction on cooling. On both faces of these cracks a thin film, of carbonaceous appearance, which, however, does not always soil the fingers, is sometimes present; or, the cracks are often filled with minute seams of quartz; or sometimes contain films, or minute seams, of pyrite. Along its immediate foot-wall there is usually a thin seam, varying from less than inch up to two or three inches in thickness, or crushed material, or clayey decomposed dike, forming what, in Cornwall, is known as a 'flucan.' The West Reef is rather in actual contact with this or is separated from it by a few inches, varying up to 5 or 6 in., of dense pyritic quartzite, almost black in color and having an average gold content of about 3 dwt. per ton.[76] Between the reef and dike, and parallel to them, in or along the lower side of the clay selvage, a thin band of vein quartz is often present, varying from about ½ to 2 or 3 in. thick, a sufficient evidence of a former water-way for circulating solutions. The walls themselves, and also some of the fracture-planes in the dike parallel to the walls, exhibit slickensided surfaces, the striations being approximately at right angles to the strike; that is, they are in the direction of the dip. The hanging wall is less decomposed and is more sharply defined than the foot-wall, apparently having been less subjected to the action of circulating solutions. Sometimes there is a few inches of crushed material along the upper margin of the dike, and normally it is overlain by a small barren layer of conglomerate. There is no noticeable outcrop of the dike at the surface, and for the first 200 ft. down it is soft and decomposed. A section cut from a specimen of the central portion of this dike, in the 15th level cross-cut of the North Randfontein mine, 2090 ft. vertically below the surface, where the dike is fine-grained and dense, was examined under the microscope and found to con-

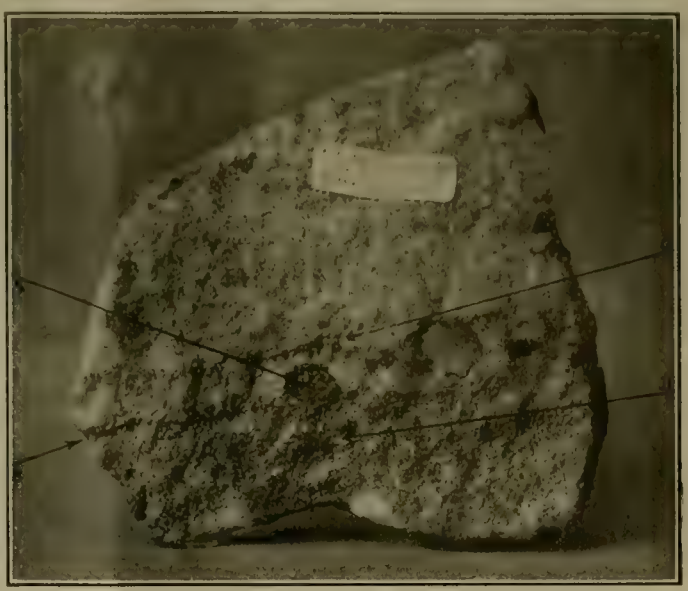

FIG. 18. LEADER, SHOWING GLOBULAR AGGREGATE OF PYRITE, WHICH INVARIABLY INDICATES RICH ORE. A, GLOBULAR AGGREGATE OF PYRITE. B, LINE OF CONTACT BETWEEN QUARTZITES OF FOOT AND HANGING WALLS. C, HANGING WALL QUARTZITE. D, FOOT-WALL QUARTZITE.

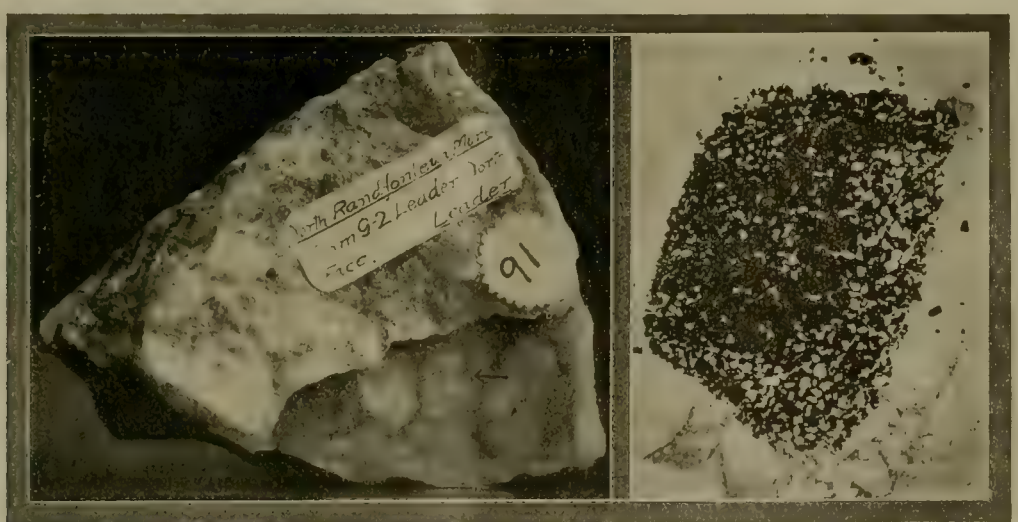

FIG. 19. SPECIMEN OF RANDFONTEIN LEADER, SHOWING A PYRITE AGGREGATE. THIS SPECIMEN CONTAINS VISIBLE GOLD AND CARBON.

FIG. 20. A SECTION FROM THE PYRITE AGGEGATE SHOWN IN FIG. 19. ENLARGED 7 DIAM. SLIDE 91.

[76]On the Rand all assays are based on the short ton of 2000 pounds.

sist of a plexus of lath-shaped crystals of feldspar in a crypto-crystalline groundmass. The feldspars are turbid through kaolinization; and there are many beautiful examples of cross-shaped interpenetration twins. Numerous minute crystals of iron pyrite are scattered throughout the mass, and a little colorless augite is also present. The assay-value of about the central portion of the dike in the cross-cut on this level, over a width of 3 ft., is approximately 1 dwt. of gold per ton. The average thickness of the dike as obtained from the various cross-cuts in this mine is about 5½ ft., but in places it widens to much more than this. To the north,[77] in the adjacent Robinson-Randfontein mine, it is only occasionally exposed, and is then poorly developed, having for the most part disappeared into the hanging wall of the 'reef', to again reappear farther north in the next mine. In the North mine it has had a marked influence on the West Reef; both ore and quartzite are blackened, greatly indurated, and exceptionally pyritic. It is particularly noticeable that the upper portion of the banket near the dike contains more gold than the lower portion, while, on the other hand, in the Robinson-Randfontein mine, where the dike is only poorly developed, and is generally absent, the reverse is the case.

Summary

The hand specimens indicate that these 'pebbles' are metasomatic replacements. The microscopic examination of thin sections clearly shows that some of the pyrite 'pebbles' are due to the replacement of original quartzite, and also quartz pebbles; some to the replacement of the quartzitic matrix; and others again to the indiscriminate replacement of both of these.

The fact that in some cases the original structure of the replaced material is still sufficiently retained to be clearly discernible in thin sections under the microscope shows that the interchange has taken place by equal, or approximately equal, volumes: the volume having remained sufficiently near that which it was before the interchange, to preserve, in greater or less degree, the original structure. In such cases the change is usually considered to be molecular; but, if so, it must be governed by some law of multiple proportions, because molecules of different substances vary in size. Thus, if the exchange were molecule for molecule, equal volumes before and after would be the exception and not the rule.

Formation of the 'Pebbles'

Thus the microscopical study of the structure of these 'pebbles' shows that they have been formed in place at a comparatively late stage in the history of the banket by metasomatic processes in every way analogous to the ordinary metasomatic changes with which one is so familiar in normal[78] fissure-veins.[79] Their occurrence shows that they are associated with igneous intrusons in the form of longitudinal diabase dikes; generally also with the presence of carbon; and invariably with ore relatively rich in gold.

(To Be Continued.)

The North Columbia Gold Mining Co., operating a placer property in the Atlin district, British Columbia, reported as follows to the Minister of Mines on its work during 1912. The ground was operated through No. 1 pit, where two lines of pipe are installed, each being 30 in. diam. at the upper end and tapering to 24 in. There are five No. 6 monitors in the pit, each usually with a 7-in. nozzle; and on the dump, a No. 6 and No. 4 machine. Here also is used a 5-ft. flume and block riffles, the average amount of water, including the 'bank-head,' being 4000 miner's inches. A small Sullivan air-compressor was used satisfactorily to operate three hand-stoping drills for drilling the largest boulders, and the large quantity of glacial clay met with in this pit. The clay is in large slabs and must be reduced before going through the sluices. The drills save a great deal of powder. The amount of gravel moved was 310,000 cu. yd., and 16,525 sq. yd. of bedrock stripped. The average depth of banks was 61½ ft. The possible working time was 185 days and actual working time was 154 days. This Company also operates the No. 2 or A. C. pit under lease from the Pine Creek Power Co., Ltd., by means of two main lines of 30 and 28-in. pipe, which taper to 24 in. at the pit. Usually four No. 6 and three No. 4 monitors are kept working in the pit, and one No. 6 and two No. 4 machines are stacking tailing and keeping the tail-race open. A 4½-ft. flume with angle-iron riffles is used. Owing to the flat bedrock, many boulders have to be reduced in size, requiring a heavy consumption of 75% dynamite. There was moved, during the actual running time of 139 out of a possible 178 days, 197,600 cu. yd. of gravel, and 30,805 sq. yd. of bedrock stripped, the average depth of banks being 19¼ ft. Total production was $72,441, an average value of 36.7c. per cubic yard.

The Pato dredge of the Oroville Dredging Co., Colombia, produced $13,650 from 18,600 cu. yd. of gravel during the week ended September 9.

Blast-furnaces in South Wales number about 30 and produce about 800,000 tons of pig iron per year, reduced from imported ores.

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[77] At Randfontein the banket strikes north and south, and dips east. The dip in the North-Randfontein mine averages about 72°, and in the Robinson-Randfontein mine about 62 degrees.

[78] The word 'normal' is used advisedly, because the beds or seams of banket are in all important essentials analogous to ordinary gold veins and may be looked upon as abnormal quartz veins, the conglomerates having played the part of the fissures and so served as channels in which mineral matter has been deposited from deep-seated circulating solutions. ('Notes and Analyses of Typical Transvaal Rocks,' *Trans.* Geol. Soc. So. Af., Vol. XIII (1910), pp. 42-43; 'The Mode of Occurrence and Genesis of the Carbon in the Rand Bankets,' *Trans.* Geol. Soc. So. Af., Vol. XIII (1910), pp. 76 and 86; also, 'Iridosmine from the New Rietfontein Mines; Its Occurrence, Analysis, and Genesis,' *Trans.* Geol. Soc. So. Af., Vol. XV (1912), p. 58; all by C. B. Horwood.

[79] For an instructive and exhaustive treatise on this subject, see 'Metasomatic Processes in Fissure-Veins,' by Waldemar Lindgren, in 'The Genesis of Ore Deposits,' 2nd Ed. (1902), pp. 498-612.

Tin Mining in Tasmania

By Peter G. Tait

*The northeastern portion of this state has been an important tin-producing centre for over 30 years. It is reached from Launceston by railroad terminating at Branxholm, a distance of 71 miles. The accompanying map shows the situation of the properties mentioned. The Arba Tin Mining Co. is working a 'lead' 400 ft. wide at the bottom and covered by 60 to 80 ft. of overburden. Drilling of 186 holes proved 750,000 cu. yd. averaging 1.9 lb. tin per yard. Two plants are at work, one with a 12-in. Austral Otis pump and a 10-in. gravel pump, and the other with a 12-in. nozzle Thompson pump. The material is sluiced down to the pump, which discharges into a bin about 80 ft. above the bottom, and from here, to lift the sand to the sluice-boxes, a somewhat unusual procedure is adopted, that of haulage by large skips. A double-track haulage line operated from a head-frame on the surface, about 50 ft. high, is equipped with a Jas. Martin & Co. hoist, steam being supplied from a 'jackass' boiler. The depth of the ground now being worked is 139 ft. below surface, and the cost of haulage is 1.5c. per cubic yard. As each part of the ground is exhausted, it is, of course, necessary to erect a new inclined haulageway and remove the plant. In the last half of 1912, 49,161 cu. yd of overburden was removed at a cost of 11c. per cubic yard, and 73,440 cu. yd. of drift yielding 0.936 lb. of black tin per cu. yd. at a cost of 13c. per cubic yard. L. B. Mitchell is mine manager.

The Briseis Company

The Briseis Tin & General Mining Co. is working a sub-basaltic river bed, the ancient channel of the Ringarooma river. The so-called northern workings of the Briseis company, which are really south of the present workings in Krushka's flat, are now exhausted, and the ground still to be worked lies under and on the other side of the Ringarooma river. In order to work the northern portion of Krushka's Flat, where the lead has been traced for a distance of 1000 ft., it was necessary to divert the Ringarooma river, and also the main Derby Moorina road. Krushka's flat was originally thought to be too poor to be profitable, and was consequently used as a dumping ground for tailing. Up to the present it has produced 730 tons of tin, an average yield of 3.5 lb. per yard. The official estimate at the end of December gives a total of 800,000 cu. yd. remaining to be extracted, and the yield of tin as 750 tons. These are the main workings at present, and the depth of the ground is about 70 ft., but as work progresses the depth increases. The new road has been completed some time, and the river diversion work is well advanced. This will give several years' work following the lead under the bed of the modern river.

On the Ringarooma hill the difficulty is in the removal of the basaltic overburden. Sluicing is principally adopted, and boulders weighing over half a ton are easily washed down the flumes. A certain amount of tramming is necessary for the heavier stones. The general manager has considered the question of a more modern system, such as steam-shovels, for doing this work, but, while the actual working costs might be reduced, the capital charges would really make the cost heavier. Up to the end of 1911, the total amount of Ringarooma overburden removed was 1,525,500 cu. yd., at an average cost of 12c. per yard. Tailing from the sluice-boxes is stacked by a 24-in. belt-conveyor, 130 ft. long, working at 33% grade, and stacking 50 yd. per hour. The mine is worked entirely by water-power. To May 1913, the black tin, 74.5% metallic, output has totaled 7075 tons, and dividends on the capital of $2,880,000 are $1,440,000. The tin is smelted at the Mt. Bischoff Tin Mining Co.'s plant at Launceston. Lindsay C. Clarke is superintendent.

The Pioneer Tin Mining Co., Ltd., is operating on

SHOWING SITUATION OF TIN PROPERTIES MENTIONED.

one of the tributaries of the main lead, and, as the overburden is not very heavy, the property can be worked much more economically than, for instance, the Briseis mine. Although the ground is comparatively friable, it should be mentioned that in places the cement is 40 ft. thick, and has to be blasted. It varies in depth from 40 to 120 ft., and four plants are installed, two steam, one of 400 and one of 220 hp., and two electric, each of 400 hp., with 16-in. pumps. The smaller steam plant has a 12-in. nozzle pump for utilizing the mine drainage, and a 12-in. gravel pump. In the deeper ground two plants work as one unit. Originally the power was steam only, but the timber areas were being cut out at such a rate that a hydro-electric plant was constructed, and the mean load in 1912 was 482 kw. The cost of electric power at the mine is 0.24c. per unit, against 0.96c. for steam-power. The sluice-boxes are 20 ft. wide and divided down the centre to control the flow and prevent scouring. A swinging belt-conveyor, 500 ft. long with 2¼ cu. yd. capacity per minute is being erected to stack the tailing and there will be room for 1,200,000 cu. yd. before any necessity for moving. From 1900 to 1913,

*Abstract from *Mining and Engineering Review.*

there has been handled 5,396,900 cu. yd. of drift, yielding 4526 tons of black tin, equal to 1.878 lb. per cu. yd. at a cost of 13.5c. per yard. The Company's capital is $960,000, and dividends total $1,180,000.

The South Mount Cameron company is working terrace ground on top of a ridge about 100 ft. above the Ringarooma, and the problem is to bring water to the ground. For this purpose a power-plant was built on the banks of the river. Water is delivered on the face at a nozzle pressure of 60 lb. by a Mather & Platt pump of 3500-gal. capacity per minute, against a head of 275 ft., driven by an Allen 400-hp. engine. The ground is up to 15 ft. in depth, and of an average value of 1 to 1.5 lb. per yard. In the neighborhood are the deserted Dorset and Ringarooma dredges. The former is now being dismantled and sent to the Philippines for a Melbourne company. The mine manager is H. P. Cecil.

The Clifton Mine

The Clifton tin mine is right at the foot of South Mount Cameron, and within a mile of the post town of that name, on the Branxholm to Gladstone road. It is only two years in May since the plant started to work, and a large area of ground has been treated. The plant consists of a 12-in. gravel pump and 12-in. nozzle pump, driven independently. Both are of Austral Otis Co.'s manufacture. The engine is by W. H. Allen, Son, & Co., and is of 150 hp. capacity, operated at a pressure of 150 lb. The pressure at the nozzle is only 25 to 30 lb. per square inch.

The ground being worked is about ten chains wide, between granite on the one side and a soft pipe-clay formation on the other. There is an overburden of 15 to 20 ft., and the wash is in a comparatively narrow bed of 2 up to 9 ft. The whole ground averages 1.25 to 1.5 lb. per cubic yard. The principal feature of the mine is the water-supply. There is no running stream in the vicinity, and it is therefore necessary to conserve the supply. After floating the barge into its present position, a dam was erected across the cut, and the tailing is run into this pond, from which the clean water is drawn off again as required. By this means it is possible to operate the plant continuously. Mark Ireland is the manager.

The Anchor Mine

The Anchor tin mine, at Lottah, is a large low-grade property, owned by a London company with a nominal capital of $336,000, of which $148,800 has been paid up. Two mines are being worked, the Anchor and the Australian mine, formerly owned by the Australian Blue Tier Tin Co. All the work is by open-cuts. At the Anchor the principal faces are known as the Pentridge, Haulage, and Tunnel faces, respectively. At the Pentridge face, the overburden, consisting of decomposed granite, is almost 80 ft. in depth, and necessitates systematic arrangements for its removal. The tin-bearing ore is trammed by gravity to the central crushing station in cars with a capacity of 1.5 tons, and there it passes through one of Hadfield's 'Heclon' gyratory crushers, driven by a Michell pelton. The oversize from this large crusher is further crushed in a No. 4 Gates. From the crushing station to the mill, 3-ton cars are used, the necessary fall being available to allow the cars to run by gravity. The Australian mine at Blue Tier is about 1500 ft. higher in elevation than the Anchor mine and on the side of a steep hill. Three faces are being worked. The ore from one is trammed to a hopper, and from the two other faces lowered by self-acting trams, the longest being 17 chains, with a drop of 400 ft. All the ore from this mine is transported to the Anchor mill by a Pohlig aerial tramway having a length of 1.75 miles. The towers are up to 40 ft. in height, the longest span being 21 chains, and the capacity 150 tons in eight hours. The tramway is in two stages, a separate crushing station being in use for the Australian mine. The mill consists of two plants, each containing 50 stamps. No. 1 plant is working solely on Anchor ore, as also are 30 head of the No. 2 plant, the remaining 20 head being on the Australian ore. All the plant is driven by water power, and the company has a ditch of 39 miles in length. J. B. Lewis is general manager, his headquarters being in Melbourne.

The following statement gives a summary of the Company's operations during the past year:

Stamps working, average	63
Stamp-duty, tons per day	5.38
Ore treated, tons	104,732
Black tin recovered, tons	188.3
Average tin content, per cent	71.6
Metallic tin per ton of ore, pounds	2.38
Cost of mining, milling, etc., per ton	$0.84

Gladstone Tinfield

The Gladstone tinfield lies between the Pioneer and the coast, and as water has been rather scarce the Tasmanian Government took over a 12-mile ditch and added 20 miles to it, costing $134,000 in all. The water now supplies 200 men, as the field is a 'small man's' district. Water is supplied at a price varying according to the market price for tin. When tin is selling at $576 on the London market, the price per sluice-head is $1.25 per week for eight hours per day; while it increases 2c. per head for every $4.80 rise, so that when tin is $960 per ton, one sluice-head costs $2.80 per week. On an average, a party of three men purchase two sluice-heads. Payments are made weekly in advance, or, failing this, on a royalty basis. The total expenditure during last year was $8400. The revenue amounted to $7700. Tin ore recovered during the last year was royalty scale, 14.9 tons, and fixed scale, 49.9 tons; a total of 64.8 tons black tin.

The Gladstone deposits are for the most part shallow, and do not call for special mention. Recently three pumping plants were put into commission for pumping water from the ditch to the Garfield ridge, a maximum height of 200 ft., but it is only the high price of tin that justifies the payment of a high price for the water, in addition to the cost of pumping.

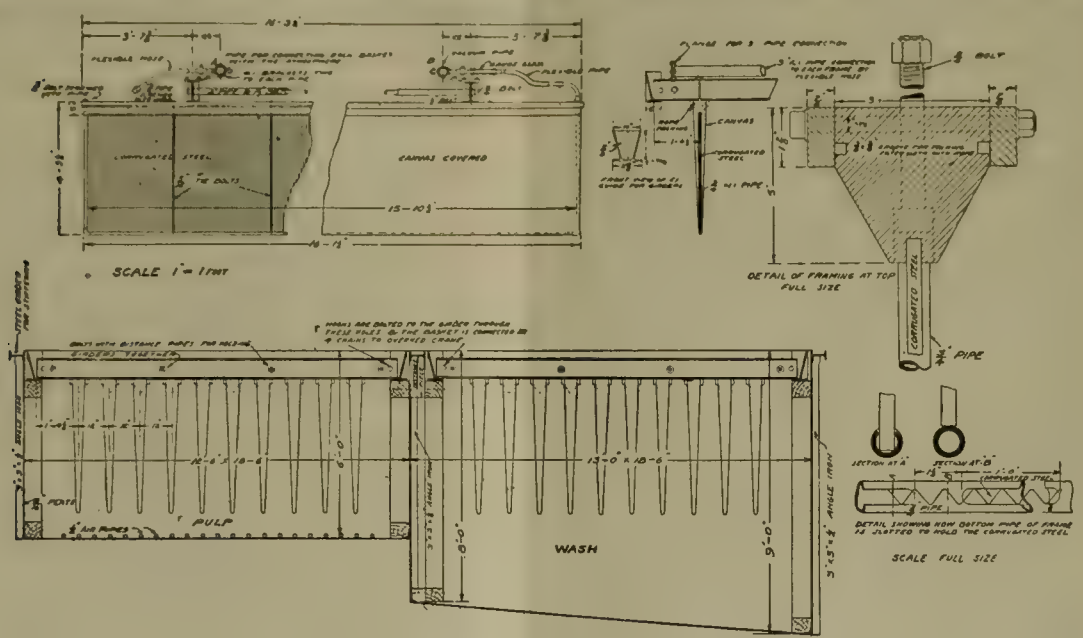
Pig iron production in the United States during August amounted to 2,545,763 tons, compared with 2,512,431 tons in the same month of 1912. At the beginning of September there were 260 active furnaces.

Vacuum Filtration at the Waihi Mine

By William MacDonald

*This article refers to operations at the Victoria 200-stamp mill of the Waihi Gold Mining Co., situated at Waikino, six miles from the mine. The ore is wet crushed, classified, the sand being leached, and the slime agitated and treated in the plant now described.

As applied to the ores from this Company's property, the vacuum-filter has been an unqualified success, but it might not be applied with equal success to all ores. In a few cases it would not be applicable with any degree of success. In the case of heavy pyritic ores or slimed concentrate, for instance, the capacity of this type of filter would be so low and the difficulty of obtaining a satisfactory wash so accentuated as to put filtration by vacuum out of the question. On the other hand, where the process was suited to an ore, and particularly where an all-sliming policy was considered profitable, a plant similar to the one under review might have a greater capacity and thus work at a reduced cost per ton of slime treated.



PLAN AND SECTIONS OF FILTER AT THE WAIHI.

The plant at this mill has been in continuous operation since the beginning of 1908, and is in as good working condition today as when erected. Previous to its installation, pressure presses were in vogue, two types of press being used, the Martin and Johnston. The vacuum plant installed was designed to treat 600 tons of slime per day, but is now capable of handling a much larger tonnage.

The filter vats are of 3/16-in. mild-steel plate and rectangular in shape. The pulp vats are 18 ft. 6 in. by 12 ft. 6 in. by 6 ft. deep. The wash vats are 18 ft. 6 in. by 13 ft. by 8 ft. deep at one end and 9 ft. at the other, an inclined bottom being provided to the wash vats to facilitate sluicing out when required. A compressed-air service is provided for all pulp vats for the purpose of keeping the pulp homogeneous and preventing settlement of fine sand on the bottom. The pipes are ¾-in. diam., spaced about 8 in. apart, and rest on the bottom of the vat. Originally these were laid right across, but difficulty was experienced in clearing the air holes when they were blocked. This was avoided by dividing the air service into two parts, each extending half way across the vats. If a block occurs, the air pressure is concentrated on the particular part affected.

All the vats are fitted with sluicing valves for discharging them if necessary. Each overhead crane is operated by a 15-hp. direct-current motor, and is provided with a magnetic brake for exact stoppage. The baskets of filter leaves, of which there are four to each bay, consist of two 8 by 4 by ½-in. I-beams, held together with distance pipes and rods. At present 12 filter-leaves are bolted equidistant across the girders. The effective filtering area of each leaf is 124 sq. ft., or 1488 sq. ft. per basket.

There are eight double-acting vacuum-pumps, two of which are held in reserve. The motive power for driving the whole plant is provided by a Crossley suction-gas engine of 200 horse-power.

An analysis of the slime is as follows: silica, 90.80%; iron oxide, 0.82; iron sulphide, 2.48; manganese, 0.43; lime, 0.69; alumina, 2.89; magnesia, 0.15; and moisture, undetermined, etc, 1.74 per cent.

The usual time occupied in a cycle of operations by any basket is as follows:

	Minutes.
Filling	50
Washing	60
Discharging	24
Transferring (three operations)	10
Total time	144

Cloths last from 12 to 15 months, and are treated

*Abstract from *Journal* of the Chemical, Metallurgical and Mining Society of South Africa.

every three months in a 5% solution of hydrochloric acid. The moisture in the discharged cakes is 30%, and the average amount of gold and silver left in the residue in a soluble form is, approximately, gold 0.048 dwt. and silver 0.022 oz. per ton of dry residue. Total costs of filtering are 9c. per ton of dry slime treated.

Localizing Coal-Dust Explosions

During the 1913 session of the American Mine Safety Association, an exhibition coal-dust explosion test (experiment No. 46) was made at the Bureau of Mines experimental mine, near Brucetown, Pennsylvania, on the afternoon of September 23, 1913, for the delegates, states mine inspectors, and other mining men. In previous public exhibitions at the experimental mine, preventing or arresting means have been shown only a subordinate feature in the airway, the main points having been to demonstrate to the observers that coal-dust itself would make a violent explosion, and, in addition, in this as one of the series of tests to study the propagation of a coal-dust explosion from point to point through the agency of measuring apparatus. As there are practically no skeptics today in the matter of explosibility of coal-dust, it was decided to use arresting means at either end of the coal-dust loading. It must be clearly understood that the Bureau does not feel that arresting methods are sufficient in themselves, but only useful as secondary safeguards; the important feature is to prevent an explosion from starting; but if it is possible to have the effect of continuous barriers, then an explosion could not be started.

One of these arresting means was a Taffanel stone-dust barrier consisting of ten shelves, which was placed at the end of the coal-dust loading in the main entry. The coal-dust loading extended 800 ft. to the face, thence 50 ft. through a cut through, and out 200 ft. on the parallel air-course. From this point forward for 300 ft. there was a stone-dust zone in which the stone-dust was distributed over the sides and floor after the manner in which it is proposed it should be used continuously in such mine entries where a good watering method cannot be employed. Beyond, or out by both of these arresting zones, was placed additional amounts of coal-dust, so that if the rock-dust did not effectively blanket the flame the propagation of the explosion would be continued, and indicate the ineffectiveness of the devices.

This test was most successful and confirmed conclusions drawn from previous experiments, as follows: (1) It is possible to get a violent explosion in a mine where the surfaces are damp, if there is an ample supply of dry coal-dust present. (2) As a secondary defense, the Taffanel barrier is of great advantage. It is fully recognized that an explosion, such as this, would suffocate all the men in the part of the mine in which it occurred, and hence means to prevent an explosion originating are most important; but if, by any mishap, an explosion should take place in one part of the mine, it would be desirable to have the other parts or other splits defended by such barriers, in order to prevent the explosion from passing from one section to other sections. (3) A zone treated with sufficient rock-dust will prevent the passage of an ordinary explosion, which is also illustrative of the impossibility of starting an explosion in a well treated zone.

There was one feature of more than passing interest in this explosion, confirming other explosion experiments at the mine, namely, the development of the explosion centre; its passage past cars, and then accumulating in intensity, the back pressure throwing the cars toward the origin of the explosion. The latter effect cannot be considered the result of a wind to fill the vacuum at the face following an explosion, for while this would be influential in throwing light articles, it would be virtually impossible to have caused the hurling through the air of the heavily laden cars.

Mining in Western Australia

The annual report of the Mines Department for 1912 contains the following information: The average value of gold produced per man employed (14,961) on gold mines increased from $1825 in 1911 to $1935 in 1912. The average tonnage hoisted per man was 203.64 tons, against 184.94 in 1911. There were 542 men employed at the Collie coalfield who average 544 tons of coal per man, against 539 in 1911. There were 35 fatal and 491 serious accidents in all classes of mines. There were more 'rock outbursts' in the Burbank's Main Lode mine, near Coolgardie. The worst ones happened on No. 6 level, breaking 10-in. timbers and breaking down about 25 tons of ore. In all instances, the outbursts occurred in the lode which is composed of quartz and a somewhat silicified greenstone, the hardness being about six. Under the 'Mining Development Act, 1902,' advances totaling $212,000 were made to help small miners with their development, drilling, transport, equipment, and subsidies to mills crushing for the general public. The superintendent of state stamp-mills reported that in 35 plants there were 282 stamps available for custom ore, and three 10-stamp mills leased under agreements. There were 1026 lots milled, totaling 56,636 tons of ore, while there was treated 18,600 tons of sand, 8085 tons of slime, and 5330 tons of tin ore. The Government lost altogether $44,600 on the year's operations; but the indirect benefit to the mining industry is a large one. Since 1898 the state mills have treated 900,416 tons of gold ore, 496,109 tons of sand, 101,068 tons of slime, and 56,883 tons of tin ore, yielding a total of $19,100,000. There were 2992 useful boilers and 3113 groups of power-driven machinery in all districts, including 121 suction-gas producer plants.

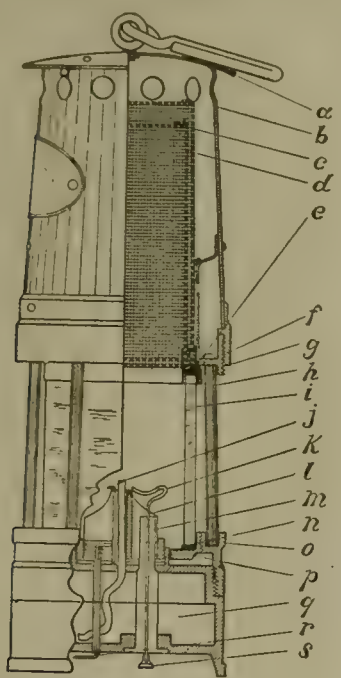
Gold production of Western Australia is showing an improvement, as up to May 31, 1913, it was valued at $10,699,000 against $10,593,000 in the same period of 1912.

During August the Elmore vacuum plant at the mines of the Sulitjelma company, Norway, produced 832 tons of copper concentrate.

Use of Miners' Safety Lamps

By James W. Paul

*Safety lamps that were defective or were not properly cared for have caused a number of accidents in foreign coal mines. Many miners in the coal mines in this country have been burned with the flame of gas (methane) that was lit by opening a safety lamp or by not using the lamp properly. Safety lamps from which the gauze had been removed have been found in the hands of inexperienced or careless men in gaseous mines. And no doubt many mine disasters have been prevented by discovering such ignorant use of safety lamps and warning the men so carelessly inviting injury or



A recent pattern, oil-burning safety lamp, bonneted. *a*, steel hood; *b*, steel bonnet; *c*, iron gauze, outer; *d*, iron gauze; *f*, asbestos washer; *g*, brass ring, middle; *h*, brass standards (five); *i*, glass globe; *j*, cotton wick, flat; *k*, copper pricker; *l*, porcelain burner; *m*, insulated tube; *n*, asbestos washer; *o*, brass ring, lower; *p*, brass ring; *q*, brass oil fount; *r*, wick adjuster; *s*, electric-current contact.

death. Defects in miners' safety lamps caused at least two disasters in this country in 1912. The lamps were of the modern type, burned naphtha or gasoline, and had a double gauze, a shield, and a glass globe. In each disaster a safety lamp ignited gas within a mine. In one case 12 lives were lost, and in the other case several men were severely burned. The first of the two disasters resulted from the parts of a lamp not being properly assembled. The top asbestos gasket was doubled on itself, so that a part of the glass did not touch the gasket, and an open space was left between the top of the glass and the gauze. When this lamp with the gasket doubled back was lighted and placed in an explosive mixture of gas and air, the gas within the lamp flamed and ignited the gas outside the lamp. The second disaster was caused by a safety lamp that had not been properly assembled. In assembling this lamp, the pull bar that works the scratcher for igniting the tape had been left out. This lamp when lighted and placed in an explosive mixture of air and gas ignited the gas outside the lamp.

*Abstract from U. S. Bureau of Mines publication.

Assembling Safety Lamps

Any safety lamp is presumed to be in a safe condition only when all its parts are properly assembled in the manner prescribed by the manufacturer. All manufacturers of safety lamps, upon request, furnish illustrations of their lamps showing each part and the completely assembled lamp. Some of the errors common in assembling lamps are:

1. Leaving out one or both gaskets, or using broken gaskets.
2. Placing gaskets in underfed lamps so as to exclude the air from below.
3. Leaving out one of the gauzes in double-gauze lamps.
4. Placing on top of the glass an expansion ring designed to be placed under the glass.
5. Placing the expansion ring upside down, thus destroying its usefulness.
6. Failing to screw the bowl (fount) sufficiently to make a tight fit between the glass globe and the gaskets.
7. Leaving out the igniting device without plugging the stem hole.
8. Leaving off the deflection rings that prevent air from blowing directly into the lamp.
9. Leaving off the shield or bonnet when the lamp is to be used in a strong current of air.
10. Placing a defective gauze in a lamp.

Hammer Drills in the Witwatersrand

The following report of work done on the Witwatersrand G. M. Co., Ltd., shows what can be done with small hand machines when there is a scarcity of labor. Six hand rotation jackhammers ran on the Witwatersrand G. M. Co., Ltd., for five months from July to December, 1912, continuously, taking up foot-wall in hard rock. The method of handling the drills was to allow one drill, weight 54 lb., per native, on contract at 1d per foot drilled, with one jumper carrier and a white boss on each three machines. The average footage obtained per drill per eight hour shift was 28.7 feet, the average depth of hole drilled being four feet, the most suitable to the mine's working condition. These six drills have been responsible for 150 tons of foot-wall broken per day during the period. This includes block holing or re-drilling broken rock which was too big for handling. The mine authorities express themselves completely satisfied with the work done, which is peculiarly significant, in view of the present shortage of native labor.—*South African Mining Journal.*

The pottery imported into the United States in 1912 was valued at $9,555,530, but the domestic production, according to the U. S. Geol. Survey, was valued at $36,504,164. The exports were valued at $1,177,784. The domestic production was 81.4% of the total consumption, against 78.9% in 1911.

Discussion

Readers of the MINING AND SCIENTIFIC PRESS are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment. Insertion of any contribution is determined by its probable interest to the readers of this journal.

Under-Estimating the Cost of Milling Plants

The Editor:

Sir—The editorial comment in the issue of August 23 on 'Under-Estimating the Cost of Milling Plants' inclines me to fear that my article, published in the issue of July 21, has been somewhat misunderstood. It was not my intention that a reader should infer that there existed any friction between the machinery houses and the metallurgical engineers. Such a condition would, I consider, be deplorable, and work a hardship on the operator. I certainly agree with you that the closest relationship should exist. And this means that each attend to his own particular line of work, leaving alone that which rightfully belongs to the other, thus working together for the best service to the operator. I believe that, generally, such a relationship does exist, except where interfered with by unthinking, unintelligent, or would-be economical operators.

The intelligent metallurgical engineer realizes the necessity for a close relationship with machinery manufacturers. He is not a designer of machinery; he only knows the exact work he wishes to perform; the machinery manufacturer must design such machinery and supply all data concerning its mechanical superiority and efficiency for this particular work. But the question of whether or not this particular work is going to be the proper thing for the treatment of the ore is not for his consideration, but solely concerns the metallurgical engineer. Judging from letters received from a few prominent machinery manufacturers, since publication of my first article, a universal close relationship of this sort would greatly please machinery dealers as well as engineers, and greatly benefit the operator.

I agree with you that "no two general managers or board of directors will agree as to most economical and efficient method of mill construction"—unless they have had the experience of at least one installation. After having had this experience, I believe that they will generally agree; and the fundamental principle which might well be called 'horse sense' will consist in the employment of a competent metallurgical engineer to properly devise treatment of ore, select properly designed apparatus for efficient service, lay out proper arrangement of such apparatus into an efficient and economical installation, all regardless as to whether the mill is built by a mining company, machinery house, or contracting engineer; and only when the 'horse' is a mule will they conclude with any other general program.

Referring to the example you mention "where identical equipment for a 10-stamp mill, when erected and placed in operation under the supervision of a competent engineer, was 40% in excess of a contract price offered by a machinery house," it is unquestionably true that a piece of work may often be done more cheaply by one person than another, but into such wide variance certainly the factor of competence or the question of whether finished installation would have been identical, must surely enter.

With your permission, I will add a reply to the criticism of Chas. Hutchinson, which appeared in the issue of August 30. Mr. Hutchinson's criticism of my diagnosis of under-estimated costs of milling plants, in the issue of August 23, is most interesting in its terseness, but I fail to find much room for an argument; we seem to be, generally, of one opinion. But a bit of a reply might be of interest. He starts by saying that he cannot agree with all of my conclusions, but upon reading his remedy it is found to fit my diagnosis almost perfectly. He lays the blame for under-estimated costs on the buyer, the superintendent who desires to hold his job, and the mining engineer-superintendent untrained in such specialized work. This is largely true, and it is just such cases that I have recorded in detail in my second article. Also, just such cases are referred to in my third article when I stated that the data for the notes had been largely secured by going over plans and specifications handed me for examination; those "atrocities in the form of mill plans submitted by mine superintendents." I have certainly not advocated mill installations by mine superintendents or mining engineers, but attempted to make the same point which Mr. Hutchinson has undoubtedly made stronger.

I cannot agree, however, to Mr. Hutchinson's remedy as he has stated it, although it may be splitting hairs to take up the point. He advises: (1) a metallurgical engineer to devise treatment; (2) a mechanical engineer to design plant; (3) a contractor to make installation, as being the most satisfactory method of securing the most efficient plant at the lowest cost. The old saying "Too many cooks spoil the broth," applies here admirably. And if it is spoiled, or if any portion or all of the plant fails, who is to blame? Where does the responsibility lie?

The metallurgical engineer devises treatment, and is through; his responsibility ends when he turns over his flow-sheet to the mechanical engineer, and he cannot be held responsible for mistakes, misinterpretations, or the injection of the mechanical engineer's ideas which might affect operation as planned.

The mechanical engineer designs the plant, as per flow-sheet, as nearly as his lack of knowledge of metallurgy, and usually his lack of knowledge of conditions under which construction and operation must be carried on, will permit him, and is through. His responsibility ends when he turns his plans over to the contractor, and he cannot be held responsible for mistakes, misinterpretations, or the injection of the contractor's ideas into his own, nor for the mistakes of the metallurgical engineer, or alterations desired later.

The contractor makes the installation, as per plans, as nearly as his lack of knowledge of metallurgy or application of items of equipment will permit him, and is through, and cannot be held responsible for

efficiency of equipment nor for results of treatment.

You are dealing with three specialists in a case where neither knows enough of the others' part of the work to enable him to do his own intelligently. And if they are all three employed on the job independently, the conflicts, if not absolutely serious, at least cause much annoyance and delay; and the Lord help the man who has to operate the plant, and the owner. I was once acting as an 'understudy' for a general manager of a mining company during construction of a plant where there was just this combination, and I hope never to have the experience again.

It sounds like the logical and most efficient arrangement, and it is, in many undertakings; but in a milling plant, especially where any chemical treatment is employed, such as cyaniding, the almost impossibility of preparing plans and specifications in such absolutely finished and perfect a manner that all details may be properly completed, precludes its adoption. There are many details about a milling plant which the metallurgical engineer has clearly worked out in his own mind, but which are very difficult to put on paper in such a manner as to be sure of correct interpretation; and many points have to be taken up by him as the work progresses, and decisions made as changing conditions are met.

As Mr. Hutchinson says, "it would appear futile to call attention to an ill without proposing a remedy," I wish to offer as a remedy the following:

(1) Employ a metallurgical engineer to devise treatment (allow him to employ a chemist to assist him if necessary).

(2) Retain the same metallurgical engineer to design the plant and estimate the cost (allowing him to employ a mechanical engineer if necessary).

(3) Retain the same metallurgical engineer to make the installation (allowing him to employ a constructing engineer if necessary, or to let contracts to machinery houses or to the contracting engineer if desired).

Mr. Hutchinson says: "If you are ill, send for a doctor. If prison stares you in the face, send for a lawyer. If you wish to develop a mine, send for a mining engineer." All of which is most excellent advice. But in this instance you have three distinct matters in hand: you are ill, you fear prison, and you have a mine to develop; while in the instance under discussion you have but one matter in hand: the installation of a milling plant to treat a certain ore. Which is, from the first step to the last step, the business of a metallurgical engineer. It constitutes the definition of the name.

I quote: "Of all the engineering professions, the engineering contractor is the only one who pays for his mistakes." Not so! The metallurgical engineer who makes a failure of an installation pays much more dearly by loss of his reputation than does the engineering contractor who loses a few dollars on a job. It is true that one hears but little about such losses by metallurgical engineers, but this is due to the too frequent application of the three-cornered method of making an installation, just discussed, where responsibility cannot be placed. All hands slip out from under, and the operator's loss is all that is heard about.

With these two points of difference out of the way, I pass on to the part in Mr. Hutchinson's criticism with which I heartily agree. He says: "As a matter of fact, the machinery houses have for years made practically all the mine superintendents' estimates for them, gratis." Correct! It is upon this fact that I based my first reason for underestimated costs, as set forth in my first article in the issue of July 21. Mr. Hutchinson says in his first sentence: "Under-estimating the cost of milling plants is the rule rather than the exception." This with the other quotation given above, shows clearly how entirely he agrees with me in this matter.

I, too, would be glad to see all machinery dealers shut down on this sort of thing. Dealers, engineers, and operators would all be greatly benefited. Metallurgical engineers only require from dealers such information as price, specifications, and records of performance of the equipment they manufacture or offer for sale, and this must be supplied them if the dealer expects to have his equipment specified. (By the way, right here I might say that the dealer who keeps the metallurgical engineer fully supplied with such data for his 'dope' book is the one who will get the most of that engineer's business, other things being reasonably equal.) In return, the metallurgical engineer is glad to reciprocate by supplying the dealer with data and information regarding performance, cost of operating, repairs, general efficiency, etc., of various equipment he may be using, also all sorts of general engineering data from the field. Which, in turn, the dealer dispenses to other engineers, buyers, superintendents, etc., as Mr. Hutchinson states.

Just one more item. It was certainly not intended that the idea be conveyed that the cost of allowing a machinery dealer to pay for a lunch was a source of expense to the buyer. The clause referred to was intended to convey a broader significance. The visiting in town of superintendents and engineers is often the source of unnecessary expense, not only in money expended, but in time lost. I have seen a construction crew wait while the superintendent finished the round of entertainment extended to him in the city.

The further statement that "the most direct route to a buyer's affections is by way of his stomach" is doubtless quite generally true, and especially when it is realized that it may be at least the most direct route known to the dealer, who may not be the 'peeple' Josh Billings referred to. However, the route is an enjoyable one sometimes, especially when the dealer's expense allowance does not call for too limited a ticket; and I must admit that any expense incurred by the buyer in this connection might have been omitted as an item of under-estimated cost, as, after lunches, dinners, and other convivial entertainment, the buyer is as apt to secure concessions wanted from the dealer, in the way of a few extra 'spares' thrown in, a better delivery agreement, an additional percentage off, etc., as the dealer is to book the order. In which case, a bit

of 'carelessness' on the part of the buyer in the matter of settling the score could be overlooked.

A. Sydney Addition.

San Francisco, September 13.

[That there should be no real cause for friction between the metallurgical engineer and machinery manufacturer is unquestioned, and where such cases have existed, they have undoubtedly been the exception rather than the rule. We agree with Mr. Addition that while the respective provinces of the metallurgical engineer and machinery manufacturer are separate and distinct, a closer coöperation would redound to mutual benefit.—Editor.]

Mineral Flotation.

The Editor:

Sir—I have read with interest Mr. Hoover's book on flotation and also the article by Edward Walker in your January issue. Having been closely connected for a number of years with both the Minerals Separation and De Bavay processes working on the large scale in Australia, I hope that I may be allowed a little space in your journal to offer a few remarks on this subject. In comparing the De Bavay process with the Minerals Separation process in operation on Broken Hill ores, many factors have to be taken into account. In the first place, De Bavay has been one of the few companies to recognize that in the treatment of Broken Hill tailing it does not pay to treat the slime product, owing to its high percentage of lead. By rejecting this slime it has been found that not only is a higher grade and consequently more profitable zinc concentrate produced, but the slime itself is kept on hand as a valuable by-product. Mr. Walker remarks that experience gained during the past year has gone to prove the efficiency of the Minerals Separation process over the De Bavay process. This certainly does not appear to be the case, judging by the enormous profits made by the De Bavay company in spite of paying high prices for tailing. Also, an interesting point in this connection is the fact that the South company, after various trial runs, decided that, from a commercial point of view, at any rate, De Bavay was the best process. This certainly does not point to the process being inefficient as compared with the other processes on Broken Hill ores. From a profit-making point of view, the De Bavay process is ahead, at the present time, of any other process in Broken Hill on Broken Hill tailing. I do not refer to the slime treatment. At the present time there is not much profit in this treatment, but it is hoped that the experiments which are being conducted by the South mine, Amalgamated Zinc, and other companies will be crowned with success. Mr. Walker further states: "Moreover, there is little likelihood of the De Bavay process being applied anywhere else than at Broken Hill, as it is obviously of inferior efficiency to the Minerals Separation process." Why obviously? In the first place, Broken Hill is not the only lead-zinc mining centre in the world, and also, with their present knowledge, the De Bavay people could greatly simplify the design of their plant, making it cheaper to erect. Mr. Walker would be greatly surprised if he knew the actual working costs of this process. I regret that professional etiquette prevents me from giving the information. The recoveries also are very high, higher than given in Mr. Hoover's book, where a crude value for the tailing is conveniently assumed. Both the De Bavay and Minerals Separation processes have their scope on different types of ore. The De Bavay process will treat material through 30-mesh with 5 to 10% slime, much coarser than can be treated by the Minerals Separation process without crushing. For very fine grained ores, however, which are eminently suitable for the Minerals Separation process, the De Bavay process is not so good. In experimenting with the De Bavay process, the method described by Mr. Hoover in his book is not suitable, as it will give bad results on any ore; and, although I have personally conducted numerous experiments on the De Bavay company is more up-to-date and more used anywhere, the methods referred to above. The stepped cone of rough design shown in Mr. Walker's article I have never seen on the De Bavay plant, as I am pleased to say that the engineering skill of the De Bavay company is more up to date and more original than this design would lead one to believe. The De Bavay process stands as a model of Australian management and metallurgical skill so lightly spoken of by Mr. Hoover. In reference to the Minerals Separation process, it is not generally known that it is really a development of the Cattermole process. The first plant erected at the Central mine was really a large Cattermole plant using Wilfley tables. On observing the tailing from these tables, falling into the tailing-boxes, a large froth was seen floating on the top of the boxes. Immediately the Central mine staff planned out the scheme of the flotation box, and the treatment was modified accordingly. It will be seen that this process was made commercially successful by the Central mine staff, and that Australians had no small share in its development. Thousands of pounds of profit was made by the Minerals Separation process on zinc tailing before Mr. Hoover's single level apparatus, which is undoubtedly the finest mechanical feature of the present plants, was introduced. To Mr. Lavers, chief metallurgist of the Minerals Separation Ltd. in Australia, is also due the rapid advance of this process in dealing with copper ores, owing to his brilliant research on the adaptability of eucalyptus and other oils to the treatment of these ores without the necessity of the use of acid.

Wilton Shellshear.

Mt. Morgan, Queensland, May 8.

The United States produced more white arsenic in 1912 than ever before, the output for last year being 3141 short tons, valued at $190,757, as against 3132 short tons, valued at $73,408, in 1911, according to a report on the subject by Frank L. Hess, just issued by the U. S. Geological Survey. The imports in 1912 were also the largest on record, amounting to more than 6156 short tons, valued at $428,741, as against 4096 short tons, valued at $247,323, in 1911. The only white arsenic produced in the United States was that made as a by-product of smelting operations.

Special Correspondence

LONDON

COPPER MINING IN THE RUSSIAN EMPIRE.—DREDGING TIN IN THE FEDERATED MALAY STATES.

American engineers are doing a large part in the work in connection with the development of copper deposits in the Russian Empire. A good deal has been written with regard to the Kyshtim company owning a property in the Southern Ural region. The same controllers are now bringing forward the Tanalyk property, situated a few hundred miles to the south in the direction of Orsk. The Tanalyk Corporation was formed in London, in April 1912, for the purpose of purchasing the entire share capital of the South Urals Mining & Smelting Co., the Russian organization owning the property. The capital is £300,000, of which £190,000 is represented by the shares of the Russian company; in the balance-sheet on December 31 last, £73,011 is shown to have been advanced in cash as working capital to the Russian company, and £37,999 cash remaining in hand. The latter has been spent since then, as well as other money advanced on loan. It is now proposed to issue additional shares of the Russian company and for the Tanalyk Corporation to subscribe for the whole of them. To provide the money, a debenture issue of £200,000 is to be made, and £200,000 new shares are to be created. Of the shares, 66,000 will be held against conversion of the debentures, and 50,000 placed under option to the Inter-Russian Syndicate, otherwise Messrs. Beatty and Hoover, at £3 per share until November 1916. A statement has just been issued, checked by R. Gilman Brown, of the various properties and their present state of development. The most important mine is the Mambet, which is being developed in two parts. The workings are down to 165 ft. and the lode has been found to average 10 ft. The ore assays from 2 to 3% copper and about 8 dwt. gold and 10 oz. silver per ton. These figures are not exact, but are intended to indicate an average of those in the report, which show considerable variation. The developments at the Tanalyk mine have not given such good results; two veins 3 ft. wide have been found averaging 2 to 3% copper, 3 to 4 dwt. gold, and 2 oz. silver. Lower-grade ore is found at the Troitsk shaft, useful as a flux for mixing with the other ore. The estate belonging to the Company contains timber and coal. A seam of coal 7 ft. thick has been disclosed in a prospecting pit 22 ft. deep, and it promises to yield a fuel suitable for metallurgical operations. Early this year it was stated that the presence of zinc in the ores was causing anxiety. It is now announced that no difficulty will be caused in this direction. A smelting plant to produce 1500 tons of copper per year is now in course of erection. The first half should be in operation early in 1914. It is estimated that the copper will contain 14 oz. gold and 244 oz. silver per ton. The average content of the ore reserve, figured by Mr. Brown at 70,000 tons, is given as 2.9% copper, 7.4 dwt. gold, and 7.5 oz. silver.

The winning of alluvial tin by means of bucket-dredges is making a gradual advance. Most of the work hitherto has been done by various modes of sluicing or by pumping the gravel to a floating barge containing the tables. I recently referred to the first bucket-dredge supplied in Nigeria. In Siam, the Renong and Tongkah companies are dredging stanniferous sand on or near the seashore. More recently the Malayan Tin Dredging Co. has started operations in Perak. The most recent accessions in this class of work are the Ipoh Tin Dredging and Kampong Kamunting companies. The Kampong Kamunting Tin Dredging Co. has been formed by Messrs. Pratten and Freeman in Sydney, New South Wales, to acquire a tract of alluvial tin ground at Kamunting, three miles from Taiping, the capital of Perak. Among the engineers who have reported on the property is M. T. Nelmes Bluck, who was recently the manager of the Tongkah Harbour Tin Dredging Co., an Australian venture to the north of the Malay district. The deposit consists of sandy gravel with comparatively little clay. Over 300 bores have been put down, and from the information so gained, 384 acres are estimated to contain 18,000,000 cu. yd., averaging 1¼ lb. cassiterite per yard. The average depth is 30 ft., and the bottom is soft clay. The proposition is eminently suitable for bucket-dredging. Two dredges with 7-ft. buckets are to be erected, and the cost of working is estimated at 9c. per yard. The capacity of each dredge is calculated at 75,000 yd. per month, and the total output of the two dredges at 80 tons of cassiterite per month. The capital of the Company is £150,000 in £1 shares, of which 80,000 shares is the purchase price, 50,000 shares are offered for subscription, and 20,000 held in reserve. The cost of installing the two dredges is estimated at £40,000. The Ipoh Tin Dredging Co. has been formed in London to acquire a tin-gravel property six miles south of Ipoh, in the Kinta valley. Reginald Pawle is on the board, and M. T. Nelmes Bluck is consulting engineer. H. D. Griffiths, late of the Tronoh, examined the property. The property has been selectively mined by previous Chinese owners, and the ground is now suitable for bucket-dredging. The average depth of the deposit is 42 ft.; and the total ground 11,306,240 cu. yd.; 100 acres average 1⅛ lb. cassiterite per cubic yard, 40 acres 1⅛ lb., and 38 acres ¾ lb. It is proposed to build a dredge with 10-ft. buckets, capable of treating 100,000 cu. yd. per month. The cost is estimated at 9c. per cubic yard. The deposit consists of a sandy gravel, and the cassiterite is very fine, so that the saving apparatus will have to be carefully regulated. The capital of the Company is £90,000, of which £43,500 in shares and £7500 in cash is purchase price. The 46,500 shares offered for subscription have been underwritten.

MAP OF MALAY PENINSULA.

NEW YORK

THE CARIBOU-COBALT MINES CO. AND CONDITIONS AT COBALT.—GRANBY COMPANY'S AFFAIRS.—RAY, BRADEN, MASON VALLEY, AMALGAMATED COPPER, CALUMET & HECLA AND THE MINERS' STRIKE.

The event of greatest interest in the past week was the debut of the Caribou-Cobalt Mines Co. This Company, which is controlled by E. P. Earle, David Fasken, and others who are prominent in the Nipissing company, has a capital of $1,000,000 in $1 shares. The Company has taken over the old Drummond mines, which have an output record of 2,200,000 oz. silver. These are in the Kerr lake portion of the Cobalt district, the total area of the property being 71 acres. It is at present producing about 45 tons of ore per day and is equipped to yield 100 tons. Trading in the shares was brisk during the week, and they were bid up to 58c. The board of directors consists of the two men mentioned and W. B. Randall, president; S. T. Baylis, vice-president, and Richard F. Greene, secretary and treasurer. The market sponsor for the stock is Baruch & Co., the firm which was prominent in the flotation of the Goldfield Consolidated. Some dejection has

been caused in Cobalt producers by the announcement that the American Smelting and Refining Co. has set a 7% limit on the arsenic content of Cobalt ore. Shipments from the district last week amounted to 439 tons of ore, and as the smelting plants at Copper Cliff and Carnegie have been shut down for some time and the Orillia plant is in process of being rebuilt, the burden falls on the Deloro and Thoroid plants. As both of these are taxed almost to capacity by the shipments of the companies by which they are controlled, the situation presents some inconvenience. Good progress is being made in draining Kerr Lake, and it is expected that the water will all be out before winter sets in. All the signs point, therefore, to somewhat of a revival of interest in Cobalt.

The Granby has issued its annual report, which shows a gratifying increase in the prosperity of that excellent, but in some respects unfortunate, company. It will be remembered that this Company, which has the all-embracing title of Granby Consolidated Mining, Smelting & Power Co., Ltd., built a huge smelting plant at Grand Forks and was proceeding merrily when, in 1910, it was discovered that the actual ore reserves were less than one-half the amount stated by the mine manager. Consternation and recrimination followed, and when a bond issue was floated, a while ago, the underwriters had to take almost the whole issue. Last year an excellent new mine was acquired at Hidden Creek, British Columbia, and nearly 8,000,000 tons of 2.2% copper ore has been developed. A 2000-ton smelting plant has been built near the mine, which is on Observatory Inlet, British Columbia, and will be ready to begin work by the end of this year. The property at Grand Forks and Phoenix has paid $4,750,000 in dividends since 1900, but as the investment in lands and plant is given in the balance-sheet as $15,000,000, and as the property there only has a life of five or six years more, the greatest hope of profits is based upon the new mine. The net working profit for the year ended June 30, 1913, was $1,214,600, the copper produced amounting to 22,688,644 lb. This was produced at an average cost of 10.64c. and sold for 16c. After paying $450,000 in dividends, $683,149 was transferred to the surplus. The Ray Consolidated is making a good showing, as the tonnage handled continues to increase. At the Braden 77,304 tons of ore was milled, yielding 1,332,000 lb. copper. The recovery in the old mill was 71% and in the new mill only 57%, due to a shortage of sulphuric acid. The Mason Valley has been suffering from a shortage of ore for its smelter since the Nevada-Douglas has been short of smelting ore for some time, and is now reported to be about to erect a 100-ton leaching plant. The Mason Valley smelter receives ore from a number of properties, but with the exception of the Nevada-Douglas, they are all small, and the total is not great. As a result, Mason Valley shares declined from 7 to around 3½. The directors of the Amalgamated will meet soon to declare a dividend, which will undoubtedly be at the usual rate of 1½% for the quarter.

The Osceola has reduced its quarterly dividend to $2 and most of the other Calumet & Hecla subsidiaries may doubtless be expected to reflect the strike in decreased dividends. The president of the Calumet & Hecla, Quincy A. Shaw, has made public a statement controverting the allegations made by J. A. Walker, of the American Federation of Labor. Mr. Shaw points out that his salary is $15,000 per year, not $300,000. The hours for men under the contract system are nine, and arrangements are being made to reduce them to eight wherever possible. The payrolls show that the average net wage of miners is $3.66 and trammers $2.89 per day, after deductions have been made for hospital assessment and the aid fund. The Company now has over 3000 men at work, and over 1500 at work underground. Mr. Shaw goes on to say that "this trouble has not come from our men, but from an element outside which has attempted for its own purposes to take control of the labor field. We have with us hundreds of men who own their own houses, who are bringing up their families in a way creditable to the district and the country, and our relations with them even during this trouble have never changed. It is a business as well as a sentimental proposition that a contented working staff is the first requisite for real efficiency in any undertaking, and that is what we have always kept in mind in our relations with our employes."

PORCUPINE, ONTARIO

Dome Mine and Mill.—Tough-Oakes and Teck-Hughes Mines.

The trouble in the directorate of the Dome Lake company arising out of the lack of information regarding the physical condition of the mine and the unsatisfactory financial position of the Company, appears to have been settled. At the adjourned meeting a report on the mine was submitted, and it would appear that while the grade of the ore is satisfactory, the ore occurs in short and disconnected lenses. Other portions of the property are so far not fully developed, but seem to be of greater promise, and the possibilities of the property are by no means exhausted. At the meeting it was shown that there was a total indebtedness of $61,000, with pressing debts of $18,000. The General Assets, Ltd., which formed the Company, and which has charge of its affairs, are creditors to the extent of $41,000. The shareholders authorized an increase of the capital by 250,000 shares, par value $1, of which 100,000 shares will be sold at a discount. The General Assets has agreed to take stock at par for its claims, and the returns from the sale of the 100,000 shares will be used to make alterations to the mill and to provide complete electric equipment. It is understood, however, that there will be no money left over for working expenses, and that an additional $25,000 will be needed for this purpose.

The results obtained at the Dome during the period from April 1 to August 31 are as follows:

	Tons milled.	Gold produced.
April	9,863	$129,333
May	10,852	148,499
June	11,300	98,216
July	11,150	75,958
August	10,720	67,660
Total	53,885	$519,666

Working costs for the first five months of the fiscal year show a reduction of $1.09 per ton as compared with the figures published in the annual report, and in August the reduction was $1.55. Operating costs at the present time, including current development, are about $4 per ton, and when the addition to the mill is completed, they should show a further reduction. Good progress is being made with the installation of the additional 40 stamps to the mill. The concrete work has been finished and the erection of the steel has been started. The Company proposes in future to issue monthly statements covering tons of ore handled and gold recovered.

The management of the McIntyre mine states that the production for September will be in the neighborhood of 7500 tons. The new mill is in operation and satisfactory results are being obtained. In the Swastika district, both the Swastika and Lucky Cross mines have been closed. The former suffered from a shortage of both ore and money, and is not likely to be reopened, but it is stated that work will be resumed on the Lucky Cross in a short time. At Kirkland Lake, which lies only a few miles from Swastika, the Tough-Oakes property, formerly known as the Foster, has opened good ore to a depth of 200 ft. While cutting the station at the 200-ft. level, the porphyry was encountered, and, while it is not definitely known what effect this will have on the grade, it is the general opinion that the small high-grade veins, such as are found in this district, will not persist very far into that formation. Driving is being carried on at the 100-ft. level, and results to date have been satisfactory. This property has every appearance of being the most profitable one in the Kirkland Lake district, although it is probable that it will never be a large mine. Indications throughout the district point to there being only two or three compara-

tively small mines, and recent unsatisfactory developments in several properties have resulted in a decline in interest. In sinking the Burnside shaft, the porphyry was cut at a depth of about 35 ft., where the profitable ore was cut off. The shaft was continued vertically to a depth of 100 ft. and a cross-cut driven into the conglomerate to prospect a vein which showed on the surface. Where opened, there was 10 in. of high-grade ore, but sufficient work has not been done to justify any opinion as to its ultimate value. The results of future development on this vein will decide whether or not the property will be purchased by those holding the option, as the terms of the option call for a heavy payment to be made in a short time. On the Teck-Hughes property at the west end of Kirkland lake, development on the 100-ft. level of the No. 1 vein, which was found in the porphyry, proved disappointing, and it was decided to abandon this shaft and concentrate work on No. 2 and 3 veins, where ore of a satisfactory grade has been found on the surface. The ore-shoots, however, appear to be short, and it is doubtful if a sufficient quantity of ore can be developed to give a reasonable return on the capital which would have to be invested.

MELBOURNE, AUSTRALIA

MT. MORGAN.—NEW MT. LYELL ACQUISITION.—NORTHERN TERRITORY OIL.—VICTORIAN RETURNS.—NEW SOUTH WALES MINING LAW.—BROKEN HILL PROPRIETARY STEEL WORKS.

At the Mount Morgan mine, Queensland, work is being pushed for the introduction of pyrite smelting, which it has been decided to adopt, and it is anticipated that the first furnace will be blown in next March. Besides this new smelting plant, there is also being erected a concentrating plant capable of treating 500 tons of ore per day. This plant is to cost $268,000, and in the meantime an experimental unit is at work and is said to be surpassing expectations. In other words, the process of change to which this great mine has been subjected during the last decade is still in progress. It was in 1906 that its first copper plant was erected, and since then the mine has been regarded as mainly a producer of copper, despite its wonderful gold yield. Perhaps even the latest innovation will not prove to be final.

The Mt. Lyell company continues to absorb small properties near its own, and the latest to be acquired is the West Lyell, a mine sold many years ago in London under the high-sounding title of The Copper Mines of Mount Lyell West. The property was one of which a local satirist sang in lines that were quoted far and wide, where the Company's policy of employing three highly paid officials, a manager, a metallurgist, and an accountant, and merely beating time and development work:

"There are three to work above ground, and five to work below,
At the famous copper mines of Lyell West;
There are three to do the figuring, and five to find the show,
At the famous copper mines of Lyell West;
There are four to see the other four their duties do not shirk;
There are four whose mission 'tis to do the labor of a Turk;
There's a very fair division—four to boss, and four to work,
At the famous copper mines of Lyell West."

And so the poem went on to the humorous suggestion that there was room for many another well-paid official on the surface: a cook (presumably to cook the estimate of the value of the ore that was not there), a chaplain, and so on, and finished up with the suggestion that the services of the miners might be dispensed with. Now, this ground, on which about $96,000 was squandered, having been abandoned at last, has been acquired by the Mt. Lyell company, 'free, gratis, and for nothing.'

What looks like a shocking case of 'error' has been brought to light. Some months ago a company was formed in Melbourne to take up certain areas in the Northern Territory of Australia supposed to be petroliferous. An expert, who was sent to report on the concession, has reported these areas to be valueless. He states that "samples of petroleum of a superior quality, known as a paraffin base, and capable of producing an illuminating oil after refining, were brought to Melbourne about seven years ago. Under sworn declaration, it was stated to have come from a gorge 10 miles from Rocky Bar, a large tributary running into Shoal reach, as shown in the British Admiralty chart of the Victoria river. There was no difficulty in locating the spot designated in the declaration, after traveling thereto by saddle and pack-horses from the Victoria River depot, situated about 90 miles from the mouth of the river. After careful and close investigation of this neighborhood, I could not discover any indication whatever either of petroleum or oil-bearing formation." This sort of thing is unfortunately all too common in Australian mining.

The mineral returns for the state of Victoria for the year 1912, are late, as usual. They show a total decline of 9.4% on the figures for the previous year, the decline in gold, which in Victoria is all important, amounting to 4.7%. Coal has decreased 10% in tonnage and nearly 14% in value. There is nothing else of importance.

The New South Wales Mining (Amendment) Bill, 1913, now before the State Parliament, provides, *inter alia*, for

MAP OF EASTERN STATES OF AUSTRALIA.

depriving lessees of mineral leases of the statutory right to exemption from the performance of the labor conditions, to the extent of one month for every six-month period during which double the required labor was employed. The maximum period of exemption under this clause of the existing act is only six months, so that it would not have been thought any objection could be made. However, if the new bill becomes law, even that trivial degree of security will be taken away from the mining leaseholder. The reason put forward for the proposal to abrogate the right is that it is unnecessary, in view of the existence of a clause providing that suspension for six months may be obtained from the warden (mining magistrate) for any reasonable cause; but there is this difference, that under this clause an exemption is a favor, whereas under the existing act a lessee is entitled first to six months' exemption as a right, after which he is at the point at which he is now desired to be, as soon as work ceases on his property. Parliament should try to liberalize the leasing conditions, instead of seeking to still further restrict leaseholders.

Operations at the Broken Hill Proprietary Co.'s iron and steel works' site, near Newcastle, are going ahead rapidly and smoothly. The New South Wales Government is carrying out its part of the undertaking, having already dredged the river along part of the waterfront to a depth of 25 ft., where the previous depth was only 10 ft. At this point the Company is building a pier where the heavy machinery, which has been ordered, will be landed. Some parts of the rolling mill will weigh 40 tons. The traveling crane to be installed on the pier will have a capacity of 60 tons. This wharf is already connected with a temporary railway for the transport of the machinery to the various sites. At all of these the necessary foundations are now being built.

KALGOORLIE, WESTERN AUSTRALIA

MINES IN THE SOUTHERN CROSS DISTRICT.—KALGOORLIE COMPANIES INVESTING IN FOREIGN COUNTRIES.—SHAFT-SINKING ON THE 'GOLDEN MILE.'—YUANMI, VICTORIOUS, AND SONS OF GWALIA MINES AND MILLS.

The additional five stamps and tube-mill have been started at the Bullfinch mill, and from August 6000 tons will be treated monthly. The grade of ore mined will be considerably reduced, as the reserves, when the plant started, were estimated at 177,300 short tons, worth $11.08 per ton, whereas for the five months ended July 31 the grade treated has been $14.40 per ton. On December 31, 1912, the Company was in debt to the bank for $130,000, and to sundry creditors for $29,900, a total of $159,900. Since then a profit of $225,000 has been earned, so that the Company is getting into a strong financial position. With an output of 6000 tons at the reduced grade of $11.08 per ton, it is anticipated that the current rate of profit will be maintained, and that the Company will soon be in a position to pay dividends. The main orebody in the mine, known as No. 3 lode, is now striking northwest with the rocks of the district, and is being opened on all three levels of the mine. The original rich east and west ore-shoot, which yielded very rich ore nearly three years ago, does not appear to go down, and cannot be found below No. 2 level. Since starting the mill, late in April, the Corinthian North has treated 8889 tons, yielding $29,100, with $46,000 left in the residue. The mine is being equipped with an all-sliming plant of the same capacity and similar to the plant on the Bullfinch. This will be completed next month and is expected to be running regularly in October. When in full operation, a monthly profit of $24,000 is expected. The lode on this property extends on the surface a distance of 2650 ft., and for the 900 ft. proved at 100 ft. averages 17 ft. in width and $8.50 per ton in value. At 200-ft. the value for 250 ft. driven is $10.50, and in a winze below that level, as high as $18 to $21 per ton. This mine looks as if it would before long become one of the big properties of Western Australia.

Since abandoning the option on the Great Victoria mine near Southern Cross, the Great Boulder Proprietary Co. has been looking far and wide for a new property to succeed the Great Boulder when it is exhausted. It is now announced that an option has been secured on a mine on the Cleveland peninsula, Southeast Alaska, and that the engineer, Frank Leahy, is to take charge of operations. Up to date, fully a score of Western Australian mining companies have scattered profits earned in this state all over the world, and not one of their outside ventures has proved a success. The Great Boulder company has cash resources of fully $750,000, is still treating 18,000 tons of ore per month, yielding $235,000 and a profit of $125,000, and paying yearly dividends amounting to $1,312,500. On December 31, 1912, the ore reserves amounted to 731,300 short tons, of the recoverable value of $12.62 per ton, equal to 40 months supply for the mill. Richard Hamilton, the general manager, has apparently made up his mind that the lode has passed into the Golden Horse-Shoe for good, as shaft-sinking has been stopped for two years at 2880 ft., the lode having passed into the Horse-Shoe at a depth of 2480 ft. Another company which is widening its sphere of operations is the Associated, which has taken an interest in the Keeley mine, near Cobalt, in Ontario. This mine is reported to have opened a rich 3-in. silver vein. A mine with such a small vein would not be considered by any English company if situated in Australia. The Association mine during 1912 treated 125,169 tons of ore, yielding $805,000, and paid a dividend of $61,900. The ore reserves on March 31, 1913, were estimated at 500,000 tons, of a recoverable value of $6 per ton, or about four years' supply for the mill. The liquid assets on March 31 were $650,000. Since the year closed, the mill has been treating 10,800 tons per month, returning $64,200 and a profit of $6200. The deepest shaft at the Associated is only down 2285 ft., and it has been at a standstill for over two years. Since the present manager, Duncan McAulay, took control in September 1911, he has reduced the development expenditure from $1.08 per ton, or $11,000 per month, to 72c. per ton treated, or $7700 per month; but the whole of this expenditure has been at or near the surface. Mr. McAulay's policy seems to be a mistaken one. When one considers that some of the richest ore-shoots opened in the Golden Horse-Shoe or any other of the mines are now being developed at 2480, 2630, and 2780 ft., the moribund condition of the Associated is still more inexplainable. Even the Lake View Consols, which suspended sinking operations in February 1905, at 1845 ft., and did not resume sinking till seven years later, in April 1912, has now found that a mistake was made, as good ore is being opened at a depth of 2100 ft., to which depth both the shaft and a winze have now been sunk. In no other country in the world have directors in recent years suspended operations, on encountering a barren or impoverished zone, as they have done in Western Australia. The Kalgurli company is another example. In June 1910 the main shaft was completed to 1900 ft., and a new Fraser & Chalmers hoist, capable of hauling 2 tons from 3000 ft., had just been installed. Because the 1750-ft. and 1850-ft. levels subsequently proved unprofitable, the shaft has not been sunk one foot since.

At the Yuanmi mine, controlled by Bewick, Moreing & Co., the sulphide mill, that is to operate with the oxide mill, has just been started. The new plant consists of an Edwards duplex roaster with 60 rabbles, a No. 8 Krupp ball-mill, rotary drier, ore-bins, elevators, and conveyors, of 100-ton daily capacity. After being crushed and roasted, the ground sulphide ore joins the oxidized for regrinding, agitating in cyanide solution, and vacuum-filtration. A 100-hp. Crossley gas-engine has been added to the one of 200 hp. to drive the additional plant, and wood gas is supplied by a down-draft wood generator, which consumes ordinary 5-ft. lengths of firewood, in addition to scrap wood, chips, sawdust, etc. This generator was built at Hoskin's foundry, in Perth, and is claimed by Bewick, Moreing & Co. to be a Commonwealth generator. However, the Cambridge company, of England, which has all along had its generators made by Hoskins, assert in writing that it is an infringement of their patent, and is really a Cambridge. A lawsuit is pending. According to calculations based on figures issued by Bewick, Moreing & Co., this gas generator, consuming wood costing $3.84 per ton, effects a saving over a Crossley generator, consuming charcoal costing $14.16 per ton, of 74c. per ton of ore treated, or $74 per 100 tons treated. The proportion of wood consumed to charcoal is 171 to 100 tons. Although a fair proportion of the tonnage treated by the mill on the Associated Northern's Victorious leases, Ora Banda, during July, came from the stope above the intermediate drift between the No. 4 and 5 levels, and was worth $60 per ton; the average of the tonnage was only $4.52 per ton. G. M. Roberts concludes from this that the sulphide gold was lost and discarded with the residue. To make sure of this, 100 tons has been carted and railed to the Company's Kalgoorlie sulphide plant to make a thorough test. If the loss is confirmed, an Edwards roaster and Krupp ball-mill, on the lines of the new Yuanmi sulphide plant, will be installed at the Victorious. The cost of transporting the ore to Kalgoorlie is $3.60 per ton for the ore now being experimented with. No. 6 level in the Victorious has been driven 100 ft. in ore ranging from $16 to $21 per ton.

General Mining News

ALASKA

CORDOVA

There is considerable excitement at Seward and the western districts over the reported discovery of another gold-placer district. Gold valued at $1200 has been brought by Olsen and Getchell to Knik, which was recovered under difficulties. The location of the new placer find is northeast of the Matanuska coalfields and about 110 miles distant from Knik, and possibly a little farther from Chitina, *via* Willow creek and Copper Centre, and then along the Taxlina river to the mouth of the Nelchina river. The formation of the country is similar to all the placer camps of the North, being a mica-schist and limestone. Low, rolling hills, indicating an erosion which has formed the placers, are characteristic of the country. There is a scarcity of timber in the immediate region of the find, but there is plenty of water. Forty claims have been recorded at the Knik office, which include the Nelchina country. Knik is the nearest settlement and the logical gateway from

MAP OF ALASKA.

this district to the new camp, which is 110 miles from Knik and about 248 miles from Cordova.

JUNEAU

August operations of the mines on Douglas Island may be summarized as follows:

	Alaska Mexican.	Alaska Treadwell.	Alaska United.
Development in ore, feet.....	79	49	449
Development in waste, feet....	6	61	257
Broken ore, decrease, tons.....	11,817	11,529	1,607
Stamps working	120	540	240
Water power, days	30.7	24.3	24.0
Steam power, days	.....	5.6	13.1
Electric power, days	.....	12.2	.....
Ore crushed, tons	19,740	80,973	38,661
Concentrate treated, tons	413	1,647	890
Gold by amalgamation	$18,103	$102,426	$48,867
Gold by cyanidation	20,342	100,574	42,459
Total realizable value	38,060	200,971	90,414
Net profit	9,094	95,368	29,342

FAIRBANKS

During the summer, 85 men were employed at No. 17 Goldstream, and the season's clean-up is estimated at $136,000. Peterson, Craig, and Johnson control this property. Many men have returned to Fairbanks from the rush to the Shushana district, and declare that there was nothing to justify such a stampede. 'Pay' was found on only three claims; no townsite has been established, and all routes are difficult to travel over.

IDITAROD

Work at this centre has been retarded during the season owing to shortage of water. The Guggenheim dredge has operated steadily and its yield is said to be equal to the average. A dredge is to be constructed next spring by Riley and Marston.

NOME

The people of this place are working hard to get things in order again, but a great deal of damage was done by the flood, especially in destroying food supplies. The *Nugget* is printing a small sheet under difficulties. That paper of September 13 and 20 contains the following items: The estimated output of gold from seven 'outfits' on Jess creek will be $30,000 for the season. Over $9300 is claimed as wages by men working on a dredge at Windy creek, and a suit has been filed against Hugo R. Johnstone. A. H. Moore has about 45 men working on No. 3 Iron creek at sluicing, and results are encouraging. The Pioneer Mining Co. will prospect some of its claims during the winter, and No. 4 on Holyoke creek will be operated by F. R. Cowen and J. W. Ferguson. This is said to be the richest claim in the Nome district, and has been the cause of litigation. The property of the Golden Dawn Mining Co. is also rich, and now that litigation has been settled work will be continued through the winter. There are 175 people at Candle, and rich gravel was opened by A. Oleson on C bench of Candle creek. Nome was visited by a heavy storm on September 13, 1900.

ARIZONA

COCHISE COUNTY

According to the 1913 mining edition of the *Bisbee Daily Review*, a well arranged publication of 94 pages dealing with the mining industry of Arizona, there are approximately 25,000 men employed in mines, mills, and smelters in the state; the output of copper ore in the current year will be about 5,500,000 tons yielding 400,000,000 lb. of copper; there are six large copper-ore concentrating plants and eight smelters, the latter having an annual capacity of 421,000,000 lb. of copper; and the assessed valuation of all Arizona producing mines, exclusive of equipment, is $113,524,544. The publication deals with all phases of mining and other industries in Arizona, and should be of interest to mining men generally.

GILA COUNTY

The eighth unit of the Ray mill at Hayden is complete, and a total of 9000 tons per day can be treated. This last unit contains several new features, and the others will be remodeled on these lines. A No. 7 Cameron sinking pump is to be installed in the Reymert shaft, near Superior, where a large flow of water was recently opened.

GREENLEE COUNTY

The furnaces at the Arizona Copper Co.'s new smelter at Clifton are now running well, according to L. D. Ricketts. The furnace foundations were faulty and one of them 'froze up' recently.

MOHAVE COUNTY

At the Boundary Cone mine the west drift on the 520-ft. level shows 4 ft. of $70 gold ore. The property was recently visited by some shareholders, and a mill may be erected. On the 200-ft. level of the Pioneer, at Oatman, 8 ft. of $30 ore has been opened. The adit of the Hot Tamale, at Chloride, is in 400 ft. in good ore. A large shoot of $15 ore has been opened on the 100-ft. level of the Pittsburgh. Good shoots of silicious copper ore have been opened on No. 1 and 2 levels of the Pinkham, and shipments will be started soon.

CALIFORNIA

The oil industry of California is to be thoroughly studied and a report issued by the State Mining Bureau, under F. McN. Hamilton, state mineralogist. The work will contain full information upon every phase of the industry.

MONO COUNTY

The number of employes of the Standard Consolidated mine, at Bodie, has been considerably reduced, while it is probable that the hydro-electric power-plant will be sold to another company operating in Nevada.

NEVADA COUNTY

The Pennsylvania Gold Mining Co. is being sued for $50,000 by the widow of Greseppe De Bernadi, who was

killed in the Herman mine, operated by the Company, near Westville, Placer county, in March last.

Shasta County

It is reported in Redding that H. F. Wierum, consulting engineer for the Balaklala Copper Co., has secured a six months' extension of the option held on the Hall process. He will return to Coram and complete erection of the gas plant, which is being constructed in Los Angeles. The Mt. Bally Gold Mining Co. has opened 30 ft. of ore, 2 to 7 ft. wide, worth up to $20 per ton in gold, at its mine in the Whiskeytown district.

Sierra County

The Kate Hardy mine, about two miles from Forest City, will probably change hands shortly. At the Hardy Kate, the shaft being sunk to cut the south extension of the Kate Hardy vein, is down 265 ft., and a cross-cut will be driven about 30 ft. west from this point. A washing plant has been built at the Miners' Home gravel mine at Howland Flat, and work will be conducted with 20 men during the winter. The Wide Awake, White Bear, Red Ledge, and other claims are being actively worked.

Siskiyou County

The Black Bear mine is being developed by the Rollin Mining Co., which has a 100-hp. hydro-electric plant and air-compressor in operation. Development from the 460-ft. level is promising, and the 16-stamp mill will probably be in operation within 60 days, crushing the ore now being developed.

Tuolumne County

(Special Correspondence.)—Rich ore has been opened north of the shaft on the 300-ft. level of the Dutch mine, at Quartz, this week. The vein is streaked with gold, and no estimate can be made of the richness of the ore. The same shoot yielded a large amount of gold in past years, but was lost at the 400-ft. level, and it has not been worked above the 300-ft. level. The mine has for some years been under the management of C. H. Segerstrom, of Sonora, and has been a profitable producer. A few months ago it was decided to do extensive development work in the deeper workings, and to sink the shaft below its present depth of 1800 ft. Adequate equipment was installed to carry out the plans, and simultaneously the work of dewatering these levels was begun. The 1500-ft. level is now above water, and in a few weeks more the deep-mining campaign will likely begin.

The Springfield Tunnel & Development Co. proposes to increase its capital stock from $200,000 to $500,000, and a meeting of directors for this purpose will be held early in November. According to the best information obtainable, the Company has outlined extensive development. Local men are reopening the old Bonanza mine, situated in the northern part of Sonora, and will operate the property on a small scale. The property has produced several hundred thousand dollars, but has not been worked to any great extent in late years. The Tuolumne Deep Channel Mining Co., with a capital stock of $100,000, has filed articles of incorporation in this county. The directors are W. R. Groves, C. W. Heinecke, H. L. Prettyman, and W. S. Brown, all of San Francisco. Articles of incorporation of the Black Oak Mines & Mill Co. have been filed here. The capital stock is $1,000,000, with shares at $1 each, and the directors are G. Coonan, F. O. Harrington, B. Van Alstine, K. M. Pryor, of San Francisco, and H. C. Quackenbush, of Pierre, South Dakota.

Sonora, October 11.

COLORADO

The northern coal-mining companies of the state have increased the price of coal by $1 per ton on October 6, on account of the miners' strike in the southern fields, where the price has not been raised.

Clear Creek County

(Special Correspondence.)—A 10-in. vein has just been opened in the adit being driven in the McClellan mine on Leavenworth mountain. Assays show 375 oz. silver and 18% lead, and shipments have been started. J. Laffey is operating under lease. A. Robert, leasing on the Virginia City, on Lincoln mountain, is shipping carloads of ore which return a settlement of 145 oz. silver and 30% lead. Twelve men are employed in dismantling the old machinery at the Pelican mill preparatory to installing the Edison rolls. The new equipment has been ordered and will arrive during the next few days. J. B. Ballantine, engineer in charge, expects to be ready to start ore treatment early in January 1914. The new rails recently ordered for the Capital adit have arrived, and track laying will be started next week. The electric motor has arrived and there is considerable activity about the premises. This trolley system is being installed by the Onondago Mining Co. in lieu of being granted a right-of-way through the Capital workings. Electric drills are to be purchased for use at the Prudential property on Republican mountain. T. W. Cunningham and B. J. O'Connell will make the improvements, holding a lease on 750 ft. of ground to the west on the Magenta-Turner vein. Shipments are being made from the East Griffith mine on Griffith mountain. Operations are carried on through the adit-level, and stoping is in progress on a 6-in. streak of galena that mills $70 per ton in silver and lead. F. A. Maxwell is manager. David Kennedy, owner of the Centennial mine, has started a test shipment of 500 tons of ore which will be treated at the Capital mill. In the event that the anticipated results are obtained, a similar plant will be constructed.

Georgetown, October 7.

Gilpin County

The Bull Moose Mining Co. is working two shifts at the Richardson mine, in Russell district, and good ore is being extracted from the Bobtail vein. Smelting ore is valued at $30 to $40 per ton, and the mill 'dirt' returns 1.5 oz. gold per 'cord' (8 tons). The Pine Comb group in the Wide Awake district is being developed by Missouri people. The Bates Leasing Co., in Chase gulch, shipped over 100 tons of ore to the Iron City mill for concentration, and four tons of smelting ore to the sampling works. In Silver creek, the Reform adit is to be driven to 250 ft. Ore shipments average up to $52 per ton. Sylvanite ore has been opened in the Hot Tamale lode in Silver creek, and the Golden Rod Mining Co., of Chicago, will prospect its claims this winter. The U. P. R. mill produced 110 oz. of $17 gold last week. Shipments of ore and concentrate from Black Hawk during September totaled 3175 tons.

Gunnison County

Mining in the Pitkin district has not been very active during the current year. On Gold creek the Carter Tunnel is the only large adit property doing any amount of work. The adit is in 7731 ft., and from the end of this Carrol M. Carter is driving a four-compartment raise 1100 ft. to connect with the old Volunteer shaft, which is 300 ft. deep. A few small veins have been cut. Little can be said regarding the Raymond, Gold Links, Balzora-Bassick, Sandy Hook, and others on the creek, as not much development has been done this summer. It is well known that these properties could be worked profitably.

On Quartz creek the Brant Independent Mining Co. has been busy all summer on the Copper Mountain adit, which is being driven to cut the Roosevelt vein. This adit is in about 1700 ft., and although a large vein was cut, it was not the Roosevelt vein, and the adit will be continued until it reaches the objective point. The Fremont is also being developed by local men.

Ouray County

The Revenue mine will be operated during the winter. C. R. Wilfley states that the Barstow mine will be shut down indefinitely, as the ore reserves are almost exhausted. Since 1909, the output has been $300,000.

San Juan County

The Silver Lake property, near Silverton, has been leased by the American Smelting & Refining Co. to Messrs. Mears, Pitcher, and Slattery. About 100 men will be employed in this well developed lead mine. Steady work is going on at the Kittimac, Queen Ann, Mayflower, and King mines, and by various syndicates.

TELLER COUNTY (CRIPPLE CREEK)

On October 20 the Portland Gold Mining Co. will distribute a dividend of 2c. per share, equal to $60,000, making a total of $9,397,080 to date. There are 30 sets of lessees at the Stratton Estate mining over 2000 tons of ore per month. During September the Gaylord mill treated 1200 tons of $3.50 ore with 80% extraction.

The Carbonate Queen claim of 10 acres, on Battle mountain, has been acquired by the El Oro Mining & Milling Co. for $75,000. A shaft is down 600 ft., and 3000 ft. of development has been done, the yield being about $100,000. The Arkansas Valley Railway, Light & Power Co. has a coal reserve of nearly 18,000 tons to provide against a possible shortage due to the strike of coal miners. This

MAP OF CRIPPLE CREEK DISTRICT.

power company supplies 7000 hp. to the district, including pumps at the Golden Cycle mine, 10 different ore-treatment plants, 22 electric hoists ranging from 5 to 175 hp., 14 air-compressors, and many small motors. The hoist safety device invented by C. R. Welch, of the Portland mine, had a satisfactory test during the past week at No. 2 shaft of that property. The engine was run 'wild,' but was automatically checked with plenty of spare room.

IDAHO

Robert N. Bell, state mine inspector, was recently in Wallace, Shoshone county, and stated that there was considerable activity in Blaine county.

BLAINE COUNTY

The geological formations and topography of this county were recently described in a special issue of the *Wood River Times*, of Hailey, by Stewart Campbell. He says that Blaine county being situated in the south-central part of the state, comprises almost the entire southern drainage area of the Boulder mountains, a branch of the Sawtooth range which projects from the general mountain area into the wide open country of southern Idaho known as the Snake river desert. The drainage is all tributary to the Snake river, having a general southern course conforming with the trend of the range. Throughout the greater part of the county the mountains rise from 500 to 3000 ft. above the valleys on the southern border and reach an elevation of from 9000 to 12,000 ft. above sea-level, where they culminate into peaks and ridges at the watershed. The most notable is Mt. Hyndman, with an elevation of 12,048 ft., being the highest peak in Idaho. In its structure, the geology of Blaine county is complicated. The oldest rocks are sedimentary in origin, consisting of limestones, sandstones, quartzites, shales and slates. Ore deposits occur in many parts of the county, the principal districts being Smoky, Wood River, Muldoon, Lost River, and Boulder. Each district is a comprehensive study in itself. The principal minerals are galena and zincblende, containing silver and gold. The veins occur both in the lime and granite. Since the deposition of the orebodies there has been a general upheaval and readjustment which has faulted all of the veins, thus causing extensive and skillful prospecting to be carried on continuously if the mines are to be permanent producers. Due to this faulting and unskilled operations, the majority of the mines in the county are at present lying idle, but the day is not far distant when they will again become steady producers. The Wood River mining district is that part of Blaine county drained by Big Wood river, lying south of Ketchum, east of the Smoky and Big Wood River divide, and west of the Big and Little Wood River divides. The principal towns are Hailey, with an elevation of 5333 ft.; Ketchum, which is situated 12 miles farther north, with an elevation of 5823 ft.; and Bellevue, which is five miles south of Hailey, with an elevation of 5150 ft. The principal mines are situated on the west side of the river, the silver-lead veins occurring in both limestone and granite. From 1879 to 1890 the annual production was about $1,500,000, when, with the decline in price of silver the camp was nearly shut down. The total production from the district to date amounts to over $60,000,000.

The area including the Wood River mining district is situated near the contact of the early Carboniferous formation, and the later granite intrusion with the former occupying the larger area. The sedimentary rocks consist of limestone, sandstone, quartzite, shale, and slate; the granite intrusion is quartz-diorite and granite. The intrusive character of the granite is apparent and shows plainly at all contacts. The veins in the Wood River district occur both in the sedimentary and granite area, the principal mines, however, being in the sedimentary formation. All of the veins have a general northwest and southeast strike, with a dip to the south of from 30 to 60°, and vary in width from a few inches to 40 ft. The walls are generally well defined and are often highly polished. In the Star mine, situated on the west side of Wood river, between Hailey and Bellevue, the vein cuts through both the sedimentary and granite area and seems to carry the same mineralization in each rock. The principal mineral in all of the veins is galena, containing also silver and zincblende. The principal gangue is siderite, calcite, and occasionally quartz and ground-up country rock. The ore forms regular lenticular bodies of solid galena to irregular masses of galena and country rock, but as a general rule the ore is clean enough to be shipped without milling, except when combined with zincblende. The veins are faulted and seldom continue for any great depth until the orebodies are intersected with a fault plane, thus compelling continuous and intelligent prospecting to be carried on ahead of the ore extraction. Due to the fact that many of the veins are faulty and practically all of the mines were poorly managed, the district is stagnant and there is not much development that shows intelligent operation. The mines that were intelligently developed have been worked to a considerable depth and have been continuous producers, which proves the fact that the orebodies are permanent in depth and that all the district needs is intelligent operators.

SHOSHONE COUNTY

The negotiations under way for a settlement of the suit pending between the Caledonia and Bunker Hill & Sullivan companies appear to have been practically completed. In the event of the final consummation of negotiations, the Caledonia is to be granted the right to run an incline raise from the Kellogg tunnel of the Bunker Hill to the Caledonia workings, thereby giving the former company an additional 300 ft. of depth to its orebodies, the Caledonia ores to be trammed out through the Kellogg tunnel on the electric line of the Bunker Hill, and the Caledonia is to

have a lease on one unit of the east mill of the Bunker Hill. In consideration for these concessions, the Bunker Hill company is to receive stock in the Caledonia company.

MONTANA

Silverbow County

During the last ten days of September the Butte & Superior mill treated 1130 tons of ore per day, and the total yield of zinc concentrate for the month from 30,870 tons of ore was 5777 tons, an increase of 225 tons over August. The average extraction was 90.09%, and the concentrate assayed 52.27% zinc.

NEVADA

Esmeralda County

The enlarged and timbered shaft at the Oro mine is now below 500 ft. in silicious rock containing pyrite. On the 500-ft. level of the Blue Bull, a cross-cut has developed 6 to 14 in. of $15 to $45 gold ore, with some silver and copper. The 700-ft. cross-cut has also opened the Victor vein. Three to four feet of $16 ore is being developed on the 300-ft. level of the Victor mine of the C. O. D. Consolidated. From the Jumbo Extension's property 45 tons of ore per day is shipped to the Bonnie Claire mill. Development at the Sandstorm-Kendall is showing promising results. Water has interfered with sinking the 500-ft. level winze. At 670 ft. east of the Kendall shaft, on this level, the cross-cut has passed through 20 ft. of ore, 7 ft. of which is worth $2 to $5 and a small streak on the foot-wall assays $44 per ton.

Mineral County

A large vein of high-grade cinnabar has been opened at Cinnabar by Al. Drew, and the district is much interested. The quarries of the Nevada Black & Gold Marble Co., of Denver, at Mina, have been sold, and considerable equipment will be installed.

Nye County

The No. 4 hole of the Railroad Valley Co. was drilled 763 ft. in 62 hours, and at 660 ft. passed through the formation mentioned in this journal of October 4. No. 5 hole is being drilled 1¼ miles from No. 4, and was to have been finished last week.

At Manhattan, the tusks and skeleton of a mastodon or some similar animal were unearthed at the Thomas placer claim at a depth of 70 ft. The main gulch is yielding gravel averaging $4.60 per cubic yard. The White Caps lessees' dump contains 1400 tons of $16 ore, and 35 tons per day is being added to it. The east ore-shoot is being mined from the 165 to 300-ft. level and is 125 ft. long. High-grade ore is still being extracted from the Manhattan Crescent, and the Reilly Fraction operators have treated 12,000 tons. About $9 per shift is being won from the Dexter No. 14 placer claim near the town.

The mines at Tonopah produced 11,731 tons of ore, worth $277,250, during the week ended October 11. The West End mill yielded 28,335 oz. bullion and 28 tons of concentrate in September, and the Extension $51,200 from 4847 tons of ore.

OREGON

Baker County

The Sumpter dredge of the Powder River Gold Dredging Co. has been in continuous operation for 10 months and is handling 8000 cu. yd. per day of 24 hours. A total of 450 hp. is used by the various motors, and the gold production is reported to be satisfactory.

UTAH

Juab County

The new mill for the Knight interests has been started and will treat ore from the Colorado, Iron Blossom, and Black Jack mines.

Salt Lake County

The United States Smelting, Refining & Mining Co. has acquired the Last Chance mine at Bingham, at a price stated to be about $100,000. The property is a valuable one and has produced $1,500,000 in gold, silver, and lead. It has been developed by three adits, the lower of which is 3200 ft. long.

The Lost Packer Mining Co., which operates a rich copper mine and smelter in the summer only in Custer county, Idaho, has declared a dividend of 25c. per share.

WASHINGTON

Ferry County

Further litigation is probable between J. L. Harper, R. A. Koontz, J. L. McCormick, S. L. Boyer, and others who are interested in the Republic Mines Corporation, Imperator-Quilp Mining Co., and North Washington Power & Reduction Co., with interests in the Republic district.

Stevens County

The Copper King mine at Chewelah is shipping ore to the Granby smelter at Grand Forks, British Columbia, and returns leave $12 per ton net. The vein being mined is 23 ft. wide. At the United Copper the lower adit is in 2700 ft., and small veins of copper ore have been cut. Eighty men are employed at the mine and mill.

CANADA

British Columbia

The Hedley Gold Mining Co. has increased the wages of employes 25c. per day, taking effect on September 1. The Granby Consolidated Mining, Smelting & Power Co., with mines at Phoenix and Hidden Creek, and a smelter at Grand Forks, produced 22,688,614 lb. copper, 324,336 oz. silver, and 47,266 oz. gold, worth $4,782,691, during its fiscal year ended June 30, 1913. The net profit was $1,214,599, dividends paid were $449,955, and surplus $683,149. The total surplus is $3,199,271. Ore reserves at Phoenix have not been fully maintained, and are 5,613,000 tons, containing 17.68 lb. of recoverable copper. At Anyox (Hidden Creek properties) the reserves are 7,759,000 tons of 2.2% ore, and the 2000-ton smelter here will commence early in 1914. During the week ended October 7, the Grand Forks smelter treated 22,979 tons of ore, yielding 262,000 lb. of copper, and for the year to date 945,529 tons and 16,609,997 lb., respectively.

Ontario

During September the Nipissing high and low-grade mills treated 156 and 6879 tons of ore, respectively, and the refinery produced 728,204 oz. silver valued at $442,588. The

NIPISSING MILL, COBALT.

monthly report shows that the hydraulic giant is working on Keewatin between veins 19 and 22. The diamond-drill is on its third hole in the diabase of 408 near the Nova Scotia. No new veins were cut in the mine. A drift near the surface of No. 8 shows the vein to be 2 to 8 in. wide, consisting mainly of calcite and smaltite, averaging low-grade ore.

At Porcupine, the Hollinger mill treated 12,264 tons of ore during the four weeks ended October 8. This averaged $17.80 per ton with 96.4% extraction, giving a profit of $145,867. Working costs averaged $5.18 per ton. The 425-ft. level is proving quite satisfactory, and the shaft will be sunk to 550 feet.

KOREA

Details of the August clean-up of the Oriental Consolidated stamp-mills and cyanide plants, which treated 27,962 tons of ore, are as follows: Tabowie mill, $29,601; Taracol

mill, $21,148; Kuk-San-Dong mill, $5545; Maibong mill, $15,650; Candlestick mill $7010, Taracol tube-mill, $59,233, Kuk-San-Dong cyanide plant, $5163, Kuk-San-Dong dump plant, $3455, and Candlestick cyanide plant, $1914; making a total of $148,714.

The rainy season is now over, and there has been an unusually small amount of rain this year, at present there being but 15 ft. of water in the Chorrie reservoir, or sufficient for a week's full run for the electric-power plant. Owing to the small amount of rain, the plants could operate at full efficiency during August, as there was no trouble with water in the mines. All plants ran steadily during August except the Kuk-San-Dong dump plant, which was closed the first 18 days of the month owing to lack of liners for the tube-mill. The extraction for August in the Taracol tube-mill was 87.2 per cent.

The September clean-up at the Oriental Consolidated mills was worth $131,855.

MEXICO

SONORA

The Lucky Tiger-Combination Gold Mining Co., operating at El Tigre, reports that exploration work with diamond-drills has been done in the Gold Hill portion of the mine, and later followed the most favorable indication by a cross-cut from the second level on the Tigre vein, which resulted in the following message from the general manager, L. R. Budrow, on September 26: "Cut vein in cross-cut from Brown shaft, 20 in. wide, assaying 295 oz. silver and 3 to 10 oz. gold ($193) per ton. Selected samples assay 800 oz. silver and 4 to 10 oz. gold ($488) per ton. Its extent is unknown, but the lode looks exceedingly promising. Shall commence to drive on the lode and cross-cut from the third level (100 ft. below second level)." This is an entirely new vein, about 150 ft. east of and parallel with the Tigre vein, as is also the Sooy vein on the west. Some of the richest ore was opened around the Brown shaft and Gold Hill on other levels, and present indications add greatly to the value of the property. Notwithstanding the political difficulties existing in Mexico, the district in which the property is situated has been exceedingly quiet throughout the entire year.

NICARAGUA

The Bonanza and other mines have been sold to the Canadian Agency, Ltd., of New York, the transfer taking place on October 10.

Schools and Societies

COLUMBIA UNIVERSITY will hold on May 27, 28, and 29, 1914, at New York, a celebration of the fiftieth anniversary of the founding of the Columbia School of Mines. The present plans provide for three days of a social, academic, and historical character, but any other suggestions will be gladly received from those interested.

The POLYTECHNIC EVENING HIGH SCHOOL of Los Angeles opened on September 15. The department of chemistry is under the direction of M. S. Moore. The curriculum for the four half-years is: mineralogy and mining chemistry; introductory geology and mining chemistry; mining geology, mining, and ore dressing; metallurgy and mine engineering, respectively.

The AMERICAN PETROLEUM SOCIETY was organized September 10 at the Experiment Station of the U. S. Bureau of Mines, Pittsburgh, Pennsylvania. This organization is the result of an effort of the Bureau for the past seven years to bring together the men interested in the petroleum industry. The final organization was completed on September 10. This society will concern itself with the study of all phases of natural gases and petroleum, including the origin, statistics, conservation, drilling methods, production, transportation, storage, refining, and specifications for refined products. The first annual meeting will be held at a place to be selected in the spring of 1914, and the second in San Francisco in 1915.

Personal

Professional men are invited to send news of their engagements and travels. Such news is interesting to friends.

STANLEY DE LA MARE is in London

CHARLES HUTTERS is in New York City.

M. K. ROGERS was in San Francisco recently.

R. H. CHAPMAN has left Yerington for Washington, D. C.

G. M. COLVOCORESSES is in the West on professional work.

GEORGE I. COHN has returned from Charcas to New York City.

SYDNEY H. BALL returned to New York from Europe recently.

W. BODYCOAT is with the Abosso Gold Mine, of Abosso, West Africa.

N. NESTOR-SHERMAN is with the Tata Iron & Steel Co., Ltd., of Sakchi, India.

C. W. PURINGTON expects to arrive in London from the Lena gold district about October 10.

ROBERT LINTON, who has been examining properties in Gunnison county, Colorado, has gone to New York.

E. C. ECKEL and E. E. ELLIS were in New York last week to testify in the Steel Corporation dissolution suit.

R. P. MCLAUGHLIN will study the water situation in the oilfields of California for the State Mining Bureau.

SIMON GUGGENHEIM, MURRY GUGGENHEIM, and M. H. DODGE returned from Europe on the *Imperator*, October 9.

E. K. SOPER has returned to the University of Minnesota from Coahuila, Mexico, where he has been during the past year.

JAMES IRVING recently made an examination of the Arizona Venture Co.'s property situated in Mohave county, Arizona.

R. M. SYLVESTER, general manager for the Granby Power, Light & Smelting Co., has been made a director of the corporation.

N. M. MUIR has left San Francisco to become superintendent for the Arizona Belmont Mining Co., at Silverbell, Arizona.

LEON PERRET, general manager for the Lenskoi Gold Mining Co., has engaged R. E. SMITH as his chief technical assistant.

A. J. EVELAND has severed his connection with Hornblower & Weeks and will hereafter devote his time to consulting work, with offices at 42 Broadway, New York City.

CHARLES HAYDEN and D. C. JACKLING have been in Butte inspecting the Butte & Superior property. They left there for Seattle enroute to the mines of the Alaska Gold Mining Company.

A. H. LAWRY, general manager of the Montana-Tonopah Mines Co., is at Pearce, Arizona, inspecting the new mill of the Commonwealth Mining Co., a subsidiary of the Nevada company.

RICHARD B. STANFORD, formerly manager and consulting engineer for the Bonanza mine, Nicaragua, is now in New Orleans. ORVIL R. WHITAKER, of Denver, is consulting engineer for the Canadian Agency, Ltd., of New York, which has recently acquired this property.

Obituary

EUGENE A. BYRNES, a prominent patent attorney of Washington, D. C., and a charter member of the American Electrochemical Society, died on August 1, at Haven, Maine, where he had gone for his vacation.

WILLIAM R. DAVEY, of Lake City, Colorado, died at Portland, Oregon, September 11, from pneumonia, following an operation for appendicitis. He was 39 years of age, and a graduate of the Colorado School of Mines, class of 1898. For several years he had been in the federal government employ, at first in the Forest Service in Colorado, and for the past four years as a mineral inspector for the General Land Office in the First Field Division, embracing Oregon, Washington, and Idaho.

The Metal Markets

LOCAL METAL PRICES

San Francisco, October 16.

Antimony	12—12½c	Quicksilver (flask)	$39
Electrolytic Copper	17¼—17⅜c	Tin	44—45½c
Pig Lead	4 60—5.55c	Spelter	7—7½c

Zinc dust, 1400 lb. casks, per 100 lb., small lots $9.50—9.75; large $7.50—8.50

EASTERN METAL MARKETS.

(By wire from New York.)

NEW YORK, October 16.—The copper market is weak, with little or no demand. The copper stocks are generally weak and, with underlying conditions unchanged, there is no reason to expect anything more than a fractional change in the market. The London market is firm with spot and futures at £71 13s. 9d. New York quotes electrolytic at from 16.50 to 16.87, Lake 16.75 to 17, and castings 16.37 to 16.75. The lead market is weak. Ordinarily this is the busy season of the year, but the uncertainty due to the new tariff has unsettled the business to some extent. A conservative policy is being generally pursued. Zinc is weak and but little trading is reported.

SILVER

Below are given the average New York quotations, in cents per ounce, of fine silver.

Date.		Average week ending	
Oct.	9 ..... 60.87	Sept.	3 ..... 59.60
"	10 ..... 60.87	"	10 ..... 59.58
"	11 ..... 61.25	"	17 ..... 60.20
"	12 Sunday	"	24 ..... 61.59
"	13 Holiday	Oct.	1 ..... 61.68
"	14 ..... 61 37	"	8 ..... 61.27
"	15 ..... 61.25	Oct.	15 ..... 61.12

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	56.25	63.01	July	60.67	58.70
Feb.	59.06	61.25	Aug.	61.32	59.32
Mch.	58 37	57.87	Sept.	62 95	60.53
Apr.	59.20	59.26	Oct.	63.16	....
May	60.88	60.21	Nov.	62.73	....
June	61.29	59.03	Dec.	63.38	....

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.		Average week ending	
Oct.	9 ..... 4.42	Sept.	3 ..... 4.75
"	10 ..... 4.40	"	10 ..... 4.78
"	11 ..... 4.40	"	17 ..... 4.73
"	12 Sunday	"	24 ..... 4.69
"	13 Holiday	Oct.	1 ..... 4.61
"	14 ..... 4.40	"	8 ..... 4.33
"	15 ..... 4.40	"	15 ..... 4.40

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	4.43	4.28	July	4.71	4.35
Feb.	4.03	4.33	Aug.	4.54	4.60
Mch.	4.07	4.32	Sept.	5.00	4.70
Apr.	4.20	4.36	Oct.	5.08	....
May	4.20	4.34	Nov.	4.91	....
June	4.40	4.33	Dec.	4.20	....

COPPER

Quotations on copper as published in this column represent average wholesale transactions on the New York market and refer to electrolytic copper. Lake copper commands normally from 1-5 to 1-4c. per lb. more. Prices are in cents per pound.

Date.		Average week ending	
Oct.	9 ..... 16.20	Sept.	3 ..... 15.69
"	10 ..... 16.15	"	10 ..... 16.32
"	11 ..... 16.10	"	17 ..... 16.44
"	12 Sunday	"	24 ..... 16.41
"	13 Holiday	Oct.	1 ..... 16.29
"	14 ..... 16.05	"	8 ..... 16.27
"	15 ..... 16.05	"	15 ..... 16.11

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	14.09	16.54	July	17.19	14.21
Feb.	14.08	14.93	Aug.	17.49	15.42
Mch.	14.68	14.72	Sept.	17.56	16.23
Apr.	15.74	15.22	Oct.	17.32	....
May	16.03	15.42	Nov.	17.31	....
June	17.23	14.71	Dec.	17.37	....

The expected effect of the Copper Producers' report in stimulating copper buying entirely failed to materialize, and the market was duller at the end of last week than it was at the beginning. On October 6 copper was being offered at 16¾c. without bringing out any domestic buyers, though sales for export were made. The large producers pegged the quotation at 16⅞c., but metal was available at the lower figure up to January. On October 7 nothing was done except wait for the statistics. When the figures came out buyers exhibited as little interest as before, and the situation remained unchanged. On October 10 small dealers were offering small lots at 16¼c. without doing much business. The big sellers adhered to the price of 16⅞c. without reporting any sales. The price in London declined, standard G. M. B. warrants closing at £71 5s. for spot and futures. The exports from New York for the week ended October 9 amounted to 5763 tons, or 8442 tons since October 1, as compared with 10,442 tons since last year. Whether this is the beginning of a decline in European consumption it is too soon to judge.

The following figures supplied by L. Vogelstein & Co., show the movements of copper in Germany from January to July, inclusive:

Imports	134,293
Exports	6,010
Consumption	128,283
Consumption during similar period of 1912	120,071
Imports from United States in 1913 period	115,349

ZINC

Zinc is quoted as spelter, standard Western brands, St. Louis delivery, in cents per pound.

Date.		Average week ending	
Oct.	9 ..... 5.32	Sept.	3 ..... 5.63
"	10 ..... 5.27	"	10 ..... 5.65
"	11 ..... 5.27	"	17 ..... 5.59
"	12 Sunday	"	24 ..... 5.50
"	13 Holiday	Oct.	1 ..... 5.39
"	14 ..... 5.27	"	8 ..... 5.24
"	15 ..... 5.27	"	15 ..... 5.28

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	6.42	6.88	July	7.12	5.11
Feb.	6.50	6.13	Aug.	6.96	5.51
Mch.	6.57	5.94	Sept.	7.45	5.55
Apr.	6.63	5.52	Oct.	7.36	....
May	6.68	5.23	Nov.	7.23	....
June	3.88	5.00	Dec.	7.09	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California, being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending			
Sept.	17 ..... 39.50	Oct.	1 ..... 39.50
"	24 ..... 39.50	"	8 ..... 39.50
		"	15 ..... 39.00

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	43.75	39.37	July	43.00	41.00
Feb.	46.00	41.00	Aug.	42.50	40.50
Mch.	46.00	40.20	Sept.	42.12	39.70
Apr.	42.25	41.00	Oct.	41.50	....
May	41.75	40.25	Nov.	41.50	....
June	41.30	41.00	Dec.	39.75	....

TIN

New York prices control in the American market for tin, since the metal is almost entirely imported. San Francisco quotations average about 5c. per lb. higher. Below are given average monthly New York quotations, in cents per pound:

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	42.53	50.45	July	44.25	40.70
Feb.	42.96	49.07	Aug.	45.80	41.75
Mch.	42.58	46.95	Sept.	48.64	42.45
Apr.	43.92	49.00	Oct.	50.01	....
May	46.05	49.10	Nov.	49.92	....
June	45.76	45.10	Dec.	49.80	....

Tin statistics at the beginning of October, 1913, showed many contradictory features, according to L. Vogelstein & Co. In the first place, and as the principal if not the only favorable factor, it is to be noted that the visible supply at September 30 this year is nearly 300 tons smaller than at the corresponding date of 1912, and the price £43 per ton or about 10c. per pound lower. The exact figures being 13,245 and 12,943 tons, £231 and £188 per ton in London, and 51 and 41c. per pound in New York, respectively. The net supplies were 3890 tons and deliveries 2996 tons for the nine months ended September 30 this year. While conceding that the drastic price reduction has partly if not wholly discounted the changed position, the trade is not hopeful of any permanent or extensive advance until the trend of events has taken a more favorable turn; that is, until the position begins to improve instead of uniformly getting worse as seems to be the case at present. Unfortunately, no such favorable change is in prospect, and we do not look for other than a fluctuating market over the immediate future. Meanwhile the position is not unsound.

The Stock Markets

SAN FRANCISCO STOCKS AND BONDS

(San Francisco Stock and Bond Exchange.)

BONDS

October 15.

Listed.	Bid	Ask	Unlisted.	Bid	Ask
Associated Oil 5s	$ 99¼	99½	General Petroleum 6s	$ 52	54
E. I. du Pont 4½s	85¼	87½	Natomas Deve. 6s	60	—
Natomas Con. 6s	—	75	Pac. Port. Cement 6s	93½	—
Unlisted.			Standard Cement 6s	90	—
Ass. Oil 5s	76¼	—	Santa Cruz Cement 6s	83	—

STOCKS

Listed.	Bid	Ask	Unlisted.	Bid	Ask
Amalgamated Oil	75	78	Mascot Copper	—	2¼
Associated Oil	38½	—	Noble Electric Steel	2¼	—
Giant	86½	—	Natomas Consol.	5	10
Pac. Cst Borax, com	—	100	Pacific Port. Cement	63	75
Pacific Crude Oil	—	35c	Riverside Cement	45	—
Sterling O. & D.	65c	1.10	Santa Cruz Cement	35	—

NEVADA STOCKS

(By courtesy of San Francisco Stock Exchange.)

San Francisco, October 16.

Atlanta	$ .14	Mizpah Extension	$ .31
Belcher	.40	Montana-Tonopah	1.14
Belmont	7.00	Nevada Hills	.78
Big Four	.25	North Star	.36
Cash Boy	.07	Ophir	.20
Florence	.22	Pittsburg Silver Peak	.42
Goldfield Con	1.45	Round Mountain	.41
Goldfield Oro	.07	Sierra Nevada	.09
Halifax	1.30	Tonopah Extension	1.60
Jim Butler	.60	Tonopah Merger	.55
Jumbo Extension	.09	Tonopah of Nevada	4.75
MacNamara	.10	Union	.10
Mexican	1.12	West End	1.37
Midway	.42	Yellow Jacket	.33

COPPER SHARES—BOSTON

(By courtesy of J. C. Wilson, Mills Building.)

October 16.

	Bid	Ask		Bid	Ask
Adventure	$ 1½	1¾	Mohawk	$ 39	40
Allouez	33	34	North Butte	23	23¼
Calumet & Arizona	62	62½	Old Dominion	47	48
Calumet & Hecla	405	410	Osceola	76½	78
Centennial	12	12½	Quincy	57	58
Copper Range	38	38½	Shannon	6½	7
East Butte	11½	12	Superior & Boston	2½	2¾
Franklin	3	3¼	Tamarack	26	27½
Granby	70	70¾	U. S. Smelting	36	36½
Greene Cananea	29	30	Utah Con.	8¾	9
Hancock	16	17	Victoria	1½	1½
Isle-Royale	17½	18	Winona	2	2¼
Mass Copper	2	2¾	Wolverine	40¾	42

NEW YORK CURB QUOTATIONS

(By courtesy of E. F. Hutton & Co., Kohl Building.)

October 16.

	Bid	Ask		Bid	Ask
Braden Copper	7	7⅛	McKinley-Dar.	1¼	1½
B. C. Copper	2⅝	2¾	Mines Co. Am.	2	2¼
Davis-Daly	1½	1¾	Nipissing	8⅜	8½
Dolores	2	4	Ohio Copper	⅜	½
El Rayo	1	2	San Toy	18	22
Ely Con.	5	7	Sioux Con.	1	2
First Nat.	2¾	3¼	So. Utah	⅛	¼
Giroux	1⅛	1½	S. O. Calif.	183	187
Greene Can.	5½	6½	Tri Bullion	⅛	¼
Hollinger	17	18	Tuolumne	½	⅝
Iron Blossom	1.20	1.30	United Copper	¼	¾
Kerr Lake	3⅞	4	Wettlaufer	7	8
La Rose	1⅞	2	Yukon Gold	3	3¼
Mason Valley	3¼	3¾			

NEW YORK STOCK EXCHANGE

(By courtesy of J. C. Wilson, Mills Building.)

October 16.

	Bid	Ask		Bid	Ask
Alaska G. M.	$ 21⅜	21⅝	Miami	21⅜	22
Amalgamated	70⅜	70⅞	Nat. Lead	43¼	44
Anaconda	34	34¼	Quicksilver, com	2	2¼
A. S. & R.	51⅝	61⅞	Ray Con.	18¼	18⅜
Calif. Pet.	17¼	18¼	Tenn. Copper	29⅜	29½
Chino	38⅜	38½	U. S. Steel, pfd	104½	105
Guggenheim Ex.	42⅜	43¼	U. S. Steel, com	53⅜	53⅝
Mexican Pet	64	65	Utah Copper	51	51½

LONDON QUOTATIONS

(By cable, through the courtesy of Catlin & Powell Co., New York.)

October 16.

	£	s.	d.		£	s.	d.
Alaska Mexican	1	17	6	Kern River Oilfields	0	7	6
Alaska Treadwell	8	2	6	Mexico Mines	5	15	0
Alaska United	3	15	0	Messina	1	8	9
Arizona	1	18	9	Oroville	0	6	3
California Amalg	0	2	6	Pacific Oilfields	0	2	6
California Oilfields	6	5	0	Rio Tinto	78	17	6
Camp Bird	0	15	0	Santa Gertrudis	0	18	9
El Oro	0	15	0	Stratton's	0	2	6
Esperanza	0	17	6	Tanganyika	2	7	6
Granville	0	11	3	Tomboy	1	5	0

AUSTRALASIAN

October 16.

	£	s.	d.		£	s.	d.
British Broken Hill	1	17	6	Mount Boppy	0	16	9
Broken Hill Prop	1	16	9	Mount Elliott	4	17	6
Golden Horse-Shoe	2	13	9	Mount Lyell	1	18	9
Great Boulder Prop	0	13	9	Mount Morgan	3	11	3
Ivanhoe	3	0	0	Waihi	2	15	0
Kalgurli	1	16	9	Waihi Grand Junc	1	3	9

Petroleum Production in 1912

By David T. Day

*The output during the year amounted to 222,113,218 bbl. The output, value, and average price per barrel, according to states, is as follows:

State.	Quantity.	Value.	Per bbl.
California	86,450,767	$39,213,588	$0.454
Colorado	206,052	199,661	0.973
Illinois	28,601,308	24,332,605	0.851
Indiana	970,009	885,975	0.913
Kansas	1,592,796	1,095,698	0.688
Kentucky	484,368	424,842	0.877
Louisiana	9,263,439	7,023,827	0.758
New York	874,128	1,401,880	1.604
*Ohio	8,969,007	12,085,998	1.347
Oklahoma	51,427,071	34,672,604	0.674
Pennsylvania	7,837,948	12,886,752	1.644
Texas	11,735,057	8,852,713	0.754
Utah-Wyoming	1,572,306	798,470	0.507
West Virginia	12,128,962	19,927,721	1.643
Total	222,113,218	$163,802,334	$0.737

*Ohio includes Michigan and Missouri.

The total petroleum production of the United States to the end of 1912 was 2,820,426,549 bbl., valued at $2,338,032,130. Stocks decreased from 137,232,998 to 122,869,702 bbl. during the year. There was a total of 157,335 productive wells in the country at the end of the year. About one-third of the oil yield was used as fuel in power plants, etc., and railroads consumed 33,605,598 bbl. Imports of petroleum were valued at $6,082,881, and exports of all kinds of oils to foreign countries totaled 1,883,479,897 gal. valued at $124,210,382. Production of the world in 1912 was as follows:

Austria-Hungary	8,535,174
Canada	243,614
Dutch East Indies	10,845,624
Germany	995,764
Italy	86,286
India	7,116,672
Japan	1,671,405
Mexico	16,558,215
Peru	1,751,143
Roumania	12,991,913
Russia	68,019,208
United States	222,113,218
Other	250,000
Total	351,178,236

Scotland and New South Wales produced 3,116,803 and 75,000 tons of oil shale, valued at $4,171,174 and $180,000, respectively.

*Abstract from advance chapter from 'Mineral Resources of the United States, 1912.'

Concentrates

Most of these are in reply to questions received by mail. Our readers are invited to ask questions and give information dealing with the practice of mining, milling, and smelting.

PRICE OF NATURAL GAS for domestic purposes in various states is as follows, in cents per 1000 cu. ft.: West Virginia, 18.12; Pennsylvania, 26.02; Ohio, 27.40; Kansas, 22.82; Oklahoma, 16.88; New York, 30.39; Indiana, 29.92; Louisiana, 22.84; Illinois, 22.85; Kentucky, 30.57; Texas, 39.73; and Alabama, 22.84 cents.

METALLURGICAL difficulties have resulted in the permanent closing of the Lancefield mine, Western Australia. The ore reserves total 200,000 tons, worth $7.50 per ton, but the arsenic and graphite contained baffled all methods of treatment, one system alone having handled 600,000 tons yielding $4,300,000. Highest recoveries were 80%, but gave no profits.

QUANTITIES of material handled daily at the Washoe plant of the Anaconda Copper Mining Co. are as follows: ore, 12,000 tons; lime rock, 2300 tons; coke used, 500 tons; coal for reverberatory furnaces, 500 tons; coal for power, 50 tons; and water used per minute, 35,000 gal. Men employed in and around Anaconda total 3000, with a monthly payroll of $300,000.

MINERS employed at the South mine, Broken Hill, are mostly on contract, and during the half-year ended June 30, 1913, they averaged $4.16 per 8-hour shift on development and stoping, and $3.22 tramming ore and waste. The average daily attendance of underground men was 787. The cost of stope-filling was $1.01 per cubic yard which amounts to 36c. per ton of crude ore mined.

THE Progress mine is situated at Reefton, South Island of New Zealand, and costs per ton during 1912 were as follows:

Mining	$2.30	Crushing	$0.05
Hoisting	0.72	Stamp milling	0.36
Transportation	0.38	Concentration (coarse)	0.15
Maintenance	0.80	Concentration (fine)	0.06
Pumping and baling	0.02	Cyaniding	0.30
		Accumulating slime	0.01
Total mining	$4.22	Total milling	$0.93

EXTENT OF ENRICHMENT IN DEPTH is a matter of great interest. According to J. F. Kemp, it depends primarily upon the vertical depth to which it will be admitted that descending, acidified, metal-bearing solutions, produced by the leaching of the oxidized zone by meteoric waters, may slowly diffuse themselves in the standing ground-water. Obviously, the chief reactions will take place near the ground-water level. One cannot reasonably expect the influence to extend very far. The production of oxidized and enriched ores of zinc is practically limited to a few feet above and below the water-level. Lead is very intractable, and its enrichment is practically a matter of oxidization and removal of other and more soluble associates above the water-level. The behavior of silver is a matter on which light is needed and on which there is a difference of opinion among engineers. Gold, though at first sight a comparatively insoluble metal, does yield to the solutions afforded by oxidizing pyrite, in the presence of manganese, as has been found by Emmons. To what depth, however, the slow diffusion of descending solutions would bring the enriching effects below the water-level is a question. Copper is the metal of preëminent importance in matters of secondary enrichment. Reported falling off in value as greater depths have been attained, has made the influence of this process of special importance. The appreciable decrease in copper percentages which were widely published fifteen years or so ago, regarding the Rio Tinto mines, called attention to it even at that early date.

UNDERHAND STOPING with square sets, according to J. C. Coldham, has become general in stoping the following at the Broken Hill Proprietary mine, Australia: (1) bridges of ore remaining from open stopes; (2) pillars which have generally become broken through pressure and creeps; (3) portions of the lode in which the ore is naturally broken; and (4) portions of the fire areas, where the action of the fires has caused a roasting of the ore, which has become a fine sand and mixed with the stope filling, forming a mass, the mining of which is difficult, owing to its soft, floury nature. This ground may be termed running ground. The chief advantages of the method are summarized as follows: (1) when the orebody is such that each fresh back must be caught immediately it is opened, the underhand method is superior to any method of back stoping, as the back must be held up only on the top floor of the stope, while in overhead stoping each floor presents the difficulties of a fresh back. The importance of this may be seen from the extreme case of running ground where the contract rate for top sets may amount to as much as 48c. per ton in excess of the rate for the lower sets; (2) with this method of working in vertical slices, much less back is left unsupported by filling than when working with a flat or rill face; (3) the filling cost is less when filling deep cuts than when filling flat, shallow cuts; and (4) should occasion arise, it is more convenient to fill close to the face when working out the ground in vertical slices. The method has proved itself more suitable than any other in working out bad ground.

GENERAL RULES for the prevention of accidents at the Copper Queen company's mines, in Arizona, include the following for underground work: 1. As all mining work is hazardous, extra care should be taken not only for your own safety, but for the safety of men working with you. 2. Watch for danger signals; they are often unnoticed if there is not sufficient light. 3. Every manhole and place of refuge shall be kept constantly clear, and no refuse shall be placed therein, and no person shall in any way prevent access thereto. 4. The general condition of the timbering in the mine shall be safe. The men shall take all the necessary precautions to insure the safety of the timber in the working places. 5. In all stopes where square sets are used, it shall be the duty of men working in stopes to see that the floors are properly centred on the caps, particularly after blasting, and spiked wherever deemed necessary. 6. When working in heavy or untimbered ground, care should be taken that there is plenty of room for a quick exit. All obstructions such as cars, wheelbarrows, etc., should be moved out of the way. 7. Existing winzes opening directly from the floor of the drift or stope must be kept covered by a substantial hatch, or planking, except when in use, at which time the passage to persons other than those working at the winze shall be barred off by a substantial rail across the roads of access to the openings. 8. The miners shall be responsible for the safety of the roof and walls of their working places. 9. In mining, care must be taken in approaching workings thought to be filled with water, and the bore holes must be kept at least 20 ft. in advance of the drive. 10. Planking over sumps and ditches must be kept secure. 11. No candle or lamp shall be left burning in a mine when the person using the candle or lamp departs from his work for the day. Sconces must positively be used, except when candlesticks or carbide lamps are employed. Lights must be placed so that timber cannot catch fire. 12. Employes shall, as soon as discovered, inform the foreman or shift boss of the unsafe condition of any working place. 13. Be sure that chutes are protected so that men cannot fall into them. 14. Men are strictly forbidden to carry tools upon their shoulders in any drifts where electric wires are installed. It is very dangerous and may result in death. 15. Two openings to surface are provided by law, except in the case of mines that are being opened. 16. Men should learn the different openings from their place of work, and their attention is called to signs at the intersection of drifts which direct them to shafts or outlets.

Monthly Copper Production

AHMEEK COPPER MINING CO., Kearsarge, Michigan $1,250,000 in $25 shares, 24,796 shares owned by Calumet & Hecla; 1800-ton mill at Hubbell; concentrate smelted by Calumet & Hecla smelter.

Month.	Pounds.	Month.	Pounds.
April	1,503,535	June	1,281,960
May	1,061,995	July	1,030,500

ALLOUEZ MINING CO., Allouez, Michigan $2,500,000 in $25 shares, controlled by the Calumet & Hecla, which owns 43,000 shares and $250,000 in notes of the Company; ore is milled by the Lake Milling, Smelting & Refining Co., in which the Allouez owns a half interest.

Month.	Pounds.	Month.	Pounds.
April	603,210	June	556,675
May	475,535	July	398,565

ANACONDA COPPER MINING CO., Butte, Montana. $108,312,500 in $25 shares; controlled through Amalgamated Copper Co. by Thos. F. Cole, J. D. Ryan, and Standard Oil interests; 10,000-ton concentrator and smelter at Anaconda; 5000-ton concentrator and smelter at Great Falls, Mont.; also 70-ton electrolytic refining plant at Great Falls. Production figures include copper from all companies which ship custom ore to Anaconda smelters.

Month.	Pounds.	Month.	Pounds.
April	23,800,000	July	21,181,000
May	25,600,000	August	22,500,000
June	21,500,000	September	22,600,000

ARIZONA COPPER CO., LTD., Morenci, Arizona. £379,974 in 5s. shares; controlled by Edinburgh investors; mill at Morenci is being enlarged to 3000-ton capacity and a new 1200-ton smelter near Clifton has just been started.

Month.	Pounds.	Month.	Pounds.
April	3,100,000	July	2,600,000
May	3,200,000	August	1,800,000
June	3,000,000	September	1,800,000

COMPANIE du BOLEO, Santa Rosalia, Baja California, Mexico. Fr. 12,000,000 in Fr. 100 shares; owned by Rothschild, Paris, interests and the Banque Mirabaud; 4000-ton smelter; matte and black copper shipped to Europe.

Month.	Pounds.	Month.	Pounds.
January	2,658,880	April	2,311,200
February	2,535,680	May	2,424,800
March	2,204,720	June	1,984,640

BRADEN COPPER CO., La Junta, Chile. $2,332,030 in $10 shares and $4,000,000 in 6% convertible bonds; entire stock held by Braden Copper Mines Co.; $12,000,000 in $5 shares; $5,000,000 in convertible bonds; controlled by Guggenheim interests; two mills at La Junta; 3000-ton capacity smelter at Raucagua.

Month.	Pounds.	Month.	Pounds.
April	1,148,000	July	1,046,000
May	1,481,000	August	1,572,000
June	1,808,000	September	1,322,000

BRITISH COLUMBIA COPPER CO., LTD., Greenwood, B. C. $2,958,545 in $5 shares; controlled by Newman Erb; 600-ton sampling plant and 2500-ton smelter.

Month.	Pounds.	Month.	Pounds.
June	634,238	August	700,000
July	618,379		

CALUMET & ARIZONA MINING CO., Warren, Arizona. $6,285,710 in $10 shares; has absorbed the Superior & Pittsburg Copper Co. by stock exchange; controlled by Hoatson and other Lake Superior interests; 3000-ton smelter at Douglas.

Month.	Pounds.	Month.	Pounds.
April	4,500,000	July	3,800,000
May	4,300,000	August	4,500,000
June	3,000,000		

CALUMET & HECLA MINING CO., Calumet, Michigan. $2,500,000 in $25 shares; controls the Ahmeek, Allouez, Centennial, Isle Royale, La Salle, Osceola, Tamarack, and Superior copper mining companies as well as a number that are non-productive; controlled by Agassiz and Shaw interests; 2 mills on Lake Linden, capacity 15,000 tons; smelter Hubbell, Mich.; electrolytic refinery and smelter at Buffalo, N. Y.; figures include output of subsidiaries.

Month.	Pounds.	Month.	Pounds.
April	10,582,870	June	9,743,300
May	10,765,400	July	7,642,163

CANANEA CONSOLIDATED COPPER CO. S. A., Cananea, Sonora, Mexico. Capital ₱20,000 in shares of ₱100; entire stock owned by Greene Consolidated Copper Co.; $10,000,000 in $10 shares; 945,320 shares are held by Greene-Cananea Copper Co.; $50,000,000 in $100 shares, which is controlled by Thos. F. Cole and J. D. Ryan; 2 mills and smelter at Cananea, 3000-ton capacity.

Month.	Pounds.	Month.	Pounds.
April	3,581,000	July	3,328,000
May	2,272,000	August	3,186,000
June	2,908,000	September	3,148,000

CENTENNIAL COPPER MINING CO., Calumet, Michigan $2,250,000 in $25 shares, 44,250 shares are held by Calumet & Hecla Mining Co.; ore milled by Lake Milling, Smelting & Refining Company.

Month.	Pounds.	Month.	Pounds.
April	243,295	June	193,295
May	153,010	July	195,455

CERRO de PASCO MINING CO., Cerro de Pasco, Peru. $10,000,000; entire stock held by Cerro de Pasco Copper Co.; $60,000,000 in $1 shares which is owned by Cerro de Pasco Investment Co., which is controlled by J. B. Haggin, and Morgan estate; 3000-ton smelter at La Fundicion; monthly production figures not given out; output in 1912 was 45,000,000 lb. copper.

CHINO COPPER CO., Santa Rita, New Mexico. $3,500,000 in $5 shares; 121,200 shares are held by Guggenheim Exploration Co.; controlled by Sherwood Aldrich and C. M. MacNeill; 5000-ton mill at Hurley, N. M.; concentrate smelted at El Paso.

Month.	Pounds.	Month.	Pounds.
April	4,046,800	July	4,831,200
May	4,003,700	August	6,050,867
June	3,904,300	September	4,435,873

CONSOLIDATED COPPER MINES CO., Ely, Nev. $8,000,000 in $5 shares; $3,000,000 in convertible bonds; is a recent merger of the Giroux, Butte & Ely, Chainman, and Coppermines companies, controlled by Thos. F. Cole, Wm. B. Thompson, Charles F. Rand, and Jas. Phillips, Jr.; reduction plant not yet built; production so far derived solely from Giroux; ore treated at Nevada Con. smelter.

Month.	Pounds.	Month.	Pounds.
April	816,935	July	607,779
May	968,368	August	541,189
June	616,742		

COPPER QUEEN CONSOLIDATED MINING CO., Bisbee, Arizona. $2,000,000 in $10 shares; owns 100,000 shares of Greene-Cananea; almost all its stock is held by Phelps, Dodge & Co., Inc.; $44,995,000 in $100 shares; 4000-ton smelting plant at Douglas, Ariz.; output of Copper Queen mine:

Month.	Pounds.	Month.	Pounds.
April	7,079,600	July	7,439,864
May	7,160,021	August	7,590,994
June	6,292,480	September	7,775,560

COPPER RANGE CONSOLIDATED MINING CO., Painedale, Michigan, $38,433,500 in $100 shares; owns 99,659 shares of Baltic M. Co., 99,699 shares Copper Range M. Co., 99,335 shares of Tri-mountain M. Co., half interest in Champion Copper Co., 16,392 shares of Copper Range R. R. Co., and $870,000 in Copper Range R. R. bonds; controlled by Wm. A. Paine; production is derived from the Baltic, Champion, and Trimountain companies, each of which mills its ore; concentrate is smelted by Michigan Smelting Co., Houghton, which is owned by mining companies.

Month.	Pounds.	Month.	Pounds.
April	3,072,000	June	3,267,600
May	3,400,000	July (est.)	2,500,000

DETROIT COPPER MINING CO., Morenci, Ariz. $1,000,000 in $25 shares; owned by Phelps, Dodge & Co.; 1300-ton mill and 350-ton smelter.

Month.	Pounds.	Month.	Pounds.
April	1,856,517	July	1,549,224
May	2,001,633	August	2,187,223
June	1,750,601	September	2,102,818

EAST BUTTE COPPER MINING CO., Butte, Mont. $3,000,000 in $10 shares; owns 83% of the stock and all bonds of the Pittsmont Copper Co., which holds 90% of the stock and all bonds of Pittsburgh & Montana Copper Co.; controlled by W. A. Paine; 350-ton mill and 1000-ton custom smelter.

Month.	Pounds.	Month.	Pounds.
April	1,435,033	July	1,060,257
May	1,268,595	August	1,162,006
June	1,020,613	September	1,233,018

FRANKLIN MINING CO., Demmon, Mich. $4,166,650 in $25 shares; controlled by R. M. Edwards and the U. S. S. R. & M. Co.; 1000-ton mill.

Month.	Pounds.	Month.	Pounds.
April	164,640	June	143,000
May	149,960	July	106,000

GRANBY CONSOLIDATED MINING, SMELTING & POWER CO., LTD., Phoenix and Hidden Creek, British Columbia. $14,849,565 in $100 shares; controlled by General Chemical

Co. interests; 4400-ton smelter at Grand Forks and 2000-ton smelter at Anyox.

Month.	Pounds.	Month.	Pounds.
April	1,806,452	July	1,654,000
May	1,828,000	August	1,827,300
June	1,789,000	September	1,824,560

ISLE ROYALE COPPER CO., Houghton, Mich. $3,750,000 in $25 shares; owns a $50,000 interest in the Lake Superior Smelting Co., owned by Calumet & Hecla; 2200-ton mill on Portage Lake.

Month.	Pounds	Month.	Pounds.
April	563,983	June	496,134
May	528,809	July	343,750

MASON VALLEY MINES CO., Yerington, Nev. $770,000 in $5 shares, $1,000,000 in 6% convertible bonds; controlled by W. B. Thompson; 1000-ton smelter at Thompson, Nev., also smelts ore of Nevada-Douglas Copper Co. and custom ore; smelter production:

Month.	Pounds.	Month.	Pounds.
April	1,274,000	June	1,132,000
May	1,226,000	July	990,000

MIAMI COPPER CO., Miami, Ariz. $3,319,690 in $5 shares; $1,433,000 in 6% convertible bonds; controlled by General Development Co. (Lewisohn interests); 3000-ton mill at Miami; concentrate smelted at Cananea.

Month.	Pounds.	Month.	Pounds.
April	2,312,000	July	2,890,000
May	1,948,000	August	3,097,500
June	2,612,650	September	2,688,600

MOCTEZUMA COPPER CO., Nacozari, Sonora, Mexico. $2,000,000; entire stock owned by Phelps, Dodge & Co.; 2000-ton mill; concentrate smelted by Copper Queen.

Month.	Pounds.	Month.	Pounds.
April	2,753,240	July	2,693,006
May	2,695,881	August	3,542,047
June	3,438,793	September	3,024,121

MOHAWK MINING CO., Mohawk, Mich. $2,500,000 in $25 shares; controlled by Stanton interests; 3000-ton mill, Traverse Bay; concentrate smelted by Michigan Smelting Co.

Month.	Pounds.	Month.	Pounds.
April	962,994	June	820,522
May	932,979	July	600,000

NEVADA CONSOLIDATED COPPER CO., Ely, Nevada. $10,000,000 in $5 shares; has absorbed the Cumberland-Ely Copper Co.; controlled by American Smelter Securities Co. through the Utah Copper Co., which owns half of the Nevada Con. stock; the Nevada company owns the Steptoe Valley Mining & Smelting Co., $10,000,000; 16,000-ton mill and 1500-ton smelter at McGill, Nevada.

Month.	Pounds.	Month.	Pounds.
April	5,650,600	July	5,403,919
May	5,933,275	August (est.)	5,750,000
June	6,344,863	September	5,989,973

NEVADA DOUGLAS COPPER CO., Mason, Nev. $4,100,000 in $5 shares, $600,000 in 6% convertible bonds; controlled by A. J. Orem; ore smelted at Mason Valley smelter.

OHIO COPPER CO., Bingham, Utah. $12,292,700 in $10 shares, $1,326,000 in 6% convertible bonds; 3500-ton mill at Lark, Utah; concentrate smelted at Garfield; production 650,000 to 700,000 lb. per month.

OLD DOMINION COPPER MINING & SMELTING CO., Globe, Ariz. $4,050,000 in $25 shares; 155,245 shares are owned by the Old Dominion Co., which is owned by Phelps, Dodge & Co.; 300-ton mill, 2400-ton smelter. Production figures include custom ore smelted.

Month.	Pounds.	Month.	Pounds.
April	3,040,000	July	2,526,000
May	2,749,000	August	2,524,000
June	2,511,000	September	2,679,000

OSCEOLA CONSOLIDATED MINING CO., Osceola, Mich. $2,403,750 in $25 shares; owned by Calumet & Hecla; 2 mills, 4000-ton capacity, at Torch Lake.

Month.	Pounds.	Month.	Pounds.
April	1,667,340	June	1,424,640
May	1,759,815	July	1,217,255

PHELPS, DODGE & CO., Inc. $44,995,000 in $100 shares; controlled by C. H. Dodge, James Douglas, and others; owns the Copper Queen, Moctezuma, Detroit, and Burro Mountain Copper companies, Stag Canon Fuel Co.; indirectly controls Old Dominion, United Globe, and Commercial Copper Mining Co.; members of the firm control the El Paso & Southwestern railway, and have large interests in the Rock Island and Great Northern railways. Production figures include all properties under its control and copper derived from custom ore, the latter ranging from 750,000 to 1,000,000 lb. per month.

Month.	Pounds.	Month.	Pounds.
April	12,819,923	July	12,611,837
May	12,999,119	August	13,981,564
June	12,667,328	September	13,561,742

QUINCY MINING CO., Hancock, Mich. $2,750,000 in $25 shares; controlled by W. R. Todd; 4500-ton mill at Mason; 340-ton smelter at Ripley.

Month.	Pounds.	Month.	Pounds.
April	1,748,460	June	1,611,840
May	1,704,300	July (est.)	1,250,000

RAY CONSOLIDATED COPPER CO., Ray, Ariz. $11,975,740 in $10 shares; controlled by Sherwood Aldrich and C. M. MacNeill; 8000-ton mill at Hayden, Ariz.; concentrate smelted in A. S. & R. smelter adjoining.

Month.	Pounds.	Month.	Pounds.
April	4,514,565	July	4,097,177
May	4,520,000	August	4,401,000
June	4,392,612		

SHANNON COPPER CO., Metcalf, Ariz. $3,000,000 in $10 shares; controlled by N. L. Amster; 500-ton mill and 1000-ton smelter at Clifton.

Month.	Pounds.	Month.	Pounds.
April	1,238,000	July	880,000
May	1,080,000	August	1,248,000
June	924,000	September	1,232,000

SHATTUCK ARIZONA COPPER CO., Bisbee, Ariz. $3,500,000 in $10 shares; controlled by Duluth investors; ore smelted at Calumet & Arizona smelter.

Month.	Pounds.	Month.	Pounds.
April	1,158,326	July	1,019,388
May	1,026,170	August	1,001,624
June	1,059,625	September (est.)	1,200,000

SOUTH UTAH MINES & SMELTERS, Newhouse, Utah. $4,300,000 in $5 shares, $1,300,000 in 6% convertible bonds; controlled by Samuel Newhouse; 1000-ton mill; concentrate smelted at Tooele, Utah.

Month.	Pounds.	Month.	Pounds.
April	132,267	July	195,254
May	201,405	August	230,410
June	142,817	September	249,323

SUPERIOR COPPER CO., Calumet, Mich. $2,500,000 in $25 shares; owned by Calumet & Hecla.

Month.	Pounds.	Month.	Pounds.
April	291,525	June	382,080
May	389,975	July	307,260

TAMARACK MINING CO., Calumet, Mich. $1,500,000 in $25 shares; owned by Calumet & Hecla; 2 mills, 3500-ton capacity, at Torch Lake.

Month.	Pounds.	Month.	Pounds.
April	630,190	June	598,770
May	655,885	July	476,725

TENNESSEE COPPER CO., Copperhill, Tenn. $5,000,000 in $25 shares; $1,500,000 in 6% convertible bonds; controlled by Jas. Phillips, Jr., and Lewisohn interests.

Month.	Pounds.	Month.	Pounds.
April	1,718,188	July	1,295,804
May	1,037,115	August	1,143,019
June	1,379,220		

UNITED STATES SMELTING, REFINING & MINING CO. $44,871,150 in $50 shares; copper production chiefly derived from its subsidiaries. The Mammoth Copper Mining Co., Kennett, California.

Month.	Pounds.
September	1,750,000

UNITED VERDE COPPER CO., Jerome, Ariz. $3,000,000 in $10 shares; owned by W. A. Clark; 1000 to 1200-ton smelter at Clarkdale; monthly figures not given out, estimated at about 3,000,000 pounds.

UTAH CONSOLIDATED MINES CO., Bingham, Utah. $1,500,000 in $5 shares; owns the Highland Boy Gold Mining Co. and 5000 shares of International Smelting & Refining Co. stock; ore smelted at Tooele.

UTAH COPPER CO., Bingham, Utah. $15,625,990 in $10 shares; owns half of Nevada Consolidated; controlled by A. S. & R. Co., Sherwood Aldrich, C. M. MacNeill, and W. B. Thompson; 2 mills, 20,000-ton capacity, at Garfield; concentrate smelted at Garfield plant of A. S. & R. Company.

Month.	Pounds.	Month.	Pounds.
April	9,834,894	July	9,849,043
May	10,312,605	August	10,900,000
June	11,637,949		

WOLVERINE COPPER MINING CO., Kearsarge, Mich. $1,500,000 in $25 shares; owns $80,000 interest in Michigan Smelting Co.; controlled by J. R. Stanton; mill on Traverse bay treated 388,500 tons during last fiscal year.

Month.	Pounds.	Month.	Pounds.
April	641,885	June	627,087
May	663,430	July	426,000

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EDITORIAL

REGARDLESS of the unsettled conditions in Mexico and the paralysis of business which is claimed, the Department of Commerce reports that the trade conditions between that country and the United States during the past fiscal year are the best on record. The figures compiled show the imports from Mexico to have increased by $11,500,000, while the exports to that country increased $1,750,000.

THE story of the ninety-nine per cent matte, which was reported to have been 'frozen' in a furnace of the Arizona Copper Company, and would require from five to six months to recover, is worthy of the pen of some of our consular representatives, who can estimate the cost of several hundreds of miles of railway construction to the dollar and perform technical feats equally as wonderful as the making of a ninety-nine per cent matte.

YES, gentle reader, 'banket' is an obsolete form of banquet and it may be that the progenator of this perfectly good geological term saw in the African deposits the possibility of a sumptuous repast when he dubbed them bankets. However, the origin of the term is Dutch, and its application to the deposits of the Rand and Rhodesia is due to their likeness in appearance to an almond sweetmeat which the Boer school-boy calls by this name.

STATE GEOLOGISTS of Missouri, Iowa, Oklahoma, Arkansas, Tennessee, Ohio, Indiana, and Illinois, with Mr. C. D. White and Mr. W. H. Herron, of the United States Geological Survey, and Mr. Stuart Weller, of the University of Chicago, met at St. Louis recently at a dinner followed by a two days field conference in Ste. Genevieve county, Missouri, at which problems in geologic correlation were discussed. So fruitful was the conference that future meetings are planned and a permanent executive committee has been chosen, with Mr. H. A. Buehler as chairman.

THE protest against the revision of the mining law that we reprinted last week from the *Bisbee Daily Review* was, we find, but part of an article written by Mr. Russell L. Dunn and originally printed in the *Mining and Engineering World*. We gladly make acknowledgment to Mr. Dunn and to our Chicago contemporary and regret that the absence of a credit line in the *Review* misled us. Mr. Dunn was at one time a member of the editorial staff of the *Mining and Scientific Press*, and while we do not at all agree with his conclusions, we recognize freely the skill with which he has presented his argu-

ment. In this issue we present something on the other side from Mr. George Otis Smith, the director of the United States Geological Survey, who writes forcefully from the basis of wide observation and much study. We have other papers on the subject in hand and are glad to believe that the time is ripe for a real revision of the mining law.

Progress In Fuel Utilization

The community of interest in the field of metallurgy was well shown at the meeting of the Iron and Steel Section of the American Institute of Mining Engineers in New York last week. During the session a number of notable papers upon the use of powdered coal as fuel, and the recovery of waste heat from metallurgical furnaces were read and discussed at some length, and the results attained in the field of zinc and copper metallurgy were presented and listened to with interest by the steel metallurgists. Curiously enough, three of the papers had almost identical titles, though Messrs. R. K. Meade, H. R. Barnhurst, and W. S. Quigley treated the general subject of the use of powdered coal as fuel from slightly different aspects. These were preceded by two papers on the generation of steam by the waste heat of furnaces, read by Mr. G. C. Stone and by the secretary for Mr. F. Peter, professor at Leoben.

The present importance of the use of pulverized coal as fuel is illustrated by Mr. Barnhurst's estimate that 10,000 tons of coal in this form is burned daily in the cement industry alone. The development of direct-firing with coal dust has indeed advanced almost *pari passu* with the growth of the output of cement, the large quantity of coal used in the production of so cheap a commodity making necessary the use of fuel in a form which permits more efficient use of its heat content than is possible in any system of indirect firing. To a less extent, it has been applied to other fields of work, and its present use at the smelter of the Canadian Copper Company and the earlier experiments at the Highland Boy plant and at Cananea are well known to many of our readers.

The difficulties in the early work in all fields arose from the presence of moisture in the coal, insufficient grinding, and the attempt to use unsuitable types of coal. It is now possible to use any long-flame coal which contains over 25 per cent of volatile hydrocarbons, and coal containing as much as 25 per cent ash has been used in cement burning. In smelting, so high an ash content would not be permissible, especially in copper treatment, for if the ash is fusible it tends to clog the flues and waste-heat boilers, while if it is infusible it is an unwelcome addition to the already highly silicious charge on the hearth. Before pulverizing, the coal must be thoroughly dried. In addition to the bad effect of moisture on pulverizing and injecting the coal, each per cent of moisture in the fuel corresponds to a decrease of 52 degrees Fahrenheit in the temperature attainable in the furnace; a decrease which cannot be overcome by burning additional fuel. This bad effect is accentuated by the fact that only part of the heat is utilized in the furnace; thus if the powdered coal contains five per cent moisture, the temperature in the zone of combustion is 1500, and the temperature of the outgoing gases is 600 degrees —the heat wasted in raising the water to the temperature of the escaping gases corresponds to nearly ten per cent of the total heat value of the fuel. Standard practice requires the grinding of the pulverized coal so that ninety-five per cent will pass 100 mesh and eighty-five per cent through 200 mesh.

The aim in coal pulverizing is to make a maximum of what the millman used to call 'slime,' namely, material too finely divided to permit measurement. Various types of mills have proved satisfactory; ball-mills, various tube-mills, Raymond, and Griffin mills. Certain types of these permit the burning of coal as fast as it is ground; in others it is caught in storage-bins. The ground coal is not explosive unless it is so stirred up as to form an explosive mixture with air.

In ordinary practice the coal is blown into the furnace by the use of twenty-five per cent of air, furnished either by a fan or by blowers which deliver it at higher pressures, the fan being preferred as cheaper. If a larger quantity of air is used, the flame becomes shorter, since the deflagration of the coal immediately in front of the nozzle is thus favored. The length of the flame attained depends, therefore, on the character of the coal, the amount of air used in its injection, and the draft. Regulation of the length of the flame is best done by manipulating the draft. It is, of course, necessary to admit an excess of air over that required for combustion, and the temperature attained can easily be controlled by regulating the amount of fuel admitted. The convenience and economy of this method of firing is leading to its increased use in open-hearth and puddling furnaces, and, within the limitations of local conditions, is likely to lead to its increased use in reverberatory copper smelting.

The high temperature of the gases escaping from such furnaces makes it especially desirable that some of their contained heat shall be recovered. This is commonly attained by the use of regenerators, but the gases escaping from these still contain recoverable heat. Unless their temperature exceeds 300 degrees Centigrade there is no economy in attempting to recover this heat, since the temperature difference between the gases and the steam generated is so small as to make the transfer of heat from the one to the other impracticably slow. The lowest practicable limit is perhaps attained at the Palmerton, Pennsylvania, plant of the New Jersey Zinc Company, described by Mr. Stone, where gases (at 450°C.) escaping from the spelter furnaces are utilized in a battery of return-tubular boilers which furnish the steam required for the gas producers. It is there found that three horse-power can be recovered in the waste-heat boiler for each ton of coal gasified in the producers, without interfering with the results attained in the spelter furnaces. With reverberatory copper-smelting furnaces the use of waste-heat boilers is standard practice, and the important paper by Mr. S. S. Sorensen, published in our issue of October 11, is of especial value, since it gives the comparative results attained by two different types

of boilers, and thus contributes greatly to that more exact knowledge of this subject which is much to be desired.

The Copper Situation

Publication of the September statistics of refinery output and deliveries of copper to the trade renders possible some interesting comparisons. Production during the nine months of 1913 has averaged a little over 134 million pounds of copper monthly, as compared with deliveries of nearly 143 million. This compares with an average of a little less than 132 millions average monthly refinery output for 1912 and average deliveries of 130 million. The increase of output has therefore been about 2½ million pounds per month, and of deliveries 12 million. The excess of average monthly output over deliveries of 1,320,000 pounds during 1912 has been converted into a monthly deficit of over 8½ millions. It is interesting to notice that the increase in output approximately corresponds to the increase in domestic deliveries, which are almost 2 million pounds greater for the average of the nine months. Deliveries for export, on the other hand, have averaged nearly 10 million pounds per month more than during 1912. The generally accepted explanation of this is that European stocks were allowed to run down to subnormal figures last year because of the impending outbreak of the Balkans, and that this year, in expectation of a speedy return of settled conditions, European consumers have been refilling their yards, doing their buying at the low points in the market price of the metal. Since exports and domestic deliveries are about equal in amount, it is evident that the increase in exports is greatly in excess of the natural growth of consumption unless it is assumed that the increase of domestic deliveries is less than normal. This may possibly be the case, for trade generally has been awaiting the passage of the new tariff act, questioning what its effect will be. It is natural that under such circumstances manufacturers, who are the immediate consumers of copper, should wish to meet the new conditions with as small stocks of unsold goods as is compatible with the safe conduct of business. European manufacturers, on the other hand, generally expect an increase in their business in this country and are stocking up to reap the cream of the profits before prices reach their new level of adjustment. The present situation, therefore, appears on the face of it, to be a natural rather than an adventitious one. It follows, then, that next year may be expected to show a relatively larger increase in domestic consumption and a relative slacking of the demand for export, the average of the two corresponding to the normal growth of consumption.

In the interest of completeness it must be added that there are those who doubt the validity of inferences drawn from the producers' statistics, which constitute only what may be called a cross-section through the copper trade at one point. The copper which has been produced by the smelters but which has not reached the refineries, the metal in the yards of consumers, and copper in the hands of others than consumers all are unknown quantities which render exact equations insoluble. It is amusing to note that the suspicion is international in character, consumers here being unable to understand the reported decreases in European stocks simultaneously with record-breaking exports to Europe, while a correspondent of the London *Financial Times* has recently written to that journal to express his view that "the optimistic reports which have been circulated of late are manifestly inspired" and that to him "it would appear to be a recurrence of the game that has been so often played upon England by the Americans." Like our police investigations, the matter will doubtless eventually resolve itself into a fruitless search for the 'man higher up.'

The most interesting point is whether the abnormally low figure to which stocks of copper have attained constitutes any menace to stable conditions, and whether a sudden increase in the domestic demand may be expected to send prices soaring. Any expression on this matter can only be one of personal opinion; an opinion, moreover, that, like the railway time-tables, is subject to change without notice, since it involves so many elements that are necessarily unknowable. The past six months have shown that consumers can remain out of the market for unexpectedly long periods, and if we get over the remainder of the year safely it will have been demonstrated that stable conditions can be maintained on much smaller stocks of the metal than was previously supposed. This will be for the advantage of everyone, for the decrease of American stocks since February of nearly 100 million pounds will represent the doing away of an unnecessary insurance charge. For example, if a merchant doing $100,000 in business per month found it feasible, through improved conditions, to reduce the stock on his shelves by $60,000 and still do business successfully, his profits would obviously benefit by the decrease in carrying charges on his stock.

The flexibility of mine and refinery production at present in the United States is probably greater than is generally supposed. The September refinery output was only 3 million pounds less than the average for the past nine months, although the output of the Lake Superior district is estimated to have been 11 million pounds below normal. The 'copper in transit' of the large companies is always considerable in amount. Thus the Utah Copper reported about 15 million pounds 'in transit' on January 1 last, following a period of disturbed conditions in which its output had been reduced to only 4 million pounds per month. The Chino, then producing about 3½ million per month, similarly reported nearly 11 million pounds of copper in transit. What inflexibility exists is due rather to the refineries, where the output of electrolytic tanks is not amenable to abrupt increases and decreases. Considering the industry as a whole and comparing the natural growth of consumption with the increase in output of many important properties and the impending output of large new mines, there seems no reason to expect any increase in what we have previously designated as the normal price of copper.

Plain Talk on Land Law Revision

By George Otis Smith

*Whatever the forum selected, public discussion in America tends to evoke more language than ideas. Most of us err in this way, and we all feel the influence when we think aloud before our assembled fellows, with the result that we sometimes strive less for common sense than for uncommon sound. Plain ideas are dressed up in borrowed or imported finery with all the tender care that a fond mother lavishes upon her little girl going to a first party, so that too often the practical man who knows the work-a-day world at first hand delivers an address conspicuous for the elegant words which completely envelop and conceal plain facts and solid opinions that deserve more appropriate treatment.

Plain talk is more becoming than oratory to a time like the present, when the signs point to large changes in the world of business and industry. The members of the American Mining Congress are men connected in one way or another with the business of taking out of the ground things that are useful. Mining is a productive industry of the first rank, and it is plain that our mines are fairly essential to human welfare. Here, then, if anywhere, do the problems of common interest to both the public and the mining industry deserve to be discussed in plain language that the everyday man uses and understands.

Mining or Public Lands

To consider now perhaps the most important matter in which this body is particularly interested, namely, the federal legislation needed to promote mining on public lands, it is imperative to recognize certain ideas that have won large popular support, if not adoption by the majority, especially as these ideas have never been written into our archaic mining laws. Some of these principles are: that the public possesses greater rights than any individual or corporation; private enterprise must be subordinated to the public good; big business is not necessarily either vicious or unfriendly to public interest, but big business more than small business is in need of a strong control by the people; the day of big business in the sense of unnatural and unrestrained monopoly and special privilege is passing; effective inspection and intelligent regulation of industry by the people's representatives will increase; the bright light of publicity should and will shine on the inner workings of all private business which either touches or controls the production and distribution of the necessaries of life, and publicity is logically the first step in regulation by the people. All of these propositions must, I believe, be accepted as premises in the formulation of any new mining statutes whose purpose is to provide at all adequately for the present and the future.

To come now to the question of what is needed in mineral land legislation, a plain statement of facts will help. Legislative programs too often resemble the hotel bill of fare which the average citizen has to ask the waiter to translate. In my opinion, we want these laws for the coal and oil and phosphate lands first of all for the sake of the citizens who wish to use the mineral product from these lands. Not that the other citizens are not to be served by the new legislation, but as consumers everyone is concerned with prices, and to benefit the many as well as the few, legislation must favor low costs. It should therefore put down as the first essential of mineral land legislation that no provision in the law should place any unnecessary charge, burden, or operating cost upon the operator. Accordingly, no royalty should be imposed with the primary purpose of revenue. The consumer will surely pay the tax, if the charge paid to the Government landlord is imposed for other than purposes of administration and of control in the interest of the consumer. The most recently issued water-power permits provide that the federal government shall receive a royalty which varies directly with the square of the average price paid by the public for the electric current. The less the consumer pays, the less the government landlord receives.

Risks and Uncertainties of Mining

A large burden which the mining industry now has to bear and which should be lightened is that made up of the various risks and uncertainties that attend it. In mining there is guesswork enough of Nature's own making to give the industry all the speculative flavor it needs. As I have pointed out in a paper published this month by the American Institute of Mining Engineers, any investment risk increases both cost and selling price, and whatever the origin of that risk, the ultimate consumer will find that he pays the carrying charge. For this reason, in order to lower the cost of coal, I favor a leasing law rather than the present method of selling government coal lands at an appraised valuation. Any scheme of selling an undeveloped resource involves uncertainties in valuation, and the risk thus created is liberally discounted by the operator—necessarily and properly, I may add, for his own protection, but the public pays the bill. Even more important is the feature that under lease the operator is relieved from all the burden of land investment.

The Oil Prospector

Other illustrations of uncertainties that can and should be removed will occur to those of you who are more familiar with mining than I am. I may mention, however, the unnecessary risk that has been forced on the oil prospector in the possibility of having his claim jumped by a more resourceful driller. Absolute protection during a proper period of exploration should be made a feature of every mining law. Another unnecessary and very costly

*Address before the American Mining Congress, Philadelphia, Pennsylvania, October 22, 1913.

risk has been mentioned by H. V. Winchell—the extralateral right embodied in our lode law. Mere mention of the 'apex' brings to mind litigation that has wasted the substance of Western mine-owners like a plague, many a long continued suit being almost as disastrous to the successful litigant as to his opponent. Even where lawsuits have been avoided, fear of them has constituted an element of risk that has surely found its place in the financing and operating of a mine on a lode claim.

Inducements to Development

Second in importance only to this matter of protecting the mineral producer from unnecessary operating costs is the need of offering to the developer of an unused resource an inducement commensurate with the hazardous or speculative character of his undertaking. This cuts both ways. To promote development, mining laws should attract the men having the knowledge and capital necessary to engage in the business of mining, but it does not follow that mining on the public domain should be set up like a public lottery, with the same big prizes for all comers whatever the risk taken. Too often in the past the practice has been for the majority of locators to sit by and watch a few real miners test out the ground, when if a strike was made, these hangers-on at once had valuable claims to sell. The 'wild-catter' who in his compliance with both spirit and letter of the law has risked his last cent in discovering oil, has received no more land from the government than the schoolteachers, drygoods clerks, and barkeepers whose names have decorated the paper locations for miles about. The present system has passed out too many large premiums to those who did not even take a chance—at least their stake was only a picayune compared with the bonanza prize. This means unearned increment in large amounts, and in the end the consumer pays for it. To continue this kind of a mineral land lottery is bad economics. On the other hand, however, any law for the disposition of mineral land, whether by lease or not, should provide large rewards for the real prospector and the wild-catter, who so often stake their all against an uncertain and secretive Nature; when they lose they have no redress, and when they win, their discoveries usually add more to the nation's wealth than to their own pockets. They deserve to be in the preferred class; but why offer the same reward to the taggers-on, who simply rush in to grab a share in a sure thing?

Rights of the Individual

A third side of this proposition is the question of the inalienable right of each citizen to his share of the nation's mineral wealth. This vague right has possibly come to appear more definite and substantial in recent years because of magazine statistics setting forth our per capita share in the wondrous wealth represented by Alaskan coal, but even writers with much more information and sense also speak of the unconditional free grant of valuable minerals as the something-for-nothing that goes with American citizenship. There is more reason in figuring the citizen's right and interest in any undeveloped minerals as a double one: (1) that measured by the possibility of the mineral being mined and thus made useful at a cost to him that shall not be unnecessarily high, and (2) his right to an equal chance to undertake mining within the limits of his own ability. He has absolutely no right to a speculative profit from public mineral lands, and his profit as a producer should be measured by his own productive contribution. It follows that it is absurd to talk about free or unconditional grants of mineral land as a perquisite of American citizenship. The privilege should pass only on condition of productive labor. The real intent, and in fact the stated purpose, of our old mining statutes is development which means use, and some attempt has been made in each law to make that the condition of occupancy of mineral land. This principle seems absolutely right, and new legislation needs only to enforce the idea best set forth by E. B. Kirby at the Tonopah meeting of the Mining Congress—"Dig or get off the claim." As I remember his plain talk at that time, we do not need to blame either Congress or the Land Office for the paralysis of mining districts, but need only to look around and see the idle claims whose owners are waiting for something to turn up and somebody else to turn it up. The law needs to offer opportunity only to the mineral entryman who uses that opportunity. Equal opportunity is more theoretical than practical with men who are unequal in capacity and purpose. The use the citizen is to make of the land should be the measure of his right and privileges.

Area of Mineral Claims

In the matter of acreages, the various mineral land laws present some curious features. The lawmaker appears to have harked back to the homestead idea, but it takes little experience to show that 160 acres, which will provide a home on the land, counts for little, for instance, in the opening of a coal mine that will have a half-million ton annual output and involves a half-million dollar investment. These legal obstacles naturally resulted in the creation of a class of dummy entrymen and speculative middlemen who grabbed government land for the purpose of selling it to the bona fide coal operators. Experience shows that it is a purposeless and bad economic policy for the government to dispose of such mineral lands in small lots simply to give everyone his chance. Let the particular use to which the land is to be put determine the appropriate acreage, and give the man who is to put the land to that use the chance to deal directly with the federal owner, and not force him to pay an idle middleman's profit.

With these purposes in mind, and with due regard for changed conditions both in the mining industry and in public opinion, how can federal legislation meet the nation's need? As a summary, I can do no better than express my conception of the main essentials of a new mining code, following in general the analysis of the whole problem recently outlined by the special committee of the Mining and Metallurgical Society of America:

1. Land classification is the duty of the landlord, private or federal, as a preliminary to the disposi-

tion of any or all of the natural resources the land contains. Separation of surface and mineral rights follows as the logical result of classification, wherever there is any reason to consider that there may be more than one estate in the land.

2. While the title to the surface of lands suitable for agricultural use should be granted in fee, thus continuing the wise policy of encouraging home making, public interest, and the need of protecting the consumer against private monopoly are believed to justify the retention in the government of such surface resources as timber and water-power, because their cheapest and fullest use is best secured by operation in large units. Even more important is the reservation by the government, at the time that the surface patent is granted, of all mineral wealth beneath the surface for separate disposition, under mineral land laws. In private transfers of land the reservation of mineral rights is becoming more and more the common practice.

3. The possessory title to the mineral should be retained in the government, not for the purpose of asserting any theory of 'sovereign patrimony' or 'regalian right,' but simply as a practical method of assuring development under the best conditions. Let us regard the federal government as a trustee rather than as a sovereign landlord, and the idea and purpose of proprietorship by the people becomes more easily understood.

Leasing of Mineral Lands

The application of the lease idea to the mining of precious metals, while logical in certain respects, is not at all of comparable importance with its application to what have been termed 'public utility' mineral resources, such as coal, petroleum, phosphate, and potash. The utilization of this class of resources is of prime importance and questions relating to their disposition have a practical rather than an academic interest. Leasehold has the advantage over permanent alienation in that it allows the government to exercise continued control in the public interest. Such control is essential in order to promote use and discourage speculative non-use, to prevent control of large land holdings by powerful corporations for such monopolization as works to the detriment of the consumer, and also to permit and even to promote consolidation of holdings and centralization of operation where large units are favorable to the public interest. To work out control of this type, the mining law should provide for prospecting permits that will give exclusive occupancy during short periods—long enough, however, for full exploration—under terms and conditions whose sole purpose should be to insure that only bona-fide prospectors will enter the land and that they will do purposeful work. The annual assessment farce has had a long enough run. The prospecting permit will ripen into a lease whenever the results of exploration justify the operation of the property on a producing basis. Where the proof of coal or oil or other mineral substance in commercial quantity is a discovery of the type termed 'wildcat' in the case of oil, the prospector rendering such service to the industry and to the public should receive his lease upon purely nominal terms.

No bonus or rent should be exacted from the lessee, except possibly rent during any period of temporary cessation of production, and that simply as a means of discouraging non-use. The royalty on the product, whether figured on quantity or value of output or on net returns, should be no higher than is necessitated by royalties or other charges prevailing for similar products under private leases in the same locality. Wherever the price to the consumer could be directly affected by the royalty to the people's trustee, the royalty should be lowered to a nominal figure.

The essential features of the lease should be conditions enforcing full and continuous use, economy, and safety of operation, and control of occupancy. Transfers should not be prohibited, but simply made subject to approval by the people's representative. If in any region large units of production are seen to favor lower costs and longer lived industry, all for the public good, consolidation of holdings should be encouraged and transfers of leases permitted; but if the purpose of large holdings is monopolization in order to curtail production and raise prices, transfers to that end should be denied the executive approval necessary to make them effective.

Public Control

As I look ahead, and not so far ahead either, I believe I see the following propositions stand out plainly in the future status of mining on the public lands. The mining men, like the rest of the people, will see that this big productive business belongs in the public-service class; because its products are so largely necessaries of life, the mining industry will be regulated by the people; the control of public mineral lands will be exercised largely through a leasing system, simply because in this way the public owner and private operator can best coöperate, and the purpose of this sympathetic coöperation will be to lower costs of production in order to permit reasonable prices to the consumer, and at the same time provide fair wages to the mine worker and adequate profits to the capitalist and operator—that will be public control, but not Socialism.

Diamond output of the Union of South Africa during the first half of 1913 was as follows:

	Carats.	Value.
Transvaal (Premier and others)	1,081,995	£1,482,510
Cape Colony (De Beers at Kimberley)	1,250,775	3,635,282
Orange Free State	273,560	839,834
Total	2,606,330	£5,957,626

The De Beers company will celebrate its twenty-fifth anniversary by granting certain holidays on full pay to its employees.

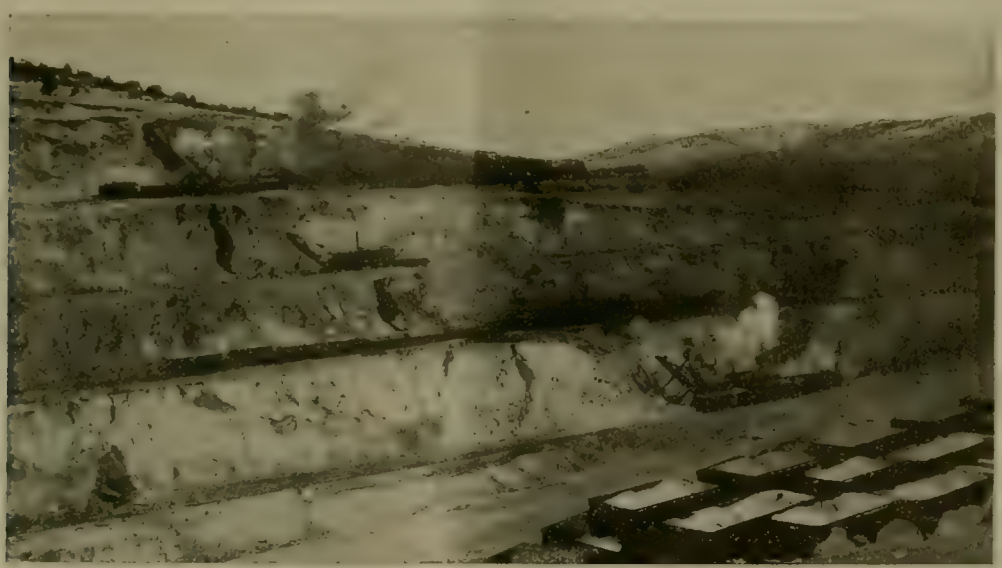
Mine-rescue work is receiving deserved attention in Canada as well as in the United States. In addition to the rescue and training stations at Blairmore and Lettisbridge opened in 1912, there are now stations at Kipp and Edmonton and a mine-rescue car furnished by the Canadian Pacific. All these are equipped with Proto rescue apparatus, oxygen pumps, oxygen reviving apparatus, electric hand lamps, and other equipment.

Blast-Hole Drilling in Open-Pit Copper Mining

*At Copper Flat, Nevada, the Nevada Consolidated Copper Co. is mining copper ores with steam-shovels in open pits. This mine is classed with the so-called 'porphyries' such as those at Bingham, Utah, and Santa Rita, New Mexico. The mines of this character have large orebodies containing from 40,000,000 to 400,000,000 tons of copper ore, with a copper content of 1 to 3%. The ore is capped by barren material, the ratio of which to the ore is so small that open-pit mining can be carried on more economically than underground mining.

The Copper Flat Orebody

The Copper Flat orebody covers an area about 3600 ft. in length and 1200 ft. in width, and has an average thickness of about 220 ft. The overburden has an average thickness of about 100 ft. The ore consists of chalcopyrite, chalcocite, and pyrite disseminated through a highly altered porphyry. The stripping is a thoroughly leached and highly altered porphyry.



STEAM-SHOVELS AT ELY.

Seven 95-ton and one 70-ton Bucyrus steam-shovels are used to remove the overburden and mine the ore. The shovels operate on benches which are usually 50 ft. apart vertically, and are about 50 ft. in width. The ore is loaded into Ingolsby ore cars of 120,000 lb. capacity. Eighteen-yard Oliver side-dump cars are used to haul the stripping to the various dumps. Both the ore and dump cars are hauled by 65-ton, 6-wheel, saddle-tank locomotives. There are twelve locomotives of this class in use around the pits. Five 85-ton locomotives are used for the transportation of the ore to the smelter, a distance of 23 miles by rail.

During the calendar year of 1912 a total of 3,981,221 cu. yd. of ore and waste was excavated by the steam-shovels. Practically all of this material had to be blasted before the steam-shovels could dig it. On account of the height of the banks and the volume of the material handled, either 'gopher' holes or blast holes must be used in order to blast the ground and keep pace with the shovels. 'Gopher holes' are adits driven into the base of a bank with a cross-cut on each side at the face, forming a T. The explosives are placed in the cross-cuts, tamped, and exploded. A 'gopher hole' is expensive to drive and cannot be efficiently tamped, necessitating the use of additional explosives. Blast holes are put down vertically through the bank and are about six inches in diameter. These are chambered at the bottom with explosives to admit a sufficient charge to break the ground. Blast holes are quickly and cheaply drilled, and can be well tamped. To blast the material excavated in 1912, 2306 holes, having a total footage of 64,846, were drilled in ore, and 2226 holes, aggregating 83,263 ft., were drilled in stripping, or a grand total of 4532 holes, and 148,109 ft. Of these, but two holes, amounting to 110 ft., were drilled which could not be used.

Blast Holes

All blast holes are drilled with eight No. 5 and one No. 3 Keystone churn-drills. These are all traction, cog-hoist drills. The drills have been remodeled slightly to suit local conditions. Jars are seldom required, consequently the strings of tools are shorter than ordinarily. For this reason a shorter mast is used, thereby lowering the centre of gravity. When moving from one hole to drill another the mast is left up and the lower centre of gravity makes the drill less liable to tip on rough ground. All operating rods have been changed to levers and are put upon the inside of the bed instead of outside. The walking beams have been reinforced, and the spudding wheels on the beam are attached to steel I-beams. The material in several other parts has been made

*From Keystone Drill *Magazine*, and Colorado School of Mines *Magazine*.

specially of a cast steel instead of cast iron, to withstand the rough usage to which they are at times subjected. Probably many of the alterations would be unnecessary if more experienced drillers were employed. Many of the drillers have not run a drill more than six or eight months, yet they drill as many feet of hole each shift as some who have drilled for years.

Each drill has the following equipment:

200 ft. of 2-in. manila cable.
150 to 160 ft. of ⅜-in. wire sand line.
1 standard Keystone rope socket.
1 4-in. by 20 ft. drill stem.
1 5⅝-in. No. 100 'Mother Hubbard' bit.
1 12-ft. sand pump (this is made from 4¼-in. casing at the shops at Copper Flat).
1 10-in. Keystone steam-driven blower.
1 forge, consisting of a pipe 2 by 36 in. and a wood box 32 by 36 inches.
1 right hand tool wrench for 3½-in. squares.
1 left hand tool wrench for 3½-in. squares.
1 single acting floor jack and circle.
2 No. 6 Barrett lever hoisting jacks.
1 spectacles.
1 anvil billet and block (this consists of a piece of 75-lb. rail one foot long, spiked to a 2 by 12-in. plank).
3 to 7 50-gal. barrels (3 are used in summer and 7 in winter).
2 gasoline torches.
2 16-lb. sledge hammers.
1 set small tools, such as machinists' hammers, wrenches, and files.
Small repair parts are also usually kept on hand, such as extra water glasses, gaskets, and pipe fittings.

Drilling Cable

The best length of drilling cable to use is 200 ft. At least 125 ft. are needed if the mast is to be lowered or raised. The rope will wear most where it is in contact with the spudding pulleys and sheave pulley, and in time must be spliced. Three splices will shorten the rope about 40 ft. After a rope has been worn out there is about 60 ft. of good rope left on the drum. Generally this 60 ft. can be spliced on to a rope having three or four splices, making a practically new rope for that drill. The other drill receives a new cable. By careful manipulation much rope can be saved in this way, and 200-ft. lengths are best suited for this purpose.

Bituminous coal is used under the boilers, and is mined at Castle Gate and Clear Creek, Utah. Water is delivered to the drills by pipe-lines from springs eight miles distant.

The drilling crew consists of one driller and one tool dresser. A foreigner, known as the coal boy, supplies two drills with coal from piles placed about every 100 ft. along the bench, and he also shovels the coal from standard coal cars to make new piles.

The drills are operated for two shifts of 10½ hours each in every 24 hours. The day shift starts to work at 7 a.m. and at 12 noon shut down for lunch. Work is resumed at 12:30 p.m., and continues until 6 p. m. The night shift starts at 7 p.m. and follows the same schedule as the day shift.

All blast holes are drilled to a depth of 3 to 5 ft. below grade, that is, a hole of 55 ft. in depth is drilled for a bank 50 ft. in height. This removes all danger of the steam-shovels encountering unbroken rock. The holes are spaced about two-thirds of their depth apart. The slopes of the banks average 45°, thus the edge is a distance equal to the height of the bank back from the toe below. Holes for a bank 50 ft. in height are drilled to a depth of 55 ft., are spaced about 37 ft. apart, and are put as close to the upper edge as they can be conveniently drilled; generally about 10 ft. from the edge, or 60 ft. back from the base.

Method of Drilling

After a drill has completed a hole and moved to the next spot, the rear wheels are made as nearly level transversely as possible by running one wheel up on blocking if necessary. Usually blocking is not needed, but occasionally a rough piece of ground is encountered. The wheels are then blocked to prevent the drill from moving and the traction pin is removed. Two track jacks are placed beneath the front end of the bed, and are used to relieve the front wheels of the weight they usually support, also to level the front end of the drill transversely. Transverse leveling is imperative in order to keep the belt on the pulleys while the machine is running. If it is possible to drill at all, no attention is paid to longitudinal leveling. Drills are sometimes operated with the tools hanging almost to the end of the A-frame tool guide, and, again, with scarcely any room between them and the front of the machine. It is well, however, to have at least 2½ ft. between the front of the drill and the tools. It is well to remember, in blast-hole drilling, that much valuable time may be lost in attempting to level a drill longitudinally. A 4-ft. piece of 7⅝-in. casing is used to guide the tools when drilling is started. This has two coils of old 2-in. drilling cable wrapped about it to prevent it from sinking into the hole, also to furnish a hold in removing it after the hole is finished. This short piece of casing is locally known as a 'conductor.' As mentioned above, the ground is blasted from 3 to 5 ft. below grade, so, for a few feet, the holes are drillled in broken ground. The 'conductor' keeps this broken ground from falling into the hole. Until the hole is about 4 or 5 ft. deep the drill must be run relatively slowly, but, below this depth, it is run at a speed of about 58 drops per minute. The hole is baled out every 2½ or 3 ft. and the sludge is allowed to run down the bank below. After the hole is completed the tools are pulled up as far as possible, and are tied to the bed of the machine to prevent them from swinging while the drill is moving. The dart of the bailer is tied to the rope on the conductor and the conductor is pulled out of the hole. The bailer, or sand pump, is hauled up into the A frame, which prevents it from swinging enough to do any damage. The track jacks are removed, the traction pin is put in place, the blocks removed from the wheels and the drill is moved to the next spot.

When it is necessary to move a drill from one bench to another, a considerable distance, or from, or to, a place difficult of access, a locomotive crane

of 30-ton capacity is used. Three chains of proper length are used to take a hold on the drill; one is attached just above the front axle and the other two are attached to the two rear wheels. The mast is not lowered, nor are the tools taken off the machine; the fire is not drawn and the boiler is not blown out. In fact, the machine is ready for work as it is loaded upon a flat car. A barrel of water is put in the bed of the drill and all other equipment is put upon the flat car. When the drill is unloaded it simply moves to its place and starts drilling. The barrel of water is used until a pipe line is laid to the drill, so no time is lost after the drill is placed upon the ground.

Moving the Drill

Formerly, all moving was done by preparing roads and running the drill on its own power. The advantages of moving a machine with the crane are that much time is saved in moving, alone; three men besides the driller and tool dresser can move the drill with the crane, whereas at least ten men are required to make roads and move equipment, otherwise. Frequently when moving a drill under its own power the drill has to travel a considerable distance along a track, and the rear wheels split many of the ties in so doing. The machine is jolted and strained appreciably, and the track is also tied up, thereby tying up a steam-shovel. If it is absolutely necessary to move a drill by its power, the tools are tied underneath the drill and dragged along the ground. A barrel of water is put in the bed of the machine, and the balance of the equipment is generally moved on a push car.

The average amount of hole drilled during a shift of 10½ hours is 60 ft. William Gibson now holds the local record of seven holes 25 ft. in depth, drilled in one shift. This was done in mid-winter, with the thermometer well below zero. During the month of August, 1912, a series of holes 15 ft. deep were drilled by one drill, aggregating 2745 feet.

A working steam pressure of 100 lb. per square inch is used on all drills. The consumption of coal amounts to 600 lb. per shift. Twelve 50-gal. barrels of water will furnish the boiler and the drill-hole one shift. The following lubricants are required: ½ pint engine oil, 1 pint valve oil, 5/7 lb. cup grease per shift; ½ gal. of gasoline will furnish illumination for one night.

The drills receive harder usage than that for which they are designed, and more or less repairs and renewals are necessary on that account. The use of the crane in moving has materially reduced repairs. By carefully noting the parts which break most frequently, and either changing the material of which they are made or increasing their size, renewals have been reduced to a great extent. Repairs are made in the field until the drill loses its efficiency. It is then taken to a well equipped machine shop, entirely dismantled and rebuilt. This allows all defective pieces to be noted and replaced properly.

A BENCH AT ELY, SHOWING DRILLS AND STEAM-SHOVELS.

Blasting

The friability of the ground is the chief factor of blasting. No set rules can be given for the most efficient use of explosives. The amount and kind of explosives to use must be determined by much experimenting. However, the following may be used as a basis upon which to start experiments. For holes 45 ft. in depth, use ten sticks of 60% semi-gelatine Red Cross powder to start chambering; the amount should be tripled for each succeeding chambering charge, that is, first 10 sticks, then 30 sticks, then 90 sticks, etc., until the chamber is large enough to receive the blasting charge. For a blasting charge use 25 lb. of black powder for every foot

of hole which has been drilled.

For holes 90 ft. in depth in solid hard rock, start chambering with 25 lb. 60% Red Cross powder, and triple each succeeding charge. Tamp the first charge with 20 gal. of water and triple the tamping with each succeeding charge. The blasting charge is 25 lb. black powder per foot of hole. A blast hole will break ground in back of it about one-quarter the distance it breaks in front. By the front is meant the side offering the least resistance. All blasting and chambering should be done by electricity, using electric exploders recommended by the powder manufacturers.

The following explosives are in use at Copper Flat: FF black powder for use in blast holes; stick Trojan No. 2 for use in blast holes in hard rock and for 'bulldozing'; bag Trojan for use in blast holes; 60% Red Cross powder for chambering; and 40% Hercules powder for chambering in soft ground.

During the year 1912 the following quantities and kinds of explosives were used:

	Lb. per ton.	Lb. per cu. yd. stripping.
Hercules 40%	0.0824	0.0910
Black FF	0.0762	0.2732
Stick Trojan	0.0689	0.1780
Bag Trojan	0.0439	0.1568
Gelatine 60%	0.0019	0.0037
Red Cross 40% N. G.	0.0059	0.0032
Red Cross 60% semi-gel.	0.0038	0.0031
Giant Ammonia 40%	0.0025	0.0015
Total	0.2855	0.7105

2.16 tons ore = 1 cu. yd.

These quantities include explosives used in 'dobying' or 'bulldozing,' but in spite of that they show clearly the efficiency of the blast hole method.

China as a Tin Producer

China is one of the important tin-producing countries of the world, being surpassed only by the Straits Settlements and Bolivia. According to a recent consular report, the mine production is expected to reach 14,000 tons of tin for 1913. Nearly all the supply is brought from Yunnan to Hongkong, where it is refined and shipped to Europe and America or distributed to the Chinese market. The output of Yunnan is now hampered by limited water-supply, difficulty of transport, and the high cost of fuel and food. The Yunnan deposits have recently been described by one of the engineers engaged in the survey of a railway line from Nanking to Yunnan-fu, and it will be seen from the following statement that the Chinese production is likely to rapidly increase.

Ko-Chiu is situated in a depression on the summit of a range running northeast-southwest, latitude 23.18 N., longitude 103.10 E., is within about 21 miles of the treaty port of Meng-tze, and within 23 miles of the French railway station of Pi-Chi-Chai. Meng-tze, situated in the middle of a plain about 20 miles north and south by an average of 5 miles east and west, is a small town of 3000 inhabitants. Ko-chiu is at an elevation of 5916 ft., actual survey made by W. S. Dawley, on the survey of the Pi-Chi-Chai Ko-Chiu railway, which it is proposed to build this fall. Meng-tze and the plain are at an elevation of 4725 ft. The plain and treaty port lie at the east of Ko-Chiu. There being no great supply of water at Meng-tze or on the plain, and no water at all at Ko-Chiu, the greatest part of the tin-bearing area cannot be worked, as water is essential to separate the ore from the sand. At present water even for drinking and domestic purposes has to be carried to Ko-Chiu from Meng-tze plain on mules. German interests have constructed a tin-refining plant at Ko-Chiu to turn out 50 tons of standard tin per day by coal-gas furnaces. It has never been fully worked, as all the coal has to be transported from Pi-Chi-Chai by mules, but as soon as the branch line is built, coal will be plentiful, and if water can be had the output will probably exceed 50 tons per day, as at present without a refinery the output is over 30 tons per day from the native smelters, which turn out tin averaging 84% pure, to be shipped to Hongkong for refining in native furnaces.

The Red river, which runs about 22 miles west of Ko-Chiu, is navigable by small boats up to a point nearly due west of Ko-Chiu (elevation 820 ft.), and a tributary rising to the west of Ko-Chiu falls nearly 4000 ft. in 22 miles. This is important, as at a point estimated about 18 miles southwest from Ko-Chiu about 10,000 hp. could be obtained. Ko-Chiu has a population of about 20,000 and is rapidly growing. Tin is found from the east side of the range, about 8 miles from Meng-tze, to the western bank of the Red river, an area 24 miles wide by about 56 miles long. It is required to deliver from the tributary of the Red river, before mentioned, to the town and mountain sides near Ko-Chiu and to the refinery, water to the extent of about 1,000,000 gal. per day of 24 hours, from a point about 18 miles distant and 3000 to 4000 ft. lower. The hydro-electric power would be generated (1) to supply the high-lift pumps with power, (2) to provide light for the towns of Ko-Chiu and Meng-tze, and (3) to supply power for mining purposes in Ko-Chiu and adjacent country. It is estimated that the total gross cost of such a scheme would equal about $3,644,000, although this estimate might be considerably reduced, as a complete survey of the western slopes toward the Red river would in all probability result in a nearer source of supply being discovered.

Operations at the Braden mine, Chile, during August resulted in the treatment of 61,874 tons of ore, with 68.06% extraction, yielding 1,572,000 lb. of copper. Development advanced 31 metres in the Fortuna adit No. 2, in which the last 63 m. assayed 3.09% copper. No. 2½ Fortuna assayed in its last 9 m. 2.55% copper. Teniente No. 1 advanced during the month 61 m. In the latter opening an average assay of 4.39% was recorded in the last 72 m. July's assays in the same opening averaged 4.73% copper for a distance of 38 metres.

Mt. Morgan, Queensland, smelted 23,705 tons of ore in July, yielding 766 tons of blister copper containing 9384 oz. gold.

The Rand Banket and Its Gold Content—III

By C. B. Horwood

Structure of the Pyrite 'Pebbles'

The term 'concretions' denotes bodies of secondary origin, with superinduced structures of various sizes, usually spherical or lenticular; but, they may occur as layers, veins, crystals, or twin crystals, or as groups or aggregates of crystals. They originate by the aggregation of mineral matter around a central point, frequently about an original nucleus that may have been mineral matter, but more usually was organic. This growth is usually due to gradual accretion of mineral matter originally diffused through the rock; but sometimes the mineral substance has been introduced into the rock later by circulating solutions. Thus the growth has essentially been from within outward. Silicious, calcareous, or ferruginous concretions are the commonest. A concretion may be compact and homogeneous throughout or may consist of concentric shells. While compact externally, it may be much cracked and fissured internally. The cracks are widest toward the centre of the concretion and die out toward the circumference, as if the interior had contracted after the outside had dried and become consolidated. These cracks are often filled subsequently with mineral matter. That there is a great tendency for spherical concretions to assume either internal, radiating, or concentric structure is well known;[80] but, as far as the author is aware, no real attempt has been made to explain the reason of this. Apparently, the fact that such structures are exhibited by some of the pyrite 'pebbles' of the Rand conglomerate has been considered sufficient evidence for classing them as concretions. Later it will be shown that this may be a superinduced structure due to contraction; and if so, it does not necessarily imply a concretionary origin for the substance in which it occurs.

Crystalline and Concretionary Structures

In discussing, in 1907, the author's paper describing the Crown Reef occurrence, F. H. Hatch maintained that the 'pebbles' (specimens of which were exhibited at the meeting) were nodules with radiate structure, evidently of concretionary origin.[81] Again, he and G. S. Corstorphine,[82] referring to the presence of a considerable proportion of iron pyrite in the unoxidized portion of the Rand conglomerate, state that it occurs in grains that with the unaided eye can be seen to be sometimes round, sometimes partly formed, and sometimes perfect crystals showing combinations of cube, octahedron, and pentagonal dodecahedron. Also, that larger rounded nodules of pyrite occur, some of which have quite a pebble-like appearance; and, further, they examined as many specimens of them as they had been able to obtain and in quite a number of them they had observed a radially fibrous structure, while others showed that the growth had been by concentric coats. They describe the appearance of specimens exhibiting radiate structure from the Buffelsdoorn mine,[83] and state that some from the same mine have a concentric structure. They point to the remarkable fact that almost every author who had previously referred to the rounded 'pebbles,' regarded them as owing their shape to attrition; but that, in their opinion, the bulk of the so-called 'rolled' pyrite owes its shape to growth by accretion.

Growth of Pebbles by Accretion

Merely to state an opinion that the 'pebbles' owe their shape to growth by accretion, or that they are concretions, proves nothing. It leaves the problem where it was before. Were they formed on, or only slightly embedded in, the soft ooze or matrix of a shingle deposit, in process of being laid down along some littoral, or in some estuary or delta? If so, they would have grown by accretion round some central point, making room for themselves by forcing aside the soft matrix; and would not have replaced quartz, as investigation with the aid of the microscope shows that they undoubtedly have done. Have they perhaps been formed in previously existing primitive cavities, spaces of discission or spaces of dissolution,[84] by precipitation from solution? It seems highly improbable that such cavities, if they ever existed, would have so effectively overcome the surrounding pressures as to have remained open sufficiently long to allow time for the formation of these 'pebbles.' Again, as already pointed out, it is hardly conceivable that they could be water-worn pebbles when one realizes the great age of the Witwatersrand conglomerates; the changes to which they have been subjected; how porous they must formerly have been, and how easily iron pyrite is decomposed and carried away in solution as iron sulphate by circulating solutions. Therefore, by what Posepny called negative indications[85] of metamorphosis, one

[80] James Geikie, in his admirable work, 'Structural and Field Geology' (2nd Ed., 1908; Gurney & Jackson, London), devotes an interesting chapter to the discussion of 'Concretionary and Secretionary Structures,' from which the above description has been condensed.

[81] Abstract of the *Proc.* of the Geol. Soc. Lond., No. 841, March 5, 1907.

[82] "The Petrography of the Witwatersrand Conglomerates, with Special Reference to the Origin of the Gold," by F. H. Hatch and G. S. Corstorphine, *Trans.* Geol. Soc. So. Af., Vol. VII, Part III (1904); also, 'The Geology of South Africa,' by Hatch and Corstorphine (2nd Ed., 1909; Macmillan & Co.), pp. 142-144.

[83] This is a banket mine, near Klerksdorp, about 100 miles southwest of the Rietfontein mines, and some 70 miles southwest of Randfontein.

[84] See 'The Genesis of Ore Deposits,' by F. Posepny (2nd Ed., 1902), pp. 13 and 74 *et seq.* (published by Amer. Inst. Min. Eng.).

[85] In treating of metamorphosis, he writes: "Frequently, however, there are only negative indications of the metamorphosis. It can be seen merely that the deposit is not an original rock, that it has not been deposited in pre-existing primitive or secondary cavities; and hence, that it must have been formed by replacement." F. Posepny, *loc. cit.*, p. 16.

is forced to the conclusion that, whether concretions or not, they must have originated by the replacement of some preëxisting matter.

Although in 1907, F. H. Hatch opposed the present author's conclusions that these 'pebbles' are metasomatic replacements of quartz and that possibly some are pseudomorphs after quartz pebbles, yet two years later he admits that the possibility of pseudomorphism after quartz must be considered.[86] Further, in support of this, he refers (as the present writer had done in 1907[87]) to Kuntz's[88] description of the occurrence in the Meyer & Charlton mine, on the Central Rand, of conglomerate in which both quartz pebbles and matrix have been replaced by calcite.

Replacement of Quartz by Pyrite

The detailed study of the Crown Reef occurrence, already outlined, showed that the pyrite had replaced the quartz, either of the pebbles, or of the matrix, or of both as the case might be, the quartz going into solution while the pyrite was precipitated in its place. Further, it has been shown that the microscopical examination, in thin sections, of the Rietfontein Buckshot Reef demonstrated that in this case also, the pyrite pellets have been formed by the replacement sometimes of the quartzitic matrix and sometimes of the quartz pebbles of the conglomerate, the original structure and outlines of each being, in some of the pellets, still clearly discernible under the microscope. In others, which evidently represent a later stage, these outlines are obliterated and a radiate or concentric structure has been developed. Also, both the Rietfontein and Randfontein occurrences showed that in addition to the banket matrix being replaced, the angular slaty quartzite pebbles and the well rounded normal quartzite and quartz pebbles are pseudomorphically replaced by pyrite. Thus, in addition to merely negative indications, the detailed study of the actual occurrences combined with petrological investigation has now furnished direct evidence that these 'pebbles' are metasomatic products[89] that made room for themselves by the expulsion of an earlier material.[90] Close study underground; the examination under the microscope of thin sections of the 'pebbles'; similar study of transitional forms, such as those previously described, which fortunately have been preserved; and careful examination of hand specimens, have clearly shown that this is what has happened; and that as just stated, the pyrite sometimes replaced the quartzitic matrix, sometimes the quartzite or quartz pebbles, the former being apparently the more usual; and, further, that some 'pebbles' have been formed by the indiscriminate replacement of quartzite or quartz pebbles and matrix.

When the replacement took place it may, or it may not, have done so by equal volumes. From an examination of the plates accompanying this paper, it will be seen that around portions of the edges of the 'pebbles' there is frequently a growth of secondary crystalline fibrous silica.[91] It is important to note that the direction of the position of the fibres is invariably at right angles to the edges of the 'pebbles.' This fibrous silica must obviously have been formed later than the 'pebbles.' Therefore, if replacement did not take place by equal volumes, then solution was more active than precipitation, the amount of matrix that was dissolved and went into solution having been greater than the amount of pyrite precipitated. If it were by equal volumes, some of the pyrite has since been dissolved; or after the deposition of the pyrite contraction of its mass has occurred. Thus, room was available in which this fibrous crystalline silica has been deposited. Probably the spaces now occupied by this silica never existed at any one time, in their entirety, as open cavities. If open spaces existed at all, they probably consisted of minute druses, or of pores in a porous mass. Precipitation of this silica probably took place either directly after or simultaneously with the precipitation of the pyrite; or (if the change was by equal volumes) simultaneously with its subsequent partial dissolution or contraction. The fibrous nature of the silica and the fact that the fibres invariably have a radial orientation round these pyrite bodies certainly suggest the influence, during its crystallization, of tensile stresses acting toward the centres of the pyrite bodies, such as might be due to the contraction of the pyrite.

Structure of Concretions

When discussing concretions, it was remarked that while perhaps externally compact, they may be much fissured and cracked internally; and, that these cracks are widest toward the centre, as if the interior had contracted after the outer portion had dried and hardened. These cracks are often wholly or partly filled with later mineral matter. Similar features are exhibited by many of the pyrite 'pebbles,' and analogy suggests the same explanation, indicating that the spaces now occupied by fibrous silica are due rather to contraction of the pyrite than to any balance between solution and precipitation having been primarily overcome by the former. The

[86] 'The Geology of South Africa,' by Hatch and Corstorphine, Macmillan & Co. (2nd Ed., 1909), p. 144.

[87] Horwood, C. B. (1907), *loc. cit.*

[88] 'Pseudomorphosis of Quartz Pebbles into Calcite,' by J. Kuntz, *Trans.* Geol. Soc. So. Af., Vol. VI, Part IV (1903), p. 74.

[89] Lindgren defines replacement or metasomatism as "the transformation of one mineral into another of different chemical composition, effected by practically simultaneous solution and precipitation." W. Lindgren, 'The Nature of Replacement,' *Econ. Geol.* Vol. VII, No. 6 (1912), p. 534.

[90] See Posepny, *loc. cit.*, p. 17.

[91] Young has also noticed and called attention to the frequent occurrence (in association with pyrite 'pebbles') of this fibrous silica. R. B. Young, 'Notes on the Auriferous Conglomerates of the Witwatersrand,' *Trans.* Geol. Soc. So. Af., Vol. X (1907), pp. 18-23. In this connection it is interesting to note that, if the white powder found in the middle of many flints be examined under the microscope, in addition to minute organic skeletons composed of carbonate of lime, silicious sponge spicules will also be found. Some of the latter may be partly dissolved. In others, the original hydrated silica will be found to have been deprived of its water and converted into fibrous crystalline silica consisting of slender prisms crowded in radiate growth about centres. Presumably, this change has occurred by solution of the hydrated silica and its subsequent deposition in this form as secondary silica. However, it is possible that this secondary silica may be the result of a direct transformation of the hydrated silica or opal, but this is less likely. (See W. J. Sollas, *loc cit.*, p. 149.)

small rounded or partly formed grains of iron pyrite, which occur in the matrix of the conglomerate, are too small for any appreciable contraction to have taken place. As regards the crystals of pyrite[92] in the matrix, it is evident from their development[93] that the force of crystallization has come into play; contraction has not taken place, for the pyrite retains its sharp crystalline form, and therefore the definite arrangement of its molecules which determines that crystalline form has been retained, and the crystals are not partly or otherwise surrounded with secondary fibrous silica. The crystal faces of the pyrite cut across, project into, and are partly imbedded in the granules of the matrix, and sometimes also in the pebbles, without interstices or the slightest break in the contacts. The crystals fit closely into whatever the host material happens to be, in which they occupy exactly the spaces needed for themselves. Their metasomatic origin, unattended by contraction, is thus clearly demonstrated. The conclusion is therefore supported that, where space has been available around the 'pebbles', it has been due to the subsequent contraction of the latter, rather than to the pyrite having originally occupied less space than the material replaced. It is evident, at least in some instances, as will shortly be shown, that the pyrite does not now occupy so much space as the material dissolved; and there would seem to be sufficient reason for believing that contraction has taken place. This contraction may, or may not, have been sufficient to account for the whole of the space now occupied by secondary crysalline fibrous quartz. This is a matter to be discussed later.

Deposition of Metals

Sullivan[94] has pointed out that the immediate condition in which a metal is thrown down from solution by a silicate is of secondary importance, as the newly formed substance is subject to spontaneous change into a more stable form, as from an amorphous or colloidal to a crystalline structure;[95] and is also subject to the modifying and transforming influence of continually renewed portions of active solutions. He also proved, by numerous experiments undertaken in the chemical laboratories of the United States Geological Survey, that the natural silicates precipitate the metals from solutions of salts, while at the same time the bases of the silicates are dissolved in quantities nearly equivalent to the precipitated metals, and that where exact equivalence is wanting it is attributable either to solubility of the mineral or to precipitation of basic salts.[96]

Changes in Structure of Pebbles

As will be shown shortly, changes in structure have certainly occurred in the pyrite pebbles since the deposition of the pyrite. It is conceivable that the latter was first precipitated in an amorphous state and later assumed a crystalline form; perhaps existing first as marcasite,[97] and then, owing to molecular changes, as pyrite. The mere change from an amphorous to a crystalline mass would probably be attended rather by an increase than a diminution in volume, depending on the massing of the molecules in the crystals[98] and of the grouping of the crystals themselves. During precipitation some gaseous or liquid solutions and other impurities may have been enclosed, which later were either occluded or dissolved out, or both, causing contraction of the mass. That contraction has in some, if not in all, cases taken place is evident from the following considerations. In a few instances the struc-

[92]Which are sometimes as much as ¼ in. or more in diameter.

[93]Lindgren has pointed out that in metasomatic processes pyrite is one of the minerals which, contrary to the general rule, show such a strong tendency to crystallization that the crystal form asserts itself in rigid material. W. Lindgren, 'The Nature of Replacement,' *Econ. Geol.*, Vol. VII, No. 6 (1912), p. 533.

[94]Sullivan, Eugene C., 'The Interaction between Minerals and Water Solutions,' U. S. Geol. Surv., Bull. No. 312, p. 61.

[95]In this connection it may be recalled that metals are usually precipitated from solution in a fine state of division as amorphous powder. Copper, for example, is thrown down as a fine dark-brown amorphous powder in the cementation process for the extraction of copper from solution by means of scrap iron. Gold is precipitated on zinc in the extractor-boxes, in the cyanide process for the recovery of gold, as a fine black amorphous powder. When assaying gold, in the ordinary process of 'parting' (dissolving silver and any other impurities that may be present) with nitric acid, the gold comes down as a brown or almost black powder; possibly this is an unstable oxide, for on annealing it is quickly converted into crystalline gold of the ordinary color.

[96]The metals are precipitated as hydroxides, or basic salts, with metal silicate, and he points out that metallic sulphides could readily result from such basic compounds by reduction of the basic salts by a reducing agent. Aluminum and other silicates are present in the matrix of the banket, and an appreciable amount of that originally present may have been replaced by pyrite, which is present in the ore to the extent of about 2 to 3%. The petrological study of the banket shows that silicates, both those forming part of the groundmass or matrix and those present in the slaty quartzite pebbles, as well as silica, have been replaced by pyrite. Sullivan's work indicates that in the case of solutions of salts of the metals the replacement of the silicates by sulphides has been accomplished in two stages. The same may perhaps apply in the case of the replacement of silica. A change from a sulphate representing the first stage, to a sulphide representing the second stage, might easily be accompanied by a reduction in volume. However, it is not really known in what form the metals were present in the solutions to which the mineralization of the banket is due; microscopical investigation of the banket certainly suggests that the replacement of silica and silicates by iron pyrite took place directly in one operation; in which case any reduction in volume would not be attributable to the double process, such, for example, as the precipitation of a sulphate and subsequent conversion to a sulphide.

[97]The majority, if not all, of these 'pebbles' are composed of pyrite. Possibly a few consist of marcasite. Young states that at least some of them consist of marcasite, since specimens which have lain in the Johannesburg museum for more than ten years show a thick efflorescence of iron sulphate ('Further Notes on the Auriferous Conglomerates of the Witwatersrand,' by R. B. Young, *Trans.* Geol. Soc. So. Af., Vol. XII (1909), p. 88.)

E. H. L. Schwarz pointed out to the present writer that an easy way to distinguish between the two is to rub the mineral with hydrochloric acid, when marcasite will show its tin-white color, while pyrite will remain yellow. Those 'pebbles' which the writer subjected to this test remained yellow.

[98]The force of crystallization would here come into play. See 'Die geologische Bedeutung, des Wachstumsdruckes Kristallisierender Substanzen,' by K. Andrée, *Geol. Rundschau*, Bd. 3, fasc. I (1912). Also, 'The Nature of Replacement,' by W. Lindgren, *loc. cit.* (1912), pp. 521-535.

arate projecting boundaries, made up of crystalline faces, rather than be merged in one continuous smooth circumferential surface; doubtless the soft yielding nature of the chalk, which in this case was the host mineral, was a favoring factor. These nodules and also the 'pebbles' of the Rand sometimes present a crumpled appearance, suggestive of subsequent contraction.

Radial Pebbles

In Fig. 11, the pyrite 'pebble' on the right exhibits radial structure, resulting in a circumferential series of radial cones having their vertices toward the centre. It will, however, at once be remarked that the central portion of this 'pebble' is a typical illustration of septarian structure with radiating cracks

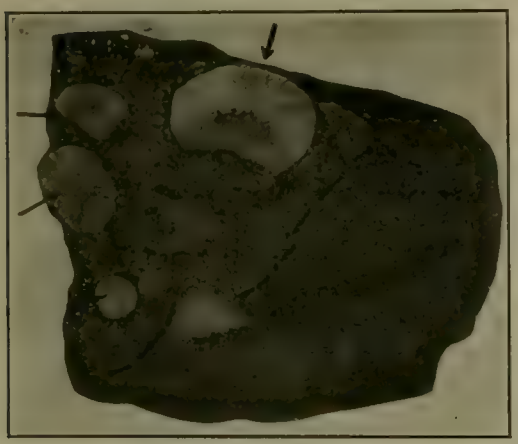


FIG. 11. PYRITE 'PEBBLES' SHOWING RADIATE STRUCTURE, IN MAIN REEF LEADER.

dying out toward the circumference. It is fortunate that both structures are to be seen so well in this photograph, for here, probably, is indicated the clue to the whole problem. The outer series of cracks, which extend to the circumference and are responsible for the radiating cones of pyrite, obviously represent the main series of fractures. It has been shown that such cracks can be produced by either expansion or contraction. Which of these has operated in this case? The Davies theory of expansion pre-supposes impregnation of the host mineral by the secondary one, whereas these 'pebbles' have been formed not by impregnation but by replacement of the host mineral. Furthermore, the microscope reveals no indication of expansion, such as signs of pressure having been exerted by the replacement product against the enclosing rock. The conclusion is that these outer series of cracks have been caused by contraction. It is noticeable that they die out as the central portion[109] is approached. This indicates that the outer portion cooled, contracted, and shrunk on to this central portion. The latter was probably at a higher temperature than the former and still semi-plastic, which would result in little tongues of it (minute dikes and apophyses, so to speak) being forced up tiny fissures in the contracting crust similar to the way that the secular cooling of the earth's crust is supposed to result in crumpling and fracturing of the crust and consequent dike intrusions. In this way, the reason the radiating cracks of the more central portion die out toward the circumference is simply explained. Irving[110] has recently remarked that the observed facts show that in by far the greater number of metallic replacements there has been an appreciable decrease in volume, which finds expression in widely distributed cavities. In the pyrite 'pebbles' of the banket a decrease in volume is represented by porosity in the replacing material, as revealed in the form of later cracks either of definite form and orientation resulting in radiate or concentric structure, or quite irregular ones, such as those shown in Fig. 6 and 7, appearing in Part II of this series of articles. That this decrease in volume is due to subsequent contraction is evident (apart from considerations already discussed) from the fact that the boundaries of the 'pebbles,' in many cases, do not coincide completely with those of the original quartzite or quartz pebbles; or (in the case of replacement of the matrix, or matrix and pebble) of the pyrite 'pebble' as originally formed, the outlines of which are still clearly discernible (see Fig. 5, 9, 12B, and 14, printed in the *Mining and Scientific Press*, October 18). In such cases portions of the present boundaries fall within the original ones and the intervening spaces are filled with secondary fibrous silica. Had the pyrite, at the time of replacement, occupied less space than the material dissolved, the surrounding pressures would assuredly have closed any cavities due to differences in the spaces occupied before and after the change. Thus one is impelled to the conclusion that the change occurred by equal, or practically equal, volumes, and was frequently followed by contraction of the pyrite and deposition of secondary fibrous silica. Herein, apparently lies the explanation of the fibrous nature of the latter, with its fibres at right angles to the circumferences of the pyrite 'pebbles.' Pressure promotes solution,[111] therefore diminution of same retards solution and also causes a slackening of the speed of flow of the mineralizers, tending to cause precipitation. Thus it is easy to understand how subsequent contraction of the pyrite would cause diminution in pressure within the original boundaries, and consequently would retard solution and also tend to start precipitation of the silica simultaneously with the contraction of the pyrite. The contraction would set up tensile stresses, exerted in directions at right angles to the surface of the pyrite, resulting in the silica being drawn out into fibres during the process of its crystallization.

Although contraction has occurred, it does not therefore follow that the original volume of the pyrite was equivalent to the original volume of quartz (or quartz and silicates) dissolved. This may or may not have been the case in a metasomatic exchange.

(To be Continued)

Coal mine fatalities in the United States during June totaled 174, and for the first half of the current year a total of 1257, as against 1226 in the same period of 1912.

[109]The darker portion in the plate.

[110]Irving, J. D., *loc. cit.*

[111]Lindgren, W., *loc. cit.*, pp. 533-534.

Development of Converter Practice

By Herbert Haas

In the *Mining and Scientific Press* of November 2, 1912, there appeared an excerpt from the well known paper by John Hollway, 'A New Application of a Process of Rapid Oxidation by which Sulphides Are Utilized as Fuel,' presented before the Society of Arts (London), February 14, 1879. In the accompanying editorial, entitled 'Development of Converter Practice,' as is usual in articles dealing with the history of copper converting, Pierre Manhès receives sole credit for having developed the first successful copper converter notwithstanding the fact that Paul David, who was then Ingenieur-Directeur of the Védennes works (Vaucluse), of which Manhès was the owner and furnished the means for the trials, did a great deal of original work, and as metallurgical engineer and co-worker of Manhès should at least share equally with him in the honor of being the first to devise a successful copper converter. Nor can I agree with a possible inference from that editorial, namely, that John Hollway made his experiments to devise a process of bessemerizing copper matte. On reading his article critically it becomes apparent that what he advocated and was trying to do is pyrite smelting as practised today. Because he used the term 'bessemerizing' and gave to his experimental apparatus the name 'converter', a number of well known metallurgists ascribe to him the important initial work of bessemerizing. As a matter of fact, Hollway wanted to get away from the bessemer converter, and so states in his article, and describes a furnace as being more practical in carrying out his idea, namely, to produce matte from pyrite ore without the use of extraneous fuel.

Using Sulphides as Fuel

Robert Sticht, in his chapter on pyrite smelting, in R. D. Peter's 'Modern Copper Smelting,' accurately remarks: "To John Hollway of England is due, therefore, the credit of being the founder of the smelting process advocated in these lines" 'A new application of Bessemer's process of rapid oxidation by which sulphides are utilized for fuel.' "When metals are extracted from their ores by fusion the necessary heat is always obtained by burning coal, coke, or other form of carbon. I wish, however, to remind you that sulphides can be made to burn in air, and are thus combustible substances, while oxides are bodies that have already burned, which as you know is the conventional expression for entering into combination with oxygen. The metallic sulphides, consequently, are natural combustible minerals, and my object is to prove that they can be utilized as a source of heat in certain metallurgical operations. The most important of the mineral sulphides is pyrite, both on account of its occurrence and the extent of its deposits." But Hermann A. Keller, in his chapter on 'Bessemerizing copper mattes', in the same work, as well as James Douglas,[1] again refers to Hollway as an experimenter trying to apply the converter to the conversion of copper sulphides. Hollway had in mind the treatment of sulphide ores, and their conversion into a molten state with a corresponding concentration of the copper sulphide into a regulus, without the use of extraneous carbonaceous fuel, but did not attempt to convert matte into copper.

A few quotations from his article will bear me out in my views. "These experiments were carried out with the ordinary bessemer plant, but for many reasons a bessemer converter is not suitable for the reduction of *cold pyrite to matte*, nor has it any arrangement for allowing the *matte to accumulate out of the reach of the blast.*" "The blowing being resumed, liquid sulphides accumulated on the tuyere hearth of the vessel, *and pyrite and sand were continuously introduced during the eight hours.*"

Form of the Furnace

"It is probable that the form of furnace eventually adopted will be a *modification* of the ordinary blast-furnace, fitted with tuyere hearth * * *, the blowing would be continuous, the hot charge coming down to a fusion zone, the height of which over the tuyeres would be determined by the amount of air blown in, and the frequency with which the blown products are withdrawn, varying likewise with the composition of the charge. The products could be withdrawn by tapping, as with a *common blast-furnace, the matte being run off from a reservoir below the tuyeres, where it would collect. Being thus unacted upon and undisturbed by the blast, rich matte, or even metallic copper, could be produced.* By continuing the oxidation and producing Cu_2S, and *some* metallic copper, the gold and silver would be found with the metallic copper."

Application of the Welsh Process

In this last sentence Hollway discloses that he wanted to make use of the well known Welsh process of bottom smelting; the concentrating of silver, gold, and impurities in a small amount of metallic copper which, if separated from the white metal, would leave the latter remarkably free from impurities, thus facilitating and cheapening the refining process of the bulk of the copper. This well known property of certain metals and metalloids to form with copper saturation products, alloys, or 'solutions,' in preference to remaining in the 'white metal' was made use of later by David in his ingenious *sélecteur* or best selecting process of making copper bottoms in the converter, in lieu of the Welsh practice of doing it in the reverberatory furnace. He provided his converter with a pocket, in which was collected the copper reduced during the first 10 minutes of blowing on white metal. This copper acts as a collector or *sélecteur* for the impurities, like arsenic and antimony, tellurium and selenium, gold, and, to a lesser extent, silver. This small amount of copper (aggregating about 10% of the total amount converted per charge) is tapped and

[1] *Trans.* Inst. Min. & Met., Vol. VIII, 1899.

leaves the rest of the copper reduced afterward (by continuing the blowing on white metal) remarkably pure and free from impurities. The importance of this practice for small works has been fully discussed by Paul David, Jannettaz, James Douglas, and others.

To continue Hollway's article: "If desired, the products could run directly into suitable reverberatory furnaces, when, after the *matte* had settled, the slag could be run off while yet in a molten state, and in which the *oxidation of the matte could be completed.*" Evidently it was Hollway's intention to oxidize this matte or white metal by the then used methods of reaction smelting, by roasting a portion of the matte and having the dead roasted and partly oxidized calcine (sulphates and oxides) react with the molten sulphides, as was done in the well known Nicholls process.

Hollway's Experiments

These quotations should prove conclusively that Hollway had not in mind the conversion of copper matte into blister copper, but that he wanted to smelt raw pyrite in order to get the copper in it into a more concentrated form, that of matte, which he wanted to collect in a hearth "*removed from the action of the blast.*" His experiments are indeed interesting as being the first authenticated attempt on record at pyrite smelting. His logic was sound as far as the well recognized facts were concerned, that sulphides can be made to burn in air and the metallic sulphides consequently are natural combustible minerals, but he made the mistake of trying to conduct the two distinct operations of smelting and of refining (which the bessemer process really is) at one and the same time and in the same apparatus. Starting with a pyrite ore, with 2 or 3% copper, and requiring the addition of ½ to ¾ ton of silicious ore, the concentration of this small copper content in the original furnace feed into blister copper would have required the handling of 60 to 100 tons of material for every ton of copper. This presents many practical difficulties, unless the two operations of smelting and converting are conducted separately. He approached this problem more as a laboratory worker than as a man who has practical knowledge of furnace operations. A parallel approaching Hollway's work is found in the Knudsen process, which attempts to smelt and convert simultaneously. The Knudsen 'converter' is, however, lined with magnesite. This process was at one time in operation at Sulitjelma, Norway, and was also tried at the United Verde smelter, Jerome, Arizona.

The Copper Converter

Reviewing briefly the essential features of the development of the copper converter, it will be found that the idea of applying the converter to the conversion of copper matte occurred to several soon after Sir Henry Bessemer's address at the Cheltenham meeting before the British Association on August 11, 1856, "on the manufacture of malleable iron and steel without fuel." Gossage, Baggs, and Keates secured patents to apply the process to copper matte in 1856. Four years later, Hunter secured a similar patent. In 1862 the Glass and Lecere patents followed.[2] In 1866 Peter von Rittinger, better known through his extensive work on ore dressing, advocated the adoption of the Bessemer process to copper sulphides, and made experiments in Hungary, in 1867, at the Schmollnitz works. In *Oesterreiche Zeitschrift für Berg-und Hüttenwesen*, 1886, pages 68-71, there is a description of his attempt to convert matte in the reverberatory furnace by passing a pipe through the matte and blowing air through the molten bath. This 'Zugutebringen der Kupferrohleche durch Verblasen derselben nach Bessemer Art' (Beneficiation of copper mattes by blowing according to Bessemer's process) met, however, with no more success than the previous attempts of others.

Bessemer Converter in the Urals

More successful was the work done at the Wotkinsk smelter in the Urals, in 1866, after Sememikow, a mining engineer, and director of the Bogoslovsk mining district, had proposed the application of the bessemer converter to the blowing of copper matte to black copper. The blowing was, however, only carried to the white metal stage, with 72 to 80% copper. The matte converted contained 31.5% Cu, 25.3% S, 39.4% Fe, and the concentrated product had the composition 77.5% Cu, 19.3% S, 1.76% Fe. The slag assayed 34.46% SiO_2, 4.73% Al_2O_3, 3.06% CaO, 55.26% FeO, 2.13% CuO, 0.11% S, and metallic copper 1.7%. About 1300 lb. was handled per charge. An English type of then standard steel converter was used. This blowing operation, taking about 20 minutes time, obviated at least one roasting and re-smelting of the matte by a slow and tedious process, the white metal thus obtained by converting being dead roasted and smelted to black copper in a reverberatory furnace.[3] The patents of Rath in America in 1866, of Dixon in England in 1869, of Gibb, Gelsthorp, and Tessie du Motay in 1870, and of Lavoissier in 1874 evince the interest men gave to this matter of devising a successful process for the bessemerizing of matte.[4] In 1878 and 1879 Hollway made his interesting experiments in pyrite smelting.

The Védennes Smelter

In 1880 Pierre Manhès and Paul David attacked the problem at the Védennes smelter, in Vaucluse, France, of which Pierre Manhès was the owner, and David the engineer in charge. Fortunately, they did not know of the many failures that had preceded their work, or it might have discouraged their efforts. They made their first experiments in a small steel converter, holding a charge of about 110 lb. It had a wind-box in the bottom, and the tuyeres were vertical, thus admitting the blast into the molten metal from the bottom. They began with a matte containing 25 to 30% copper, which was first melted in a reverberatory furnace. The lining was made of sand. The operation went along

[2] *Bulletin* de la Société Scient. Industrielle de Marseilles, 1901, pp. 78-79.

[3] Berg-und Hüttenmannische Zeitung, 1871, p. 7 *et seq.*

[4] P. David. *Bulletin* de la Société Scient. industrielle de Marseilles, 1901, p. 78.

nicely until the matte had been concentrated into white metal. Then, after the tuyeres had been cleared, there was a violent boiling and foaming of the charge, and a portion of the charge was thrown out. It is quite possible that the slag had not been removed and that when blowing on white metal began, the well known phenomenon of 'foaming' was the result. This takes place when the white metal is blown with the slag still covering it. As the oxidation of the white metal proceeded, and the copper was thrown down, being immediately above the tuyere orifices, and having no heat producing impurities to give off, it chilled. The tuyeres clogged, and the blow came to a premature end. Variations of the copper and iron content of the matte had no appreciable influence on the result.

Difficulties with the Early Converters

But Manhès and David were not discouraged by these first failures. They soon discovered that the chief difficulty appeared to be the clogging of the tuyeres by the chilling of copper, which cut off from the superimposed white metal the wind supply and thus stopped the blowing operation. They exchanged the vertical tuyeres for horizontal ones, placed a few inches above the bottom of the converter. The wind-box was changed into a hollow ring which supplied the blast to the different tuyeres. This arrangement is similar to the one used later on blast-furnaces instead of the bustle pipe and tuyere pipes, the main delivering the air into this wind-box, this type of furnace having been used at Bisbee at one time (1902-1903). With this construction they overcame the difficulties first encountered, the copper remained liquid until the entire charge was blown, even in this small apparatus.

In view of Hollway's work and that of Manhès and David, it is significant that the latter two started with matte, recognizing from the start the essential differences between a bessemerizing operation and a purely smelting operation, starting with raw ores. Another departure they made from steel bessemerizing is that they initially intended to have the sand lining furnish the silica required for slagging the iron, whereas Hollway painstakingly tried to avoid the attack on the gannister lining of the converter by attempting an impossible silicious slag. Since the extent to which iron and silica combine with each other in the acid copper converter is left to the free disposition of these two substances, the natural slag is a basic one, and for this reason a basic lining is the successful lining of the copper converter of today.

The Eguilles Plant

After these preliminary trials, conducted over a period of one year at Védennes, the process was introduced on a larger scale at Eguilles, near Sorgues, Vaucluse. The new works consisted of three blast-furnaces, two reverberatories, and three converters. In 1884 the plant was increased to five blast-furnaces, two reverberatories, six converters, and two refining furnaces.[5] As a variety of mattes had to be treated (mattes high as well as low in iron and correspondingly low and high in copper), with the variety in custom ores handled and treated, it frequently happened when blowing low-grade matte that the enriched matte or white metal would be *below* the tuyeres, so that the blowing was on slag, and the charge could not be blown to a finish, yielding copper. This difficulty was first overcome by removing the enriched matte or the white metal to another converter and finishing the blow in that manner. But it soon led to the adoption by Paul David, in 1885, of a cylindrical form of converter that could be turned around its central longitudinal axis. With this construction the relative position of the tuyeres could be changed (raised or lowered), so that a variety of mattes could be blown in the same converter and in one operation. It also reduced the blast pressure needed. It is this cylindrical form of converter that was introduced at Livorno, Italy (known as the Leghorn converter), and adopted later by the Copper Queen Con. Mining Co. for its Bisbee works.

Soon after success had been achieved by Manhès and David at Védennes, the Société de Metallurgie du Cuivre (procédé Pierre Manhès) was formed to exploit the process. Vernis, who had formerly worked at the Eguilles works, built and operated for one year the first converters in America, those of the Parrot Silver & Copper Co., at Butte, Montana. Franklin Farrel, of course, was instrumental in introducing the process in the United States, and deserved the credit of 'pioneering.' This is all the more creditable, because the Anaconda was then, as it is now, the largest copper producer in Montana, its production then being nearly 50% of the total state production, whereas that of the Parrot works was materially less. The Parrot works was the only works which at that time shipped black copper, or blister copper, the other works shipping rich matte.

[5] *Bulletin* de la Société de L'Industrie Mineral de St. Etienne, 1901, p. 614.

Ore Reserves of Australian Mines

The following data were recently compiled by the *Kalgoorlie Miner*, and cover the larger properties in ten districts:

Name.	Short tons.	Value per ton.
Great Boulder	731,260	$13.28
Golden Horse-Shoe	799,800	7.28
Ivanhoe	1,080,850	9.74
Kalgurli	250,000	9.60
South Kalgurli	252,480	5.70
Lake View & Star	423,720	6.82
Perseverance	856,740	5.58
Oroya Links	126,740	6.08
Chaffers	104,000	6.90
Sons of Gwalia	560,000	7.68
Bullfinch Prop.	158,300	12.42
Ingliston Consols	60,000	11.76
Queen of the Hills	86,000	10.92
Fenian	70,000	19.20
Corinthian North	158,600	5.92
Edna May	20,000	20.40
Sand Queen	30,000	19.20
Royal Standard	56,000	8.76
Black Range	15,000	10.80
Mountain Queen	23,780	6.96
Burbank's Main Lode	34,000	9.60
Marvel Loch	13,000	6.24
Ida H.	15,000	15.30
Great Fingall	21,150	6 34

The New Tariff on Mineral Products

A comparison of the duties under the old tariff and the present Underwood-Simmons law which recently was put into effect by President Wilson, is shown in the following table:

Schedule A—Chemicals, Etc.

	Old tariff.	New tariff.
Acid, sulphuric, or oil of vitriol, ns. pf	¼c lb	free
Alumina, hydrate of, or refined bauxite:		
not over 64% alumina	4-10c lb	15%
over 64% alumina	6-10c lb	15%
Alum, alum cake, patent alum, sulphate of alumina, aluminous cake, containing not over 15% alumina and over 0.3% iron oxide	¼c lb	15%
containing over 15% alumina or not over 0.3 iron oxide	⅜c lb	15%
Alumina, manufactured compounds of, not specially provided for	25%	15%
Ammonia, carbonate of	1½c lb	¾c lb
muriate, or salammoniac	¾c lb	¾c lb
phosphate of		1c lb
liquid anhydrous	2½c lb	5c lb
Ammoniacal gas liquor	20%	10%
Barium, chloride of	25%	¼c lb
dioxide of	25%	1½c lb
carbonate of, precipitated	25%	15%
Cobalt, oxide of	15%	15%
Baryta, sulphate of, or barytes, including barytes earth:		
unmanufactured, per ton	$1.50	15%
manufactured, per ton	$5.25	20%
Lead pigments:		
Litharge	2½c lb	25%
Orange mineral	3¼c lb	25%
Red lead	2⅝c lb	25%
White lead	2½c lb	25%
All pigments containing lead dry or in pulp, and ground or mixed with oil or water not specially provided for	2½c lb	25%
Lead, acetate of, white	3c lb	1¼c lb
nitrate of	2¼c lb	1¼c lb
acetate of, brown, gray, or yellow	2c lb	1c lb
all other compounds of, not specially provided for	25%	20%
Potash: Bicarbonate of, refined	25%	½c lb
chlorate of	2c lb	½c lb
chromate of	2¼c lb	1c lb
bichromate of	2¼c lb	1c lb
cyanide of	12½%	free
nitrate of, or saltpeter, refined	½c lb	$7.00 ton
permanganate of	25%	1c lb
prussiate of, red	8c lb	2c lb
yellow	4c lb	1¼c lb
Salts and all other compounds and mixtures of which bismuth, gold, platinum, rhodium, silver, or tin constitute the element of chief value	25%	10%
of uranium	free	10%
Soda: Benzoate of	20%	5%
chlorate of	1½c lb	½c lb
nitrate of	2c lb	½c lb
bicarbonate of, or supercarbonate of, or saleratus	⅝c lb	¼c lb
other alkalies containing 50% or more of bicarbonate of	⅝c lb	¼c lb
hydrate of, or caustic	½c lb	¼c lb
phosphate of	25%	¼c lb
hyposulphite of	⅜c lb	¼c lb
sulphide of, containing not over 35% sulphide of soda	⅜c lb	¼c lb
containing over 35% sulphide of soda	¾c lb	¼c lb
sulphite of	25%	¼c lb
chromate and bichromate of	1¾c lb	¾c lb
yellow prussiate of	2c lb	¾c lb
borate of, or borax refined	2c lb	⅛c lb
crystal carbonate of, monohydrate, and sesquicarbonate of	¼c lb	⅛c lb
sal soda	1/6c lb	⅛c lb
crystals, not concentrated	1/6c lb	⅛c lb
concentrated	¼c lb	⅛c lb
cyanide of	25%	free
sulphate of, crystallized, or Glauber salts	$1.00 ton	$1.00 ton
Zinc, oxide of	1c lb	10%
white sulphide of	1¼c lb	15%
lithophone	1¼c lb	15%
pigments containing, but not containing more than 5% lead, ground dry	1c lb	10%
when ground or mixed with oil or water	1¾c lb	10%
chloride of and sulphate of	1c lb	½c lb

Schedule B—Earths, Etc.

	Old tariff.	New tariff.
Firebrick, not over 10 lb each; not glazed, enameled, painted, vitrified, ornamented or decorated in any manner	$1.25 ton	10%
glazed, enameled, etc., as above	35%	15%
more than 10 lb each; not glazed, enameled, etc., as above	30%	10%
glazed, enameled, etc., as above	35%	15%
Brick, magnesite, chrome, and brick not specially provided for; not glazed, enameled, etc., as above	25%	10%
glazed, enameled, etc., as above	35%	15%
Roman, portland, and other hydraulic cement, in packages	8c 100 lb	free
in bulk	7c 100 lb	free
Cements, all other, not specially provided for	20%	10%
Lime	5c 100 lb	5%
Plaster rock or gypsum, crude	30c ton	10%
ground or calcined	$1.75 ton	10%
Clays or earths, unwrought or unmanufactured, not specially provided for	$1.00 ton	50c ton
wrought or manufactured, not specially provided for	$2.00 ton	$1.00 ton
China clay or kaolin	$2.50 ton	$1.25 ton
Fuller's earth, unwrought and unmanufactured	$1.50 ton	75c ton
wrought or manufactured	$3.00 ton	$1.50 ton
Fluorspar	$3.00 ton	$1.50 ton
Asphaltum and bitumen, crude, if not dried or advanced in any manner	$1.50 ton	50c ton
if dried or otherwise advanced in any manner	$3.00 ton	50c ton
The weight of the casks or other containers shall be included in the dutiable weight.		
Mica, unmanufactured, valued not above 15c lb	5c lb & 20%	4c lb
valued above 15c lb	5c lb & 20%	25%
cut or mica splittings, built up mica	10c lb & 20%	30%
manufactures of, wholly or in chief value	10c lb & 20%	30%
ground	20%	15%
Marble, breccia, and onyx, sawed or dressed, over 2 in. thick	$1.00 cu. ft.	75c cu. ft.

	Old tariff.	New tariff.
Marble or onyx slabs or paving tiles, not less 4 superficial inches, not over 1 in. thick	8c sup. ft.	6c sup. ft.
over 1 and not over 1½ in. thick	10c sup. ft.	8c sup. ft.
over 1½ and not over 2 in. thick	12½c sup. ft.	10c sup. ft.
If rubbed in whole or in part, in addition	2c sup. ft.	2c sup. ft.
Marble or onyx mosaic cubes, not over 2 cu. in., if loose.	½c lb & 30%	20%
If attached to paper or other material	5c sup. ft. & 35%	35%
Marble, breccia, onyx, alabaster and jet, wholly or partly manufactured into monuments, benches, vases, and other articles, or of which these substances or either of them is the component material of chief value	50%	45%
Agate, rock crystal, or other semi-precious stones, articles composed wholly or in chief value of, except such as are cut into shapes or forms fitting them expressly for use in the construction of jewelry, not specially provided for	50%	45%
Freestone, granite, sandstone, limestone, lava, and all other stone suitable for use as monumental or building stone, except marble, breccia, and onyx, not specially provided for—hewn, dressed, or polished or otherwise manufactured	50%	25%
unmanufactured, or not hewn, dressed, or polished	10c cu. ft.	3c cu. ft.
Grindstones, finished or unfinished	$1.75 ton	$1.50 ton
Slates, slate chimney pieces, mantels, slabs for tables, roofing slates, and all manufactures of slate, not specially provided for	20%	10%
Carbon, unmanufactured, not specially provided for	20%	15%
Electrodes for electric furnaces, electrolytic and battery purposes, brushes, plates and disks, all in the foregoing composed wholly or in chief value of carbon	30%	25%
Carbon, manufactures of, not specially provided for	45%	20%
Surveying instruments, telescopes, microscopes, photographic and projection lenses, and frames and mountings for same	45%	25%

Schedule C—Steel, Iron, Etc.

Chrome or chromium metal, ferrochrome or ferrochromium, ferromolybdenum, ferrophosphorus, ferrotitanium, ferrotungsten, ferrovanadium, molybdenum, titanium, tantalum, tungsten, or wolfram metal—valued $200 per ton or less	25%	15%
valued over $200 per ton	20%	15%
ferrosilicon—containing not over 15% silicon	$5.00 ton	15%
containing over 15% silicon.	20%	15%
muck bars, bar iron, square iron, rolled or hammered.	3-10c lb	5%
Alloys used in the manufacture of steel not specially provided for	20%	15%
Iron, round, in coils or rods	6-10c lb	5%
bars or shapes of rolled or hammered iron not specially provided for	6-10c lb	5%
beams, girders, joints, angles, channels, car truck channels, T's, columns and posts or parts or sections of columns and posts, deck and bulb beams, and building forms, together with all structural shapes of iron or steel not assembled or manufactured, advanced beyond hammering, rolling or casting, value 9-19c lb or less	3-10c lb	10%
valued over 9-10c lb	4-10c lb	10%
punched or fitted for use, or whether assembled or manufactured	45%	10%
sashes, frames	45%	10%
Iron or steel, boiler or other plate, not thinner than No. 10 W G, cut or sheared to shape or otherwise, or unsheared—value 8-10c less per lb	3-10c lb	12%
value over 8-10c, not over 1c lb	4-10c lb	12%
value over 1c, not over 2c lb	5-10c lb	12%
value over 2c, not over 3c lb	6-10c lb	12%
value over 3c lb	20%	12%
thinner than No. 10 W G	as sheets	12%
Iron or steel, sheets, common or black, of whatever dimensions, plain, valued 3c lb or less; thinner than 10 W G, not thinner than 20 W G	5-10c lb	12%
thinner than 20 W G, not thinner than 25 W G	6-10c lb	12%
thinner than 25 W G, not thinner than 32 W G	8-10c lb	12%
thinner than 32 W G	9-10c lb	12%
valued over 3c lb	30%	12%
corrugated or crimped, valued 3c lb or less	8-10c lb	12%
valued over 3c lb	30%	12%
crucible plate	same as steel ingots	12%
	Add to steel plates	
saw plates	1¼c lb	12%
strips, iron	45%	12%
strips, steel	35%	12%
skelp, sheared or rolled in grooves not thinner than 10 W G	same as plate iron	12%
thinner than 10 W G	same as sheet iron	12%
anchors or parts thereof	1c lb	12%
forgings of, or combined iron and steel, but not chined, tooled, or otherwise advanced in condition by any process subsequent to the forging process, not specially provided for	30%	12%
or other metal, antifriction balls, ball bearings, and roller bearings	45%	35%
hoop, band, or scroll, not otherwise provided for, valued 3c lb or less, 8 in. or less wide, less ⅜ in. thick; not thinner 10 W G	3-10c lb	10%
thinner 10 W G, not thinner 20 W G	4-10c lb	10%
thinner 20 W G	6-10c lb	10%
railway fish-plates or splice bars	3-10c lb	10%
sheets, plates, or strips, and hoop, band or scroll, galvanized or coated with metal	add'l duty 2-10c lb	15%
copper, nickel or other metal, sheets or plates, with layers of other metal imposed thereon	40%	15%
sheets, polished, planished or glanced, by whatever name designated	1½c lb	15%
sheets, pickled or cleaned by acid, or by any other material or process, or which are cold rolled, smoothed only, not polished	add'l duty 2-10c lb	15%

	Old tariff.	New tariff.
sheets, cold hammered, blued, brightened, tempered, or polished by any process	add'l duty 4-10c lb	15%
sheets or plates, or taggers, iron or steel, coated with tin or lead, or a mixture of which these metals, or either of them, is a component part, known as tin plates, terne-plates, or taggers tin	1 2-10c lb	15%
Tin plates coated with metal.	45%	15%
Metal sheets decorated in colors or coated with nickel or other metals by dipping, printing, stenciling, or other process	45%	15%
Steel; bars, and tapered or beveled bars; mill shafting, pressed, sheared, or stamped shapes, not advanced in value or condition by any process or operation subsequent to the process of stamping; hammer molds or swaged steel; gun barrel molds not in bars; all description and shapes of dry sand, loam, or iron molded castings, sheets, and plates, if made by the Bessemer, Siemens-Martin, open hearth, or similar process, not containing alloys, such as nickel, chromium, tungsten or wolfram, molybdenum, titanium, iridium, uranium, tantalum, and similar alloys, valued at ¾c or less lb	7-40c lb	8%
over ¾c, not over 1 3-10c lb	3-10c lb	8%
over 1 3-10c, not over 1 8-10c lb	5-10c lb	8%
over 1 8-10c, not over 2 2-10c lb	6-10c lb	8%
over 2 2-10c, not over 3c lb.	8-10c lb	8%
over 3c, not over 4c lb	1 1-10c lb	8%
over 4c, not over 7c lb	1 2-10c lb	8%
over 7c, not over 10c lb	1 9-10c lb	8%
over 10c, not over 13c lb	2 3-10c lb	8%
over 13c, not over 16c lb	2 7-10c lb	8%
over 16c, not over 24c lb	4 6-10c lb	8%
over 24c, not over 32c lb	6c lb	8%
over 32c, not over 40c lb	7c lb	8%
over 40c lb	20%	8%
All of the foregoing (excepting mill shafting), and including alloys used as substitutes for steel in the manufacture of tools, when made by the crucible electric or cementation process, either with or without alloys, and finished by rolling, hammering, or otherwise	same rates as foregoing	15%
rolled wire rods in coils or bars not smaller than No. 6 W G	6-10c lb	15%
Steel wool or steel shavings..	40%	20%
Iron or steel, grit, shot, and sand that can be used as abrasives	½c lb	30%
rivet, screw, fence, nail, and other wire rods, valued 4c or less per lb	3-10c lb	10%
valued over 4c per lb	6-10c lb	10%
flats up to 6 in. wide		10%
bars, cold rolled, cold drawn, cold hammered, or polished	add'l duty ⅛c lb	10%
rods smaller than No. 6 W G as wire round	not less 35%	15%
or other metal, except gold or silver wire, covered	45%	20%
corset clasps, steels, and dress steels	45%	20%
flat wires	45%	20%
strips not over 15 W G and not over 5 in. wide	35%	20%
telegraph, telephone, and other wires and cables of metal and rubber or of metal, rubber and other material	40%	20%
wire galvanized or coated with metal	add'l duty 2-10c lb	20%
Wire, all other, not specially provided for	45%	20%
articles made of iron or steel wire	not less 40%	20%
articles of other wire	45%	20%
heddles or healds	25c per 1000 & 40%	25%
rope	not less 40%	30%
Iron or steel; anvils	1⅝c lb	15%
Aluminum; aluminum scrap alloys	7c lb	2c
Aluminum, in strips	45%	3½c
plates, sheets, bars, rods	11c lb	3½c
Barium, calcium, magnesium, sodium and potassium, and alloys of	3c lb and 25%	25%
Antimony, as regulus or metal and matte containing not over 10% lead	1c lb on the antimony	10%
oxide of	1½c lb and 25%	25%
salts and compounds of	25%	25%
Argentina, albata, or German silver, unmanufactured ..	25%	15%
Bronze powder, brocades, flitters, and metallics	12c lb	25%
Bronze, or Dutch metal or aluminum, in leaf	6c 100 leaves	25%
Copper, in rolled plates, called brazier's copper, sheets, rods, strips, pipes, and bottoms	2½c lb	5%
sheating or yellow metal..	2c lb	5%
Gold leaf	35c 100 leaves	35%
Silver leaf	10c 100 leaves	30%
Lead bearing ore	1½c lb on lead	¾c lb on lead
dross, bullion, pigs, bars, any form not provided for, old refuse run into blocks and bars, old scrap	2½c lb	25%
sheets, pipe, shot, glaziers and wire lead contained therein	2⅝c lb	25%
Metallic mineral substances, crude	20%	10%
Metals unwrought	20%	10%
Monazite sand and thorite...	4c lb	25%
Thorium, oxide of and salts of	40%	25%
Nickel, nickel oxide, alloy, pigs, ingots, bars, rods or plates	6c lb	10%
sheets or strips	35%	20%
Quicksilver flasks or vessels dutiable as if empty	7c lb	10%
Zinc ores, including calamine, containing less 10% zinc.	free	*10%
containing 10% or more, and less 20%	¼c lb on zinc	*10%
containing 20% or more, less 25%	½c lb on zinc	*10%
containing 25% or more	1c lb on zinc	*10%
blocks, pigs, or dust	1⅜c lb	15%
sheets	1⅝c lb	15%
worn out, fit only to remanufacture	1c lb	15%
Articles not provided for of or in part of platinum, gold, or silver, and articles or wares plated with gold and silver	45%	50%
of other metal, not plated with gold or silver	45%	25%

*On zinc contained therein.

Special Correspondence

BUTTE, MONTANA

WASHOE SMELTER RESUMES WORK.—EAST BUTTE MINE.—BUTTE & SUPERIOR ZINC. ELECTRIC RAILWAY COMPLETE.—CORBIN COPPER CO.—EXTRALATERAL RIGHTS.—BARNES-KING AND BUTTE & BALLAKLAVA.—U. S. ASSAY OFFICE.—LEACHING PLANTS.

The Anaconda smelter is at work again after the 10 days' shut-down required to clean and repair the flues leading to the big stack. The flues had been used continuously for ten years without inspection, and hereafter it is proposed to clean and repair them every five years. The amount of dust taken from the flues and its value make large figures, namely, 12,000 tons of dust, valued at $300,000. When removed from the flue, the dust had to be wet down to keep it from blowing away. It will be briquetted for re-treatment.

Now that the East Butte Copper Co. is engaged in increasing its smelter capacity from 1,250,000 to 2,000,000 lb. per month, it behooves the management to be sure of sufficient ore reserves in the mines to keep the smelter busy. To this end the main shaft is being deepened to the 1800-ft. level, or 600 ft. lower than the present stopes. Also, the Dutton shaft, which the old Pittsmont management never sank below the 600-ft. level, is to be unwatered and deepened, on the assumption that sufficient exploratory work had not been done previously to justify the abandonment of the shaft. On the whole, the future of East Butte seems brighter than at any time in the past, and its efficient management is to be complimented for having so ably resuscitated a doubtful-looking venture.

At the present rate of production of zinc concentrate, nearly 6000 tons of concentrate per month, the Butte & Superior is probably the largest zinc mine in the world.

The electrification of the Butte, Anaconda & Pacific railway has been completed, and it will not be long now before electric will be substituted for the present steam locomotives. The trial run of a train recently between Anaconda and Butte, was witnessed with keen interest by officials of the local railway and also by A. J. Earling, president of the Chicago, Milwaukee & St. Paul Railway system. Mr. Earling was particularly pleased with the success of the test, in view of the fact that his Company is contemplating the electrification of a long stretch of its main tracks through Montana.

Reports from the East state that the Corbin Copper Co. has raised sufficient funds to enable it to sink the Gambrinus shaft in Butte and properly to explore the ground. It is not made clear whether the funds are also sufficient to complete the purchase of the property in case the development should justify that step.

The deep orebodies of Butte are a continual source of anxiety to their owners. Shafts are sunk to great depths before cross-cutting to the veins, and it often proves difficult to say with certainty to which outcropping vein the discovered orebody belongs. Now comes new proof of this in a suit just brought by the Anaconda Copper Mining Co. to enjoin the Pilot-Butte Mining Co. from working a certain orebody on the 2000-ft. level of that mine. The Anaconda company asks that the Pilot-Butte company be restrained from working on the disputed orebody until sufficient development work has been done by both parties concerned to satisfy them of the real conditions. The Pilot-Butte company admits that the vein in question has its apex in Anaconda ground, but believes that it junctions with the Pilot vein 1600 ft. below the surface, from which point down it should belong to the Pilot-Butte because of the older location of the Pilot vein.

The Barnes-King Development Co. continues to prosper. Since December of last year the Company has mined 37,000 tons of ore from the North Moccasin property with net bullion returns of $302,000, or $8.23 per ton. Mining and milling expenses absorbed $128,000, the former North Moccasin owners were paid $130,000, and $43,000 was retained by the Barnes-King company.

As the rumor still persists in Boston that the Anaconda Copper Mining Co. is negotiating for the purchase of the Butte & Ballaklava Mining Co., it can be once more authoritatively stated from Butte that the story has positively no foundation in fact.

In spite of the vigorous efforts of local congressmen to stave off the sentence, the United States Assay Office at Helena seems doomed to disappear. Congress has not made the necessary appropriation for its further operation, and lamentations fill the air locally. The United States Assay Office has been an institution of historic interest in the community, even if Congress can find no justification for its continuance.

Increased activity and production characterize the experiments with copper leaching on the east side. The Butte-Duluth company reports 2850 tons mined and milled during September. This ore yielded 27 lb. of copper per ton at a reported total cost of $2.64 per ton, or 9c. per pound of produced copper. If these costs allow for proper amortization on equipment, the showing is certainly creditable and argues well for the success of the process and of the mine. The Company is mining its ore by open-cut methods, drilling holes for blasting by churn-drills as in the porphyry coppers. Churn-drilling is also under way in blocking out and proving the orebodies.

RHODESIA

THE GIANT PROPERTY.—PROSPECTING IN THE TERRITORY.—NATIVE LABOR SITUATION.

The Giant Mines of Rhodesia, Ltd., has been a particularly unfortunate property lately. A few years ago the mine was one of the leading profit earners of Southern Rhodesia, but today, although it continues to yield fairly satisfactory returns, it is clear that the property is falling from its hitherto high estate and the future seems full of uncertainty. A year or two ago it was announced that, on account of faulting, the vein had been lost on the lower levels. Despite extensive and costly boring operations and the employment of an eminent geologist in the person of G. S. Corstorphine, of Johannesburg, the Company so far appears to have met with little success in the re-discovery of the lode, a banded ironstone body associated with chloritic and talcose schists. The troubles of this Company have lately been further increased by subsidence of ground. During July the tonnage treated was substantially reduced, and there was a consequent decline in profit, due to trouble with ore passes during the

HUNTINGTON MILL PLANT, CAM MINE, MASHONALAND.

month, this being the outcome of caving-in of certain stopes. One who knows the underground workings of the Giant can scarcely be surprised to learn that some of the levels are occasioning the management considerable anxiety, and large quantities of the hanging wall have fallen in. The vein is lenticular in character, in some places narrowing down to a few feet, and in others attaining widths of over 100 ft. In the past the management stoped the mine with little regard to pillars or means of supporting the roof, and the Company now has to pay the penalty for the faulty methods pursued then. It was anticipated that the returns for August and the current month would be substantially better than those obtained in July. Notwithstanding, it cannot be denied that the mine is in

anything but a satisfactory state at present, and whether the lost vein is found or not, the management will have an anxious time. While on this point of insecurity of workings, it may be remarked that the Giant is far from being the only mine in Rhodesia which is open to criticism in this respect.

The dry season in Rhodesia, which extends throughout the so-called 'winter' months, from April until the end of October, is the best and most favorable time of the year for the carrying on of prospecting operations. In the first place, a prospector can count on the absence of rain for at least five months, and he is not subject to the tropical deluges of the summer; transport is easier, and the climate more pleasant. In the second place, about June the tall rank grass becomes dry, bush fires spread all over the country, and rocks which are obliterated after the rains can be examined *in situ*. During this dry season there has been the usual exodus of prospectors from Salisbury, Bulawayo, and the other mining townships, to the *veldt*, and a considerable number of discoveries have been reported. What their value is can only be determined after further development and preliminary crushing. While there have been large numbers of men investigating promising localities in both the Matabeleland and Mashonaland provinces during the past few months, it is doubtful whether there has been as much prospecting activity this dry season as in former years. The country is just beginning to recover from a period of severe depression which was accentuated by the severe drought of last summer; consequently there has not been nearly so much money for the exploration of outlying areas as in more prosperous times, and it is noticeable that, while new properties are being staked, groups of claims continue to be abandoned and forfeited to the Government in numerous localities. In the Gwelo district alone, about 100 claims were forfeited a week ago, and upon instructions from the Secretary for Mines, are now open and may be re-located.

At the quarterly meeting of the Rhodesian Chamber of Mines, held in Bulawayo at the beginning of September, P. B. S. Wrey, who presided, mentioned the signing of an agreement between the Portuguese Government and the local authorities providing for the recruiting of natives by the labor bureau in the Tete district of Portuguese East Africa. In the past, the Witwatersrand Native Labor Associaion has drawn extensively from this area, but on account of adverse health conditions, the Union of South Africa Government recently took steps to reduce the importation to the Rand of tropical natives, these including natives from the Tete district. The granting of recruiting facilities to the Rhodesian native labor authorities in this densely populated district is of great importance, and is partly due, no doubt, to the satisfactory mortality statistics referred to by the chairman at the meeting. Thus what is the Union of South Africa's loss is Rhodesia's gain. Referring further to the native labor position, Mr. Wrey stated that the average number of natives employed in Rhodesian mines for the first six months of the current year was 31,909, which is 3500 less than the average number employed during the same period in 1912. Toward the end of the current year, however, the demand is likely to be keener, as a larger number of local natives than usual may be expected to return to their homes for the plowing season, while several large new plants will be working and need help. Taken on the whole, the native labor outlook is decidedly hopeful at the time of writing. 'Boys' are coming in freely, and although mines like the Shamva and the Cam & Motor will soon call for a substantial augmentation of the complement at present available, there is little doubt that a sufficient number will be forthcoming when called for. At the same time, there is scarcely likely to be a large surplus, and accordingly the granting of facilities for recruiting in the Tete district will be greatly welcomed by both the mining and agricultural industries.

During the first six months of the current year the mineral output of Southern Rhodesia shows an advance in value of £85,894 in comparison with the corresponding six months of last year. In gold the increase amounts to 21,439 oz. and £89,655 in value. The increase in coal sales was 2900 tons; in scheelite and wolfram, 327 tons; and in the value of diamonds declared, £5877. In respect of silver, lead, and chrome iron ore, there were decreases of £1770, £1582, and £9513, respectively. The total production for the six months of the year was valued at £1,521,387, while the output of gold for July constituted a record. It is probable that this rate of output will be maintained until the close of the year, when an increase in production is practically certain. In any case, the mineral output for 1913 should constitute a material increase over that of 1912.

DEADWOOD, SOUTH DAKOTA

BLACK HILLS BULLION PRODUCTION.—OPERATIONS AT THE DAKOTA, BISMARCK CONSOLIDATED, RATTLESNAKE, HILL CITY, AND BLACK HILLS TUNGSTEN MINES.

That the mining industry of the Black Hills is in a flourishing condition is reflected in the receipts of the United States Assay Office at Deadwood during the last quarter ended September 30. According to L. P. Jenkins, the assayer in charge, the purchases of bullion amounted to $2,018,500, all of which came from Black Hills mines. During the history of the office there was but one quarter's business in excess of this amount. This does not represent the entire production of the Black Hills for the period, as the output of smelting ores, which are shipped to Omaha and Denver, are not included. At the present rate of production the year 1913 should exceed 1912, which was the banner year for the district, according to the U. S. Geological Survey figures.

Announcement is made by the Forest Service that a number of tracts of land within the reserve will be opened for homesteading. The land in question is in the limestone range, and is particularly adapted to the raising of small grain, hay, and potatoes, and includes considerable good grazing land. The tracts are within easy reach of the mining towns of the Black Hills, and were they cultivated might reduce the high cost of living among the miners. P. H. Bertschy has resumed work on his leases on the Dakota ground, at Trojan, and is shipping his output to the New Reliance mill. Formerly he shipped to the L., D. & W. mill at Terry, but when that plant suspended operations in August he stopped work.

An assessment of one cent per share has been levied by the Bismarck Con. Mines Co., operating a property adjoining the Wasp No. 2, at Flatiron. It is expected that this assessment will take care of all current liabilities and provide a working fund which will enable the property to be put on a good footing. Since starting last spring the mill has attained its normal tonnage of 250 tons per day, with practically no repair expense, and mining operations have been accomplished at a minimum cost. Everything would seem to point to an ultimate success, and the future of the property is promising.

At the Rattlesnake mine, in the Galena district, good progress is being made in the erection of the 20-stamp mill and cyanide plant. The machinery equipment was purchased from the North Star mine, at Custer, and is in excellent condition, having had but little use. The cyanide department is all new, and the whole plant will be operated by electricity. C. B. Harris, of Galena, is manager of the property.

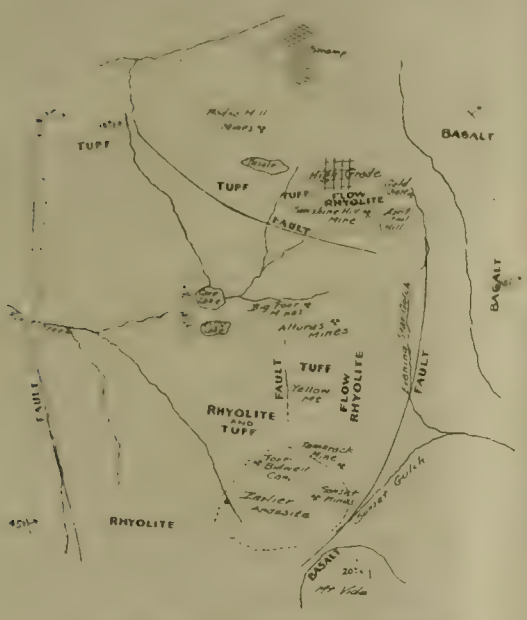
A double-drum hoist, 4-drill air-compressor, drills, steel, cages, pumps, boilers, etc., in fact a complete mining output, has been purchased by the Hill City M. & D. Co., and will be immediately removed to the property and erected at the main shaft, which is now 100 ft. deep. The shaft will be sunk to 300 ft. and a level opened at the bottom and at the 150-ft. point. H. B. Lake, of Hill City, is president. Denver people are interested in the Black Hills Tungsten Co. and are making an earnest endeavor to put the mining of wolframite on a commercial basis, having just completed a small concentrating plant near Hill City. The plant is being tested, and results will be awaited with much interest. The district in which the plant is situated is known to contain a large amount of low-grade wolframite ore.

HIGH GRADE, CALIFORNIA

PRESENT CONDITIONS IN A PROMISING DISTRICT.—WORK GOES ON STEADILY AT A NUMBER OF PROPERTIES.—GOOD ORE AND GOOD CONDITIONS.

Within the last two years since the ill advised boom the men who have stood by the district have made substantial strides toward the placing of High Grade in the productive list. The Modoc mine is in good ore on the 50-ft. level, where they are extracting $200 to $400 ore from a body 6 or 7 ft. thick. A large contract has been let for winter's wood for the hoist, the only one here. Lately officers of the Company visited the property and were pleased with the progress being made. Orders were given to extend the work on the 50, 100, and 200-ft. levels. There is a commodious shaft-house containing boiler, pump, and hoist, and a blacksmith-shop adjoins. A fully equipped assay office is in charge of George Kline.

C. H. Miller & Detweiler, lessees on the Sunshine property, are sinking a winze from the main level. They have an ore-shoot running from 8 in. to 2 ft. wide, much of which shows gold. The ores averages $60 to $80. Lessees are expected to start work on the north drift soon. Some very high assays were secured on this property when first opened, and the present work should show good results as the ground is developed. Fred Sahrott, lessee on the Yellow Jacket, has a nice body of ore opened on the south face of the mountain, with a drift on the vein from a shaft about 40 ft. deep. A shipment to the smelter has just been made.



SKETCH MAP OF HIGH GRADE DISTRICT.

The Big Four company has given a lease, but will also do considerable development work. The orebodies on this property are large and range in value from $4.50 to $200 per ton. There are a 5-stamp mill, several adits, a shaft over 100 ft. deep, with another about 30 ft. deep. The Alluros property has a shaft 110 ft. deep, from which a cross-cut to the east has been driven to intercept a vein being worked on an adjoining property. The ore is principally a sulphide, assaying $68 per ton. While few men are employed at the Gold Shore property to the east of the Sunshine, an adit is being driven steadily to cut the vein which crosses the ground and from which float ore assaying over $400 per ton was taken. A shaft sunk on a cross-fissure gave assays of $15 to $35. The Brodus or Evening Star group has done much surface work and a quantity of ore has been exposed on the Klondike vein. There is a shaft over 20 ft. deep and a number of open-cuts in ore worth $20 per ton. Richer ore has been found as float. The Consolidated property will soon be working a number of men, the order having been given to extend the present level or main adit on the Mountain View. The equipment here includes a 5-stamp mill and 1000 ft. of aerial tramway from the Sugar Pine tunnel to the mill.

At the Griffith mine the shaft has been deepened and is in ore of a high grade. Some of this shows black manganese and hematite with coarse gold. The body is 1 to 2½ ft. wide. The shaft is protected by a shaft-house and black-smith shop. The O'Connor property is steadily being developed by two cross-cut adits which will intercept the veins at 600 and 1500 ft. depth. This will, when developed, make one of the largest properties in the district and, judged by the veins at the surface, gives promise of some ore. The property includes a millsite, and all conditions favor large operations.

The Fox property has an adit driven 300 ft. to cross-cut the veins. Some work is yet necessary before the ore will be reached, which will be at about 250 ft. depth. The Coombs property has a nice showing of ore in an adit, which cuts the veins at about 100 ft. depth. The value is from $40 to $50 per ton. The Discovery group is being developed by opening new veins, and some rich finds are being made as the work progresses. This property, the original one of the district, under proper development should make a fine property. Very rich ore is to be found at the surface and in a shaft of 20 ft. depth. Several hundred feet of exploratory adits and drifts have been driven. The Sunset group is being steadily worked through a drift run from a main adit. A small quantity of ore is in sight. Some work is being done on an outcrop which gives promise of rich ore. One of the latest discoveries was on the Baty group, on the Eugene claim, where coarse gold was found at the surface. Sinking to determine width and direction of the vein has been in progress, and an adit on the Luckyboy will be driven to intercept this vein. The ore is of high grade as indicated by panning.

On the west side of Mt. Vida considerable work has been done by Snider and Lynch, who have driven an adit 150 ft. in rich ore which pans high. They are developing their ground. Nance and Callahan have claims adjoining and are sinking a shaft on ore of much promise. On over 20 prospects the work has been done for the year, and all indicate a value up to the average of the district. I have personally visited all the properties being worked, also several of the prospects, and made my own selection of ore and pannings, and find values verifying those given at the several properties. The gold is mostly fine and crystalline in structure. At the Brodus property the size was somewhat coarser, and on the Baty property a little coarser than on the Brodus. Whatever the sulphides show, an average of ¼ to 2½% is indicated. Assay values of 5 gold to 1 silver have been the average on all ore mined. Preparations have been made to continue work throughout the winter at the several properties. The economic conditions of High Grade should make this camp one of the great producers.

MELBOURNE, AUSTRALIA

BROKEN HILL SOUTH.—A BENDIGO MINE.—ANOTHER OSMIRIDIUM DISCOVERY.

The half-yearly report of the Broken Hill South Silver Mining Co. presents some unpleasant features, despite the fact that a net profit of $554,000 was made. Big as it is, that does not compare favorably with the profit of $1,028,000 made in the previous half-year, out of which dividends of $824,500 were paid, and this year, with but little more than half the profit, the amount paid was $776,000; that is to say, $222,000 more than was earned. A main cause of the decrease in profits is the decline in the prices of metals. This has had a marked effect upon the revenue from the sale of lead concentrate, the Company's chief source of income. But the decline in the metal market is by no means the only cause of the Company's present position. There was also a reduction in the output of ore, though this was to some extent offset by an improvement in the grade treated, and also in the recoveries. Another source of trouble has been the rise

in costs, development costs in the mine having advanced as much as 132.5% in 12 months, while the advance in total working costs has amounted during the same period to 15%. The sinking cost totals $34 per ton of concentrate.

The South New Moon mine, one of the leading Bendigo producers, has paid dividends totaling $2,425,000. The Company was formed in 1871, but its first dividend was not paid till 1890. The amount of assessments on the 32,000 shares owned has been almost $4.25 per share, and the dividend paid about $72 per share. The equipment expenditure has amounted to less than $100,000, and the output has been 381,324 tons yielding 223,891 oz. of gold, exclusive of residue.

In the issue of July 26 mention was made of an osmiridium discovery on the west coast of Tasmania. Now another one, two miles distant, but in the same line of country, is reported. The prospectors claim that the osmiridium occurs in a lode, but that is a matter on which one may well be more than skeptical. If it be a lode formation, then something unique has been discovered, and a tremendous impetus should be given to the use of the metal, the price of which has been fast increasing of late.

NEW YORK

THE COPPER SITUATION.—MINING IN MEXICO.—AMERICAN INSTITUTE OF MINING ENGINEERS DISCUSSES IRON AND STEEL PROBLEMS.

The anuouncement that the miners at Rio Tinto have struck makes the copper situation still more interesting. The output at Rio Tinto is about 6,000,000 lb. per month, and this is a considerable amount, superimposed on the 12,000,000 lb. or so which is still lacking from the normal Lake Superior output. It is the latest of a series of events which have conspired to help the sellers of copper, and apparently they have needed its aid, for the metal exhibits little sign of going above 17c., even with the decreases in the supply and the heavy European demand. Progress is being made toward the settlement of the strike in Lake Superior, and a committee of mine-managers has stated to the Copper Country Commercial Club that the 8-hour day will be introduced before the end of this year, and a time will be set each week for the making of complaints by the operating force. On the other hand, the one-man drill must be retained, a minimum wage scale will not be adopted, and the Western Federation will not be recognized. The companies are making fair progress in getting men, and it is to be expected that within a comparatively short time the strike will be settled on essentially the lines mentioned. The Utah Copper Co. produced 11,817,428 lb. copper during September, and has been steadily breaking record after record of output. This and other companies are making hay while the sun shines. Last year at this time, Utah Copper was shut down by a strike and the copper production for the fourth quarter of the year was very small, but now it is making up for it.

The American Smelting & Refining Co. is badly hampered in Mexico. The smelting plant at Chihuahua is running at about 80%, that at Aguascalientes at half, and the Monterrey plant at one-third capacity. The plants at Matahuela and Velardena are shut down, but are in shape to resume work when railroad traffic can be restored. Some of the companies in northern Mexico are not at all disturbed; at El Tigre, for example, operations are in full swing. The Teziutlan Copper Co., in Puebla, has had to shut down, while, on the other hand, the Mexican United Co., in Guanajuato, has started sinking three shafts, and the Mexican Mines, Ltd., has resumed operations after having been shut down for some time. The San Toy, in Chihuahua, has been steadily at work since June last.

The autumn meeting of the American Institute of Mining Engineers, held in New York on October 16 and 17, was devoted to the discussion of papers on iron and steel, and was under the auspices of the iron and steel committee, of which Albert Sauveur is chairman. The first session was held in the United Societies building, 29 West Thirty-ninth street, at 10 a. m. on October 16, Mr. Sauveur in the chair. The first paper read was by W. A. Forbes, on blast-furnace gas cleaning. This was followed by a paper on the slagging gas producer, by W. H. Blauvelt, which evoked good discussion. Then followed a paper on the generation of steam by waste heat from furnace gases, by F. Peter, read by the secretaray, Bradley Stoughton. A brief paper on the same topic by George C. Stone, giving the result attained at the Palmerton plant of the New Jersey Zinc Co., followed, and the two were discussed together, bringing out some interesting comparison with practice at other places. The concluding paper of the morning session was by W. R. Shimer on over-oxidation of steel. This provoked animated discussion, in which H. M. Howe, A. S. Cushman, and a number of others joined. At noon, lunch was served in an adjoining room, and the social hour thus afforded seemed to be as highly appreciated as the technical sessions. The first paper of the afternoon, at which J. W. Richards presided, was by Richard K. Meade, on the use of pulverized coal as fuel. This was a statement of practical conditions, and was followed by a more general paper on the same topic by H. R. Barnhurst. W. S. Quigley also contributed a paper on the same topic. The discussion was general and excited much interest. This was followed by two papers on briquetting practice, by E. Stuetz, and F. A. Vogel, which also called forth good discussion.

The session on the morning of October 17, at which Mr. Sauveur presided, was chiefly devoted to the three papers by H. M. Howe discussing Ae_3 and Ael in carbon-iron alloys which naturally evoked much interest and called forth good discussion. G. K. Burgess and J. J. Crowe presented a paper on this topic, and also a paper on the thermal and microscopic examination of steel. Luncheon was served at noon, as on the preceding day. At the afternoon session Dr. R. W. Raymond presided, and the paper by W. A. Ruder on grain growth in silicon steel, carried over from the morning session, was presented. This was followed by a discussion of the effect of various elements on the absorption of carbon by steel, by R. R. Abbott, presented in abstract. Lively discussion was evoked by a paper by J. H. Hall, on shock tests of cast steel, though another paper by the same author on the life of crucible steel furnaces was not so thoroughly discussed. A paper by G. H. Clevenger and B. Ray on the influence of copper on steel was presented in abstract by D. A. Lyon. This lead to good discussion, in which A. S. Cushman took a leading part, giving the results of tests on 60-ton lots, which generally confirmed the results obtained by the laboratory study of Messrs. Clevenger and Ray. The meeting was concluded by an informal subscription dinner at the Engineers' Club, where only about 60 members and guests were present, the date conflicting with the dinner and evening session of the New York section of the Electrochemical Society.

COBALT, ONTARIO

MINERAL PRODUCTION OF NORTHERN ONTARIO.

The first official report since 1908 on the silver, cobalt, nickel, and gold mines of northern Ontario has just been received. W. G. Miller, who compiled the report, states that the Cobalt district, besides being one of the world's most productive silver areas, controls the market for cobalt and arsenic and is among the three or four areas that have the largest output of nickel. As a general rule, however, these ores are so complex that the nickel is not saved in the smelting process. Statistics show that up to the end of 1912 the Cobalt mining district has produced 155,815,839 oz. of silver, valued at $81,731,115. The quantity of cobalt, nickel, and arsenic produced cannot be determined. Up to the end of 1912 the total dividends from the mines amounted to $39,834,740, without including the profits from two or three privately owned companies. This is approximately 50% of the value of the output and constitutes a unique record. If the dividends for the present year are added, the total distribution will be approximately $45,000,000. It is interesting to note that the discoveries in the Cobalt district were directly due to the building of the Temiskaming & Northern Ontario railway, and that while the railway cost only $18,500,000, the mines have paid $45,000,000 in dividends.

General Mining News

ALASKA

Valdez

The Granby Consolidated company, of British Columbia, has purchased the Midas mine at Solomon gulch, near Valdez, for $123,000. The first cash payment of $25,000 was made at Valdez on October 1. The property was staked in 1900 and has passed through several hands. Development has covered about 1800 ft. to date, and a large tonnage of ore averaging 4% copper and $2 per ton in gold and silver has been blocked out.

ARIZONA

Cochise County

(Special Correspondence.)—The Copper Queen company is erecting a new hoist on Copper Queen mountain near the postoffice. The head-frame is complete. Development by the Higgins Leasing Co., on property above the postoffice, is full of promise. J. Letson is in charge. The Wolverine & Arizona Mining Co., with W. Roberts in charge, is also opening satisfactorily. New stations and ore pockets are being cut on the 1600 and 1700-ft. levels of the Calumet & Arizona Junction shaft. At 1800 ft. a large pumping plant is to be installed. W. Gohring is mine superintendent. About 300 tons of lead ore is being shipped weekly to El Paso from the Shattuck-Arizona mine.

Bisbee, October 16.

Gila County

(Special Correspondence.)—At the Arizona Commercial mine sinking to the 1400-ft. point has been commenced. A carload of ore has been shipped to the Old Dominion smelter No. 3. In a cross-cut 50 ft. of vein has been opened to date and 31 ft. of it is in ore. The face of the cross-cut at 50 ft. was also in ore. The ore will average about 6% copper and contains a heavy content of iron. At the Iron Cap, stoping is being carried forward on No. 8 level. Seventy-five feet remains to be driven on the 650-ft. level before connection with the Eureka shaft of the Arizona Commercial is established. Shipments this month will exceed those of September.

Underground work continues at the Inspiration and new headings are being started. Although the Joe Bush orebody has all been blocked out and ready for caving, it is expected that this shaft will soon be in operation again, as a new electric hoist has recently been installed. On the fourth level the drift to the main shafts has now reached a point opposite the two shafts and as soon as the stations are cut at these shafts the Inspiration company will have underground connection with all of its workings on the Inspiration division. Considerable work is being done in the way of preparations for sub-levels in the Colorado orebody.

Globe, October 17.

Developments at the Arizona Commercial are satisfactory according to a recent report. Twenty-five feet of good grade sulphide ore was cut in No. 3 cross-cut; then a talc seam cut off the ore, but after getting through talc it went through 5 ft. of good sulphide and is still in it. Sinking has been started to No. 14 level, and drifts are now being opened on No. 7, 10, and 12 levels. Development to date indicates the large size and permanency of the orebodies.

Maricopa County

A fair tonnage of $40 ore has been opened in the Mammoth mine, 16 miles northeast of Mesa. At the mill, 10 of the old 20 stamps have been put in order. The cyanide plant consists of three 60-ton steel leaching vats, weak and strong solution tanks and sumps, and 12 zinc-boxes of the movable type. The Buffalo-Arizona company, near Morriston, is shipping rich gold ore to the Douglas smelter.

Yavapai County

Work is to be restarted at the property of the Monarch Mining & Smelting Co., near Wickenburg. The Ophir claims are to be thoroughly developed by A. J. Kent. At the Monte Cristo, new shafts are being sunk. A large mineralized dike is being prospected by E. Block on the Sink to Rise claims. High-grade silver ore is being shipped from the Humboldt mine. At the Eureka, in the Walker district, 400 tons of $45 gold ore is on the dump. The ore also contains zinc. Gold, silver, and lead ore has been opened in the Pioneer, near Walnut Grove. The adit has been finished at the New Year's Gift mine.

CALIFORNIA

Amador County

The suit between the Kennedy Extension and Argonaut companies is still being heard at Jackson. At the present time there is considerable activity in the county. The Zeila mine will probably be sold. The cross-cut from the Oneida to the South Eureka was completed last week, the length being 3200 ft. Sinking at the Central Eureka has been completed and cross-cutting is being done. An adit is being driven to prospect the West Eureka property, and $5 to $7 ore has been opened. The Wildman-Mahoney mines are inactive, and the Keystone is being prospected by C. R. Downs. At Drytown there is some work being done at the Little Illinois, and a tube-mill has been installed in the mill. The Empire-Pacific and Alpine at Plymouth are being worked. Regular mining and milling continues at the Kennedy, Argonaut, Zeila, Original Amador, Bunker Hill, and Fremont-Gover.

Butte County

In order to centralize control of the various dredging companies operating at Oroville, the following will be merged in one company: the Boston & Oroville Mining Co., Boston & California Dredging Co., Continental Gold Dredging Co., Oroville Gold Dredging & Exploration Co., and the Bear River Mining Co. These companies will be voluntarily dissolved and their properties will be deeded to the Oroville Dredging, Limited.

Nevada County

The North Star Mines Co. has declared its third dividend of the present year, amounting to $50,000, at the rate of 20c. per share. This makes $150,000 distributed to stockholders in the first nine months of 1913, and it is confidently expected that a fourth dividend will be disbursed in December. The last dividend brings the grand total of profits paid to North Star stockholders to $3,936,898, on a capitalization of $2,500,000. The steady disbursement of dividends has been maintained despite the money set aside for the development of the Champion mines at Nevada City and financing of other projects in the Grass Valley field.

Placer County

The hull of the dredge for the El Dorado & Placer Counties Gold Dredging & Power Co. is complete, and is to be launched in a few days. The Great Western Power Co. is stringing the power-lines for the motors.

The Pioneer Gold Mines Co. has been incorporated with a capital of $1,000,000 in $1 shares. The directors of the Company are E. McLaren and M. F. McShane of San Francisco, T. H. Minto of Corte Madera, R. C. Smith of Berkeley, and L. Linderman of Oakland. The above Company is the one that recently purchased the claims of the Pioneer mine situated near the junction of Humbug cañon and the North Fork, and worked for many years by J. D. Sullivan and his son Jerry Sullivan.

Rich ore containing arsenical pyrite has been opened again by A. R. Seymour in the Independence mine on Winters creek. The vein is 12 in. wide.

Shasta County

There are 150 men employed at the Gladstone mine, and the shaft is now in good order for its 1100 ft. depth. Three asbestos claims have been located west of Hazel creek near the Trinity-Shasta county line. Several months ago 30 claims were located on Mears creek.

Siskiyou County

The Isabella Copper Mining Co. is mining copper ore from a large vein in its mine 18 miles from Gazelle.

Trinity County

(Special Correspondence.)—The State Mining Bureau has an engineer studying mining conditions in the East Fork

district of the county, this being the first time for nearly twenty years that an examination has been made. The area is exceedingly promising, well timbered, good water and climate, an interesting field for the geologist, and good opportunities for capital in the many gold-bearing veins being prospected.

Carville, October 18.

The water-supply of Lagrange hydraulic mine is being improved by the laying of a new pipe-line from Stewart's fork of the Trinity river to the gravel deposits. It is expected to have the work completed within a few weeks, before the heavy winter storms set in. Considerable repair work has been performed around the mines, ditches, and flumes during the past few weeks, and everything placed in readiness for the usual winter activities. The Trinity River Consolidated Co., the second largest hydraulic operator in the county, has also been busily engaged in completing preparations for the winter. Placer miners throughout the county are actively placing their claims in shape for vigorous production with the advent of the rains, and from all indications the coming winter will be the busiest for some time.

TUOLUMNE COUNTY

The Johnson ranch has been bonded by L. H. Elliott for the Springfield Flat Development Co., which will develop the gravel deposits in the Springfield basin, by a 6000-ft. adit. A. L. Horner is superintendent.

COLORADO

LAS ANIMAS COUNTY

Forty-nine striking miners, charged with picketing, were arrested at the McLoughlin mine of the Santa Fe Coal Co. and marched three miles to the county jail at Trinidad. Fifteen deputies, armed with rifles, flanked the prisoners on either side, and a machine gun, mounted on an automobile, brought up the rear, but in spite of this, several members of the crowd of 300 strikers that followed the party attempted to break through the lines and liberate the prisoners.

OURAY COUNTY

A custom zinc plant has been built at Ouray by David Forrester for handling the middlings from the various concentrating mills of that district. It is equipped to handle 20 tons per day and has been operating since the fall of 1912. Some of the ores treated come from the Atlas, Barstow, Camp Bird, and Mickey Breen mines. The following results indicate the feed treated by the Huff electrostatic method, according to Frank S. Macgregor:

	Class 1.	Class 2.	Class 3.
Gold, ounces	0.11	0.13	0.20
Silver, ounces	59.30	13.00	11.00
Lead, per cent	6.90	7.00	1.95
Copper, per cent	0.80	1.90	2.50
Zinc, per cent	25.40	28.30	14.70
Iron, per cent	16.90	22.00	30.50
Insoluble, per cent	19.60	2.00	5.60

TELLER COUNTY (CRIPPLE CREEK)

On October 26 the Mary McKinney Mining Co. will pay a dividend of 2c. per share, amounting to $26,185, making a total to date of $1,090,751. Orebodies on the 900 ft. level are producing good ore.

The main shaft of the Strong Gold Mining Co., situated at the Strong mine, on the southern slope of Battle mountain, near to the boundary limits of the city of Victor, has been sunk to a depth of 1200 ft., where the water-level was reached an elevation of 8556 ft. above sea-level. A station is now being cut at this point.

IDAHO

SHOSHONE COUNTY

Net earnings of the Stewart Mining Co., operating near Kellogg, were $95,000 in September.

The following is the itinerary of the Bureau of Mines mine-rescue car Billings No. 5: October 17 to 24, at Burke; October 24 to 31, at Mace; November 1 to 8, at Morning mine; Mullan; and November 9 to 18 at Hunter mine, Mullan. From here the car will go to Phillipsburg, Montana.

MICHIGAN

HOUGHTON COUNTY

Eviction notices on striking miners in houses owned by the Champion Copper Co. at Painesdale were served on October 16, and similar action is said to be contemplated by the Calumet & Hecla Mining Co. at Calumet.

(Special Correspondence.)—Mention was made recently that the Copper Country Commercial Club was to investigate the strike. Its report of 76 pages of details of the mining industry and 26 pages of illustrations has now been issued. In summing up its conclusions, the committee finds that the mine managers will not recognize the Western Federation of Miners, that no minimum wage scale can be applied in justice to all of the mines; that the one-man drill has come to stay; that the eight-hour working day will be in operation in every mine in this district by next January; that a system for grievance and complaint hearings will be arranged, the mine managers agreeing to set aside a day or half a day each week for that stated purpose, agreeing also to investigate and adjust every legitimate grievance with all possible speed; that no discrimination will be made against men presenting complaints. On the day that the report was issued, October 8, there were 5445 men at work, against 14,300 in all occupations just prior to the strike. These latter included from 23 at the Oneco to 4107 at the Calumet & Hecla. The wages paid during 1912 amounted to $12,606,409, so that in normal operations the men receive over $1,000,000 per month.

One of the most interesting features is an actual table of wages including every mine in the district for a six-month period just previous to the strike. These figures are taken from the company books. They show the average wage for all mines to be $3.20 per shift for miners, $2.63 for trammers, and $2.98 average for both miners and trammers. Another table taken from the books of the Calumet & Hecla subsidiaries shows the average wage of miners for the month of May this year to be $3.47, of whom 14% were drawing over $4 per shift and the same percentage under $3, running from $2.50 to $3. A similar table on trammers' wages from this corporation and subsidiaries shows an average of $2.83. The average for miners on the conglomerate lode is $3.67 and contract trammers $3.40.

Houghton, October 12.

During October the Victoria company will break ground for a new working shaft at a point 1200 ft. east of the so-called No. 2 shaft, which, practically since organization, has been the sole producing shaft open in this area. The new shaft will sink in ground already proved by drifts on several levels run out from the present working shaft. The monthly copper output is about 250,000 lb. The Keweenaw Copper Co. has completed drill holes No. 47 and 48, on the Ashbed lode, in the western limits of the property; and the drills are being moved to new positions, east of Mosquito lake, nearly seven miles distant. The showings obtained in the borings made in the west area are quite satisfactory.

MONTANA

BLAINE COUNTY

(Special Correspondence.)—The cyanide plant of the Ruby Gulch Mining Co., in the Little Rockies, was entirely destroyed by fire on August 7. As the Ruby Gulch property was the only active one in the district at this time, the loss of the mill was particularly unfortunate.

Butte, October 20.

GRANITE COUNTY

(Special Correspondence.)—The Royal Basin Mining Co. reports an important development in its lower adit. The vein contains 7.5% copper and from 5 to 70 oz. of silver per ton over a width of several feet.

On his ranch near Maxville, J. D. Fields claims to have opened a bed of phosphate rock, 5 ft. thick, which will assay 77% tricalcic phosphate. Mr. Fields is said to be negotiating with Japanese importers for the sale of the output.

Maxville, October 20.

JEFFERSON COUNTY

Mine-rescue car, Billings No. 5, of the Bureau of Mines, will be at Elkhorn from December 17 to 23.

POWELL COUNTY

(Special Correspondence.)—The U. S. Geological Survey has had a geological party in the vicinity of Elliston during the past season, outlining the boundaries of the rock-phosphate deposits. It is claimed that the work done was satisfactory, and that good-sized commercial beds of phosphate rock were found and mapped. These deposits all occur in strata of the Pennsylvanian (Quadrant) period.

Elliston, October 20.

Mine-rescue car, Billings No. 5, of the Bureau of Mines, will be at Phillipsburg from November 20 to 28.

SILVERBOW COUNTY

Mine-rescue car, Billings No. 5, of the Bureau of Mines, will be at Butte from November 30 to December 16.

NEVADA

CLARK COUNTY

(Special Correspondence.)—A. W. Geiger has been examining properties at Searchlight and Hart for the California Ore Testing Works and has shipped a large number of samples to San Francisco. At Searchlight, interest centres in the work of Jonas & Miller at the old Quartette property, from which occasional shipments of ore worth $150 to $300 per ton are being made. At Hart, the free-milling ore extends to a depth of about 800 ft., and while the mines are only about four years old a considerable tonnage has been developed.

Searchlight, October 20.

HUMBOLDT COUNTY

(Special Correspondence.)—An examination of the properties of the Rochester Mines Co. with a view to their purchase by the Guggenheim interests is in progress at Rochester. It is said that an initial payment of $50,000 will be made on the conclusion of the examination if the sampling is satisfactory. The money and five men experienced in making such tests have been sent out from Salt Lake City. Information to the effect that the Nenzel and Cowan interests, controlling more than 500,000 of the 700,000 issued shares of the Rochester Mines Co., are the vendors in the prospective deal, and that the total price to be paid is about $1 per share. Salt Lake City capital is interested heavily in the Queen of Sheba and De Soto properties, west of Rochester camp, and these people promise a revival of activity in that old mining district within the next three or four months. Both of the old mines are now under lease.

Rochester, October 15.

LINCOLN COUNTY

On October 12 a fire destroyed $100,000 worth of property in the business portion of Pioche. Help from the Prince Consolidated mine prevented its spreading farther.

NYE COUNTY

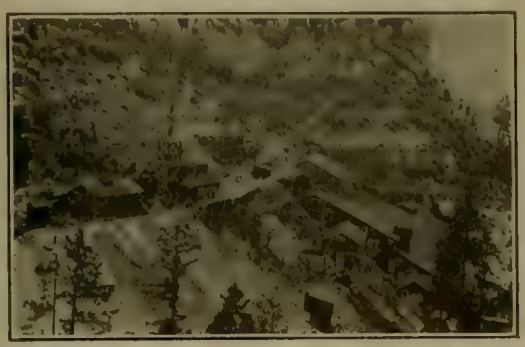
The mines at Tonopah, during the week ended October 18, produced 11,832 tons of ore valued at $278,960. In September, 11 mines yielded a total of 47,745 tons having a gross value of $937,720, a decrease of 5437 tons and $108,880 respectively, compared with August, due to a holiday and storms. Individual outputs are as follows:

	Tons.	Value.	Profit.
Belmont	13,000	$271,423	$182,906
Extension	4,847	.....	.....
Jim Butler	1,426	.....	8,507
MacNamara	2,387	.....	.....
Merger	2,309	36,282	11,500
Montana	4,496	.....	.....
North Star	1,757	.....	.....
Tonopah	13,150	207,520	110,400
West End	3,948	.....	45,198

NEW MEXICO

SOCORRO COUNTY

(Special Correspondence.)—The Socorro mill treated 5700 tons of ore in September yielding approximately 70,000 oz. bullion. High-grade concentrate was shipped. The mine is opening splendidly. The Deadwood mill is working full time, and 6375 oz. bullion was melted from a 10 days' run. At the Ernestine mine good progress is being made in shaft-sinking. The Pacific mine is yielding $15 ore. No. 1 winze of the Lincoln is being sunk 10 ft.



DEADWOOD MINE AND MILL, KNOWN AS THE 'DEADWOOD SCHOOL OF MINES.'

per week in spite of water troubles. Work has been resumed at the Alberta. Lessees at the Oaks property report good results.

Mogollon, October 13.

PENNSYLVANIA

(Telegraphic Correspondence.)—Attendance at the opening session of the American Mining Congress Monday was disappointingly small, but the numbers and enthusiasm increased through the week. The presidential address of D. W. Brunton dealt with the need of revision of the mining laws; E. B. Kirby, chairman of the committee on this subject, reported a growing approval of the plan of having a congressional commission for revising the law. Tuesday there was an interesting discussion of mine taxation, participated in by R. V. Norris, H. M. Chance, H. H. Webb, B. W. Vallat, J. W. Malcolmson, and C. E. van Barneveld. In the afternoon there was an excursion on the river. The Mining Show contained numerous interesting exhibits, especially the coal mining machinery. The U. S. Bureau of Mines rescue team gave excellent exhibitions of mine rescue work. Among papers presented was one by C. R. Van Hise strongly urging an Interstate Trade Commission to permit and regulate trade agreements; a project of especial interest to bituminous coal mine operators.

Philadelphia, October 22.

UTAH

The production of gold, silver, copper, lead, and zinc in Utah in 1912 from 7,770,270 tons of ore from placers was valued at $42,922,302, an increase of $6,084,845, as compared with 7,268,530 tons of ore in quantity and $36,837,457 in value in 1911 from deep mines and a nominal placer yield. There were 207 properties, 9 of which were placers, producing ore and bullion, as against 200 lode producers and 8 placers in 1911. Over one-half of the total value in 1912 represented the copper production, which was valued at $22,655,735, an increase of $4,285,632 as compared with the production of 1911. Increases in total value were made in all the other metals except gold, the yield of which was $431,147 less than in 1911. Salt Lake county had the greatest total value for its metal output, which increased from $22,561,615 in 1911 to $24,684,132 in 1912. This was chiefly due to the higher price of copper in 1912, as all the metals produced in the county decreased in quantity as a result of the labor strike. Concentrates recovered from ores at milling plants in 1912 contained 21.4% of the gold against about 22% in 1911; 20.1% of the silver, against 19.8%; 76% of the copper, against 73%; 33% of the lead, against 34%; and 63% of the zinc, against 74% in 1911. In 1912 the concentrates were valued at $22,781,896, or an average value of $59.74 per ton, as against a total value in 1911 of $18,633,465

and an average value of $52.14 per ton. Crude ores shipped directly to smelters yielded 67.3% of the gold in 1912, as against 63.8% in 1911; 78% of the silver, as against 79%; 23% of the copper, as against 26.3%; 63% of the lead as against 65.6%; and 37% of the zinc, as against 26.2% in 1911. In 1912 the total value of the crude ore shipped to smelters was $19,188,571, or an average value of $18.51 per ton, as against a total value in 1911 of $17,364,933, or an average value of $15.74 per ton. At gold and silver mills, 10.3% of the gold and 0.46% of the silver was recovered from ores treated principally by the cyanide process, valued at $479,724, or an average value of $2.80 per ton. The placer production of gold increased slightly, and was valued at $5680, as against $5634 reported in 1911. Statistics of the average annual production from 1904 to 1912, inclusive, are shown in the following table, according to V. C. Heikes of the U. S. Geological Survey.

Metal.	Quantity.	Increase or decrease.
Gold, value	$4,265,851	— $431,147
Silver, ounces	13,835,903	+ 1,362,116
Copper, pounds	137,307,485	— 9,653,342
Lead, pounds	140,311,135	+ 3,814,385
Zinc, pounds	17,067,177	— 773,084
Total value	$42,922,302	+$6,084,845

SALT LAKE COUNTY

(Special Correspondence.)—Being in need of machine-drills and other labor-saving equipment, the stockholders of the Alta Consolidated Mining Co. recently voted to increase the capital stock of the Company from 300,000 to 500,000 shares. All the work done in the last two years was by hand, and most of the ore was hauled 22 miles by teams. Since the summer, the Alta has been using the Michigan-Utah tramway, which passes its dump. The Michigan-Utah company is shipping again from its Utah Mines Coalition workings, and has five leasing companies mining in its City Rocks property. The Montana-Bingham tunnel, designed to be 4000 ft. long, is about half done. It is making 150 ft. per month. In six months the bore has passed through about 300 ft. of ore averaging 1.25 to 1.5% copper, 80c. gold, and 3 oz. silver per ton. The Utah Copper is handling about 25 tons of capping to 30 tons of copper ore, with its steam-shovels. A record of 30,000 tons of ore was made one day recently.

Salt Lake City, October 12.

A considerable amount of new equipment is being added to the American Smelting & Refining Co.'s plant at Garfield. A steel bridge over the railroad to the north of the smelter leading to the slag dump north of the old dumps has been erected at a cost of about $75,000. This gives a much larger slag-dumping area. Preparations have been made for a stack and new flues. The former will be 350 ft. high. and 25 ft. diameter, against 300 and 30 ft., respectively, at present. All the reverberatory furnaces are being fired with oil. Copper ore and concentrate are coming in from the Yampa, Ohio, Utah, and other copper companies.

At the Midvale plant of the United States Smelting, Refining & Mining Co., a Huff electrostatic plant has been in continuous operation since 1909, saving 5,000,000 to 7,000,000 lb. of zinc per year, which heretofore had gone to waste, according to Frank S. Macgregor. This plant treats about 50 tons per day of zinc-iron middling, part of which is furnished by the Company's concentrator and part from custom ore from the district. The work has been uniform since the beginning. The feed to the mill assays approximately 0.04 oz. gold, 2.5 oz. silver, 2.5% lead, 1% copper, 23% iron, and 28% zinc. The separated zinc product assays 48 to 50% zinc, with 3 to 5% iron, and the iron product about 10% zinc. Most of the gold, silver, copper, and lead is found in the iron product, and this product is smelted in the Company's lead furnaces. Four sizes are made in the mill, ranging from 20 mesh down. The feed to the fine-crushing machines often runs more than 50% through a 200-mesh screen.

During September the Ohio Copper Co. produced 685,900 lb. of copper from about 71,000 tons of ore containing 1.06% copper.

WYOMING

LARAMIE COUNTY

It is reported that the Hecla copper mine, 25 miles southwest of Cheyenne, has been acquired by French and English interests. Henry Schwartz, of Denver, Colorado, will continue to act as president of the Hecla Consolidated Mines Co. The property consists of 600 acres and has produced copper ore for the last fifteen years, according to the *Colorado Springs Gazette*.

CANADA

ONTARIO

The Trethewey mine at Cobalt produced 56,400 oz. silver in September from 2900 tons of ore, with 82% recovery. A winze below No. 2 level of No. 4 shaft is yielding rich ore. At the Casey-Cobalt mill 30 stamps are working crushing 90 tons of ore per day. Electric power is supplied by the Montreal river power-plant.

In a smaltite vein in the diabase at the Millerette mine, assays have returned 3 to 34 oz. gold per ton. No economic importance is attached to the discovery, but from a metallurgical point of view it is interesting. The specimens from which the high assays are obtained contain no visible gold. Two hundred feet distant in the same formation, high-grade smaltite is found. The gold ore is found in a belt of silver veins which have been opened this summer on the Millerette mine which last February passed into the possession of M. J. O'Brien, the owner of the Miller Lake O'Brien mine and adjoining property.

YUKON

Two unknown men held up the hydraulic employees at the Yukon Gold Co.'s property at Lovett gulch on October 2, cleaned-up part of the sluice-boxes, and escaped with about $20,000 of gold. The Company had not cleaned-up this place all the summer, and had intended doing so on the day of the robbery.

COSTA RICA

The Abangarez Gold Fields of Costa Rica reports that during August there was treated 6800 tons of ore, 619 tons of sand, and 5572 tons of slime, yielding $12,579 by amalgamation and $53,921 by cyanidation. The profit was $12,208 and $4399 was spent on improvements.

MEXICO

CHIHUAHUA

During August the Buena Tierra mine was worked 26 days, yielding 3000 tons of lead ore, of which 2600 tons was sold to the smelters. The net return was $15,600 from this ore, and $6350 was spent at the mine.

COAHUILA

According to the *Mexican Herald* of October 3, the Carrancista rebels of the northeastern portion of this state have done enormous damage to the coal mines of that district, especially at the Lampacitos and Rosita properties, others being Las Esperanzas, Agujitas, Cloete, El Menor, Palau, Fiente, Diaz, Fenix, and Rio Escondido. Practically the whole region is paralyzed and 11,000 men are out of employment. The Matehuala smelter is still shut down.

GUANAJUATO

Mining operations throughout the state have not suffered much on account of revolutionary movements or marauding bands of rebels. There are good prospects that work will be resumed in various mines, that have lain idle for some time, and also that new properties will be opened. During the past week shipments from Guanajuato to the smelters were worth approximately $61,500. Regular weekly shipments of about 80 tons of ore are being made to local buyers from the Calicanto and Anexas mines, owned by Fernando Rubio Rocha and Manual Aranda, situated between Mineral del Cubo and Nayal. The ore yields from 150 gm. of silver and 15 gm. of gold to 250 gm. of silver and 25 gm. of gold per ton. The properties are being developed by a 6½ by 6½-ft. adit, 1500 ft. long. Pumps have been installed to unwater three shafts.

HIDALGO

The Cortez Associated Mines Co. has an authorized capi-

tal of 500,000 shares at $3 each, of which 275,000 have been issued, and is incorporated under the laws of West Virginia, and operates mining properties at Jacala and Zimapan. The report covers the year ended April 1, 1913, when work was discontinued indefinitely, although during the year there was no direct interruption from revolutionary disturbances. At the date of the report, openings in new ground at Jacala covered 21,458 ft., not including 2465 ft. of core-drilling, the Cortés and Humboldt adits being 1770 and 1304 ft. long respectively. Several large deposits of low-grade copper ore and some rich ore were opened, as well as silver-lead ore in the Encino Largo mine. The old Carmen mine was almost reopened and connected with the new main winze. At Zimapan, prospecting has confirmed previous estimates of the properties, and the Sirena lead-antimony deposit is of great size and richness, and contains 18.89% lead, 12.87% antimony, 4.20% arsenic, and some gold and silver. There were 263 men employed, and the average monthly development covered 662 ft., this costing $5.593, and core-drilling $1.307 per foot.

The report contains the summary of an examination of the properties by Waldemar Lindgren, made in February and March, 1913, who stated the following: Zimapan is 35 miles north of Mexico City, and Jacala is 35 miles from the former place. Mining and smelting has been carried on at both places for centuries, there being three small lead smelters at Zimapan at present. Water is scarce at Jacala, but can be obtained by pumping, while timber is abundant nearby, but at Zimapan the country is arid. Thick beds of blue limestone form the prevailing country rock at Jacala. Along the contacts of the main masses of intrusive igneous rock deposits of copper and silver-lead have been formed. The Cortés adit has developed 35,000 tons of 1.72% pyrite ore, and about 100,000 tons of low-grade ore is available at the Santa Maria and Gallo and Humboldt deposits. Under present conditions these ores cannot be profitably mined at Jacala. The Carmen mine is the most important property, and a shoot of silver-lead ore, forming a replacement in limestone, has been followed on the incline for 900 ft., producing over $500,000. Zimapan lies in a broad arid valley surrounded by mountains, and the ore deposits are replacements in limestone. It is difficult to estimate the ore reserves, and there is 3000 tons of ore on the dump and 2000 tons in the mines, which would net $5 to $10 per ton at a modern smelter at Zimapan if freight was $5 per ton. There is a probable profit of $70,000 in the old Purisima slag dump at Zimapan. La Sirena lead-antimony deposit is an unusual one, and should be developed. In summarizing the Company's resources, Mr. Lindgren estimates a net return of $120,000 from all the properties. Only high-grade ores can be shipped at present, and a 500-ton smelter may be profitable. Considerable capital is necessary for development, mining, and building a mill and smelter.

Nueva Leon

The Monterey smelter of the American Smelting & Refining Co. was blown-in on October 1 after a shut-down of several months due to the revolution. Over 1000 employes have been given work.

Sonora

The arrival of General Carranza in Cananea was the occasion of a three days' *fiesta*, and it was only by heroic methods that the smelter was kept going. The mines were completely closed, and Cananea went on record as being a Constitutionalist stronghold. The three-day celebration in honor of General Carranza proved to be almost as serious a handicap to the Cananea Consolidated Copper Co. as was the battle in Cananea last spring which lasted for three days, during which time Mr. Cole, the superintendent, experienced many difficulties in keeping the smelter going. Since the new management has come into power, there has been a marked reduction in the number of Americans employed by the Company, the number being reduced from 600 to 120. Evidences of well planned economy are to be seen in every department. The Democrata Mining Co. is continuing operations under Gene Hoffman as superitendent, as is also the Moctezuma-Arizpe Development Co. The Calumet & Sonora Mining Co. is deepening the shaft, which is the only work that is being done at present.

Personal

Professional men are invited to send news of their engagements and travels. Such news is interesting to friends.

Heinrich Ries was in New York recently.

C. W. Purington has returned to London from the Lena district.

Charles Janin has been traveling in Spain and has gone to Italy.

R. T. Mishler has been appointed superintendent for the El Tigre Mining Company.

N. O. Lawton has resigned as superintendent for the Miami company and is returning to Michigan.

Simon Guggenheim has been elected chairman of the board of directors of the American Smelting & Refining Company.

W. D. Murray has been appointed general manager for the Corrigan McKinney Mining Co., at Terrazas, Chihuahua, Mexico.

S. S. Sorenssen has moved his office from New York and is now general manager for the Braden Copper Co. at Rancagua, Chile.

L. B. Smith, of Pittsburgh, has started on a several months' trip to the West Indies for the purpose of examining supposed oil properties.

George E. Fabish has left Nelson, British Columbia, and will stop in San Francisco on professional business, until November 1, before returning to New York.

Stanly A. Easton and J. F. McCarthy are members of the commission appointed by the Governor of Idaho to draft a workingmen's compensation act for that state.

The Associated Geological Engineers of Pittsburgh, Pennsylvania, is engaged in examination of oil properties in Vera Cruz, Mexico, the field work being in charge of L. G. Huntley.

J. W. Malcolmson was in New York to attend the meeting of the nominating committee of the American Institute of Mining Engineers and has been in Philadelphia during the week.

E. J. Carlyle has returned from professional work in the Argentine and is spending a holiday in the United States. He recently passed through New York on his way to Montana.

E. G. Banks, for over twenty years metallurgist with the Waihi Gold Mining Co., New Zealand, has been appointed superintendent of the property in place of H. P. Barry, who has resigned after many years in that position.

The United States Civil Service Commission, Washington, D. C., announces open competitive examinations for the following positions with the Bureau of Mines: electrometallurgists, at salary from $1800 to $3000 per annum; chief metallurgist, $4000 to $4800; metallurgist for work with smelter fume, $2700 to $3600; metallurgist for work in low-grade ores, $3000 to $4000; assistant metallurgist, $2000 to $3000; metallurgical engineer for work in iron blast-furnace operations, $2500 to $4000; metallurgical engineer for work in iron and steel, $3000 to $4000; and assistant petroleum chemist, $1800 to $2160 per annum.

Obituary

Alfonso A. Tregidgo will long be remembered as one of the most popular and able presidents of the California Miners' Association, with which organization he was connected from the time of its founding. Among the first of his undertakings was the organization of the Nevada County Power Co., of which he was the superintendent. Mr. Tregidgo had charge of the construction of the power-plant and the six-mile flume leading from the dam to the power-house, and after the completion of this work superintended the operation of the Grass Valley division of the Company. When the Alaska rush occurred, he sold his interest in this Company and went to Alaska, from which country he returned to take up his old work as superintendent of the St. John Quicksilver mines, which position he held at the time of his death.

The Metal Markets

LOCAL METAL PRICES

San Francisco, October 23.

Antimony	12—12½c	Quicksilver (flask)	$39
Electrolytic Copper	17¼—17½c	Tin	44—45½c
Pig Lead	4 60—5.55c	Spelter	7—7½c

Zinc dust, 1400 lb. casks, per 100 lb., small lots $9.50—9.75; large $7.50—8.50

EASTERN METAL MARKETS.

(By wire from New York.)

New York, October 23.—The copper market is firmer and a slight upward movement is to be noted in the stocks. The fortnightly statistics on the foreign stock of copper show that the supply in England and France on October 16 amounted to 21,964 tons which is a decrease of 589 tons during the first two weeks of the present month. The visible supply of copper at Rotterdam, Hamburg, and Bremen on October 15 show a decrease in the stocks of 453 tons since October 1. The European demands at the present are good. The lead and spelter markets are quiet. Copper closed strong with spot at 16.75, electrolytic 16.87, casting 16.75. The tin market is steady with spot, and October at $40.25 to $40.50. Antimony is dull with Cookson's quotation at $7.60.

SILVER

Below are given the average New York quotations, in cents per ounce, of fine silver.

Date.		Average week ending	
Oct.	16	Sept. 10	59.58
"	17	" 17	60.20
"	18	" 24	61.59
"	19 Sunday	Oct. 1	61.68
"	20	" 8	61.27
"	21	" 15	61.12
"	22	" 22	61.14

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	56.25	63.01	July	60.67	58.70
Feb.	59.06	61.25	Aug.	61.32	59.32
Mch.	58.37	57.87	Sept.	62.95	60.53
Apr.	59.20	59.26	Oct.	63.16	....
May	60.88	60.21	Nov.	62.73	....
June	61.29	59.03	Dec.	63.38	....

The weak spot during the week has been China, whence selling orders have been sent with some freedom, according to Samuel Montagu & Co. on October 2. In a normal all-round market, probably the effect of these sales would have been felt less, but at the present time, with often only one buyer in the field, any tendency on the part of one of the great consuming countries to contribute supplies rendered it an easy matter for the buyer to let prices fall. So long as China sells, or threatens to sell, prices are likely to sag, but when an exchange level is reached, at which operations cease to be advisable, China may begin to cover and thus afford the market the stimulus of competition. The latter rains in India have proved favorable, so that, within the next few weeks, the Indian Government will be in a position to estimate the future needs of its currency with some degree of confidence. A review of the Indian silver position shows that this country alone, exclusive of those parts of India not administered by the Crown, consumed during the past decade an annual average of 71,909,900 oz., approximately one-third of the present annual output of the world. This absorption took place side by side with greatly increased gold imports.

COPPER

Quotations on copper as published in this column represent average wholesale transactions on the New York market and refer to electrolytic copper. Lake copper commands normally from 1-5 to 1-4c. per lb. more. Prices are in cents per pound.

Date.		Average week ending	
Oct.	16	Sept. 10	16.32
"	17	" 17	16.44
"	18	" 24	16.41
"	19 Sunday	Oct. 1	16.29
"	20	" 8	16.27
"	21	" 15	16.11
"	22	" 22	16.38

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	14.09	16.54	July	17.19	14.21
Feb.	14.08	14.93	Aug.	17.49	15.42
Mch.	14.68	14.72	Sept.	17.56	16.23
Apr.	15.74	15.22	Oct.	17.32	....
May	16.03	15.42	Nov.	17.31	....
June	17.23	14.71	Dec.	17.37	....

The copper market last week achieved the feat of strengthening considerably without any great volume of business having been transacted. On October 11 there was a decline in the price of standard warrants, and on the 14th G. M. B. copper closed in London at £70 10s. for both spot and futures, showing a marked decline. The market here was flat, but the rebound of £1 per ton in London, reported by cable the following day, gave the market a stronger tone. The figure asked by the chief sellers here and abroad was 16⅞c., but Aron Hirch & Sohn were quoting the equivalent of 16⅜c. in London, while sales in small lots by 'second hands' were made as low as 16⅛c. here during the week. On October 16 and 17 European buyers bid 16¾c. for 30 days and placed good-sized orders at that figure. The domestic buyers still hold off, and spot copper can be had for 16½c. Domestic buyers usually follow the European lead, so that larger sales were expected the week following. Exports of copper from New York, October 1 to 16, were 15,521 tons, as compared to 13,740 tons for the same period last year. The European statement showed a decline of 1042 tons in the visible supply during the first two weeks of October. On the 16th the report came that the miners at Rio Tinto have struck, and a further decrease in the output should strengthen the situation of the metal.

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.		Average week ending	
Oct.	16	Sept. 10	4.73
"	17	" 17	4.73
"	18	" 24	4.69
"	19 Sunday	Oct. 1	4.61
"	20	" 8	4.33
"	21	" 15	4.40
"	22	" 22	4.35

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	4.43	4.28	July	4.71	4.35
Feb.	4.03	4.33	Aug.	4.54	4.60
Mch.	4.07	4.32	Sept.	5.00	4.70
Apr.	4.20	4.36	Oct.	5.08	....
May	4.20	4.34	Nov.	4.91	....
June	4.40	4.33	Dec.	4.20	....

ZINC

Zinc is quoted as spelter, standard Western brands, St. Louis delivery, in cents per pound.

Date.		Average week ending	
Oct.	16	Sept. 10	5.65
"	17	" 17	5.59
"	18	" 24	5.50
"	19 Sunday	Oct. 1	5.39
"	20	" 8	5.24
"	21	" 15	5.28
"	22	" 22	5.10

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	6.42	6.88	July	7.12	5.11
Feb.	6.50	6.13	Aug.	6.96	5.51
Mch.	6.57	5.94	Sept.	7.45	5.55
Apr.	6.63	5.52	Oct.	7.36	....
May	6.68	5.23	Nov.	7.23	....
June	6.88	5.00	Dec.	7.09	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California, being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending			Week ending		
Sept.	24	39.50	Oct.	8	39.50
Oct.	1	39.50	"	15	39.00
			"	22	39.00

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	43.75	39.37	July	43.00	41.00
Feb.	46.00	41.00	Aug.	42.50	40.80
Mch.	46.00	40.20	Sept.	42.12	39.70
Apr.	42.35	41.00	Oct.	41.50	....
May	41.75	40.25	Nov.	41.50	....
June	41.30	41.00	Dec.	39.75	....

TIN

New York prices control in the American market for tin, since the metal is almost entirely imported. San Francisco quotations average about 5c. per lb. higher. Below are given average monthly New York quotations, in cents per pound:

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	42.53	50.45	July	44.25	40.70
Feb.	42.96	49.07	Aug.	45.80	41.75
Mch.	42.58	46.95	Sept.	48.64	42.45
Apr.	43.92	49.00	Oct.	50.01	....
May	46.05	49.10	Nov.	49.92	....
June	45.76	45.10	Dec.	49.80	....

The Stock Markets

SAN FRANCISCO STOCKS AND BONDS

(San Francisco Stock and Bond Exchange.)

MINING

October 22.

Listed.	Bid	Ask	Unlisted.	Bid	Ask
Associated Oil 5s	$ 99	99½	General Petroleum 6s	$52½	52½
E. I. du Pont 4½s	83½	85½	Natomas Dev. 6s	99	—
Natomas Con. 6s	—	71	Pac. Port. Cement 6s	99½	—
Unlisted.			Standard Cement 4s	90	—
Ass. Oil 5s	78½	—	Santa Cruz Cement 6s	83	—

STOCKS

Listed.	Bid	Ask	Unlisted.	Bid	Ask
Amalgamated Oil	77	—	Mascot Copper	—	2½
Associated Oil	38½	39½	Noble Electric Steel	2½	—
Giant	86½	—	Natomas Consol.	9	12
Pac. Cst Borax, com	—	100	Pacific Port. Cement	63	75
Pacific Crude Oil	—	35c	Riverside Cement	45	—
Sterling O. & D.	65c	1.10	Santa Cruz Cement	39	45

NEVADA STOCKS

(By courtesy of San Francisco Stock Exchange.)

San Francisco, October 23.

Atlanta	$ .12	Mizpah Extension	$ .30
Belcher	.35	Montana-Tonopah	1.10
Belmont	7.02	Nevada Hills	.75
Big Four	.20	North Star	.85
Cash Boy	.06	Ophir	.17
Florence	.20	Pittsburg Silver Peak	.38
Goldfield Con	1.37	Round Mountain	.40
Goldfield Oro	.06	Sierra Nevada	.08
Halifax	1.32	Tonopah Extension	1.65
Jim Butler	.59	Tonopah Merger	.55
Jumbo Extension	.09	Tonopah of Nevada	4.75
MacNamara	.10	Union	.08
Mexican	1.12	West End	1.30
Midway	.37	Yellow Jacket	.29

COPPER SHARES—BOSTON

(By courtesy of J. C. Wilson, Mills Building.)

October 22.

	Bid	Ask		Bid	Ask
Adventure	$ 1½	1¾	Mohawk	$ 40	41
Allouez	34	35	North Butte	24½	24¾
Calumet & Arizona	64½	64½	Old Dominion	50½	51
Calumet & Hecla	415	420	Osceola	77	79
Centennial	13	13½	Quincy	58	60
Copper Range	37	37½	Shannon	6¾	7
East Butte	12	12¾	Superior & Boston	2¾	2¾
Franklin	3	3¾	Tamarack	28	29
Granby	72½	73	U. S. Smelting	38	38½
Greene Cananea	28	30	Utah Con.	9	9½
Hancock	15	16	Victoria	1½	1½
Isle-Royale	18	18¾	Winona	2	2½
Mass Copper	2	2½	Wolverine	41¾	42¾

NEW YORK CURB QUOTATIONS

(By courtesy of E. F. Hutton & Co., Kohl Building.)

October 22.

	Bid	Ask		Bid	Ask
Braden Copper	7⅛	7¾	McKinley-Dar.	1¼	1½
B. C. Copper	2⅜	2½	Mines Co. Am.	2⅛	2½
Davis-Daly	1⅝	1¾	Nipissing	8⅜	8½
Dolores	2	4	Ohio Copper	½	⅝
El Rayo	1	2	San Toy	18	22
Ely Con.	5	9	Sioux Con.	1	2
First Nat.	2¾	3¼	So. Utah	⅛	¼
Giroux	1⅛	1½	S. O. Calif.	189	192
Greene Can.	6	6½	Tri Bullion	⅛	¼
Hollinger	17	18	Tuolumne	½	⅝
Iron Blossom	1.20	1.30	United Copper	¼	¾
Kerr Lake	3⅞	4	Wettlaufer	7	8
La Rose	1⅞	2	Yukon Gold	2	2¼
Mason Valley	3¼	3¾			

NEW YORK STOCK EXCHANGE

(By courtesy of J. C. Wilson, Mills Building.)

October 22.

	Bid	Ask		Bid	Ask
Alaska G. M.	$ 22¾	23	Miami	22¾	22¾
Amalgamated	75½	75⅝	Nat. Lead	43½	45
Anaconda	35¾	36	Quicksilver, com	2	2¼
A. S. & R.	64½	65½	Ray Con	18¾	19
Calif. Pet.	16	17	Tenn. Copper	29⅛	29¾
Chino	40	40¾	U. S. Steel, pfd	106¾	107½
Guggenheim Ex.	45¼	45¾	U. S. Steel, com	57¾	57⅞
Mexican Pet	65	65½	Utah Copper	53¾	53½

SAN FRANCISCO MINT RECEIPTS IN SEPTEMBER

The following table shows the receipts of bullion from various states and other sources during the past month:

	Fine ounces.
Alaska	17,204,643
Arizona	8,480,160
California	18,927,699
Idaho	28,334
Montana	2,763
Nevada	3,856,304
New Mexico	267,014
Oregon	556,498
Philippine Islands	1,566,419
Refineries, government offices, etc.	153,515,328
Mutilated United States coin	164,039
Foreign coin	2,494,990
Jewelry	723,809
Central America	142,929
Mexico	30,237
South America	10,652
Total	207,971,818

Value of gold, $4,299,159.03.

DREDGING AT OROVILLE

The consolidated statement of operations of the companies comprising Oroville Dredging, Limited, for the 18 months from August 1, 1911, to January 31, 1913, contains the following data on dredging work:

Dredging time, hours	55,307
Average daily time, hours	20.06
Gravel excavated, cubic yards	7,062,528
Area dredged, acres	143.23
Average depth of gravel, feet	30.50
Gravel per acre, cubic yards	49,308
Gross gold output	$726,302
Average per cubic yard, cents	10.28
Yield per acre	$5,071
Net revenue, total	$367,758
Net revenue per cubic yard, cents	5.21
Expense per acre	$2,503
Profit per acre	$2,508
Costs per cubic yard:	Cents.
Labor and material	1.35
Electric power	0.75
Water	0.10
Repairs	1.89
Smelting and freight	0.04
General	0.67
Taxes, etc.	0.27
Total	5.07

ASBESTOS PRODUCTION

A comparison of the figures of production of asbestos in the United States for 1911 and 1912 shows that the output for 1912 was considerably less than that of the previous year, yet notwithstanding this fact the production for 1912 was the largest in the history of the industry, except that of 1911. The production in 1912 was 4403 short tons, valued at $87,959, against 7,604 short tons, valued at $119,935, in 1911, according to a U. S. Geological Survey report.

The San Francisco Stock and Bond Exchange held its annual meeting on October 14 and re-elected G. I. Ives, president; Milton A. Bremer, vice-president; Frank C. Shaughnessy, chairman; L. Strassburger, vice-chairman; Harry Schwartz, secretary; and the Bank of Daniel Meyer, treasurer. All of these are the present incumbents of their respective offices. The report of the exchange of the business transacted during the year ended September 19 shows bonds of a total market value of $13,503,242 and stocks of a market value of $7,335,215.50. The total is $20,838,458. The stocks dealt in included water stocks to the market value of $1,554,207; gas and electric, $439,916; insurance, $129,974; commercial bank, $382,773; savings bank, $19,686; street railways, $46,568; powder, $97,360; sugar, $886,090; oil, $2,607,718; and miscellaneous, $1,170,919.

Company Reports

OROVILLE DREDGING COMPANY, LTD.

OROVILLE DREDGING, LTD.

This company operates dredges at Oroville, Butte county, California, and also in Colombia, Central America. The reports and accounts of the English company cover the period from October 1, 1911, to June 30, 1913; while in connection with the American company, Oroville Dredging, Ltd., there is a report by Theodore J. Hoover dated May 16, 1913; a report by W. P. Hammon dated July 15, 1913; and accounts to July 31, 1912; and January 31, 1913. The annual meeting of the Company was held in London on September 30, 1913.

The directors' report states that since the last report 10,773 shares of the English company have been issued in exchange for an equal number of the American company's shares, making a total to date of 570,514 shares. No dividends having been paid by the latter Company, the English company's income was derived from agency and transfer fees only. The operating profit of the American company for the year to July 31, 1912, was $261,624, and the net balance, after charging general expenses, etc., was $255,509. Of this, $60,808 was written off for dismantling dredges, leaving $194,701, and adding the balance from the previous year, the surplus July 31, 1912, was $299,603. The American company's accounts for the half-year to January 31, 1913, shows a further surplus of $101,894, making a total of $401,497.

During the 18 months to January 31, 1913, the dredges at Oroville handled 7,062,528 cu. yd. of gravel yielding gold worth $726,302, equal to 10.28c. per cu. yd., against $456,789 and 10.24c., respectively, in the previous twelve months, the relative profits being 5.21 and 4.42c. per cubic yard. The final and total net profit which the Company may expect to derive from its Oroville property during the six years of its life, will be about $480,000. The estimated net return to Oroville Dredging, Ltd., from the Pato business, Colombia, is £350,000, but does not include the probable returns from California hill on the 'ring of gravel around the periphery of the 310-acre area,' or possibilities from other parts of the 20,000-acre concession. Drilling and sampling California hill is to be done. The cash outlay for the Pato equipment is $986,278. Up to August 9, 594,570 cu. yd. of gravel had been dredged, yielding $115,077, equal to 19.35c. per yard. Regarding the financial condition of the Company, on August 31, the net liability was $178,000, not including a loan and interest of $149,000 due the Consolidated Gold Fields of South Africa, Ltd. Dividends may be expected early in the summer of 1914.

The report of Theodore J. Hoover to the English company, Oroville Dredging Company, Ltd., deals with the condition of the dredges at Oroville, California. Exploration No. 1 dredge was dismantled as being completely out of repair; California No. 2 has reached the limit of its existence, and has practically dredged all its available ground; Exploration No. 2 is 10 years old and has nearly finished its work; Exploration No. 3 has been kept in good order and will operate for five or six years; and Boston No. 4 should have a similar life. The position now is, that at the end of 1913 there will be only two dredges working. There is no prospective value in the Oroville operations. The report of W. P. Hammon shows that during the 18 months under review, 143.23 acres was dredged at Oroville, leaving 386 acres to be treated. At the Pato property there are 40 white men and 350 natives employed, and 6% are treated daily for ailments incident to the tropical climate. A heavy investment has been made in this property.

TRANSVAAL GOLD MINING ESTATES, LTD.

The Company now owns freehold farms with an area of 172,209 acres; mineral rights over 18,779 acres; concessions granted by the Government in respect of various farms, and 891 mining claims; also water rights, etc. The capital is £640,000 in 640,000 shares of £1 each; 604,225 of the shares are issued and fully paid. Debentures totaling £105,564 have been issued. The report for the year ended March 31, 1913, gives detailed accounts from the Central, Elandsdrift, and Vaalhoek mines. The tonnage mined at the Central Mines amounted to 148,834 tons, at a cost of 7s.8.07d. per ton mined. At the 60-stamp mill 148,600 tons of ore was crushed, at a cost of 1s.4.27d. per ton milled. The total value of the gold recovered from the tube-mills was £205,940, at a value of 27s.8.610d. per ton milled. In the cyanide operations 146,050 tons was treated, and 47,902 oz. fine gold recovered, valued at £200,814, a value of 27s.5.99d. per ton treated, at a cost of 3s.3.79d. per ton milled. Also 7342 tons of accumulated slime was treated and 2572 oz. of fine gold recovered at a cost of 5s.4.98d. per ton treated. The total revenue was £407,180, and the working profit was £245,296, or 33s.0.17d. per ton milled. The ore reserves were estimated to be 385,547 stoping tons, valued at 14.23 dwt. per ton. At the Elandsdrift mine 7872 tons of ore was transported to the mill, at a cost of 1s.0.65d. per ton milled. The yield per ton was 18.68 dwt., a total value of £30,720, at a cost of 5s.1.38d. per ton milled. The total value of the 7908 tons treated in the cyaniding operations was £5836 1s.11d., at a cost of 4s.1.51d. per ton milled. The total working expenses were 31s.7.16d. per ton milled. The revenue was £36,556, and the year's profit was £24,260, or 62s.2.07d. per ton milled. The ore reserves were 30,210 tons. At the Vaalhoek mine the tonnage mined was 15,607 tons. At the mill 16,355 tons was crushed, at a cost of 2s.4.59d. per ton. In the cyaniding operations 16,243 tons was treated, at a cost of 8s.6.10d. per ton. The total revenue was £25,860 and the profit was £8395, or 10s.3.19d. per ton. A calculation of the ore reserves showed 40,892 tons of an average value of 10.36 dwt. The net profit of the Company for the year was £277,415. Dividends to the amount of £226,584 were paid.

GREAT FINGALL CONSOLIDATED, LIMITED.

This Company was registered in 1899 to acquire the holdings of the Great Fingall Reefs, Ltd., and the Consolidated Murchison Gold Mines, Ltd., consisting of property situated at Day Dawn, near Cue, Western Australia. The capital is £125,000, in 250,000 shares of 10s. each; all the shares are issued and fully paid. The report for 1912 shows that 67,177 tons of mine ore was treated at the Company's mill during the year, the total working expenses being 23s. 10d. per ton. In addition, 4426 tons of customs ore and 467 tons of purchased concentrate were treated. The total extraction of gold was 92.8% of the assay value. The gold recovered from the mine ore amounted to £115,783; that from the customs ore amounted to £16,262. The total income was £133,910, the surplus being £16,250. It was estimated that on December 31, 1912, there was, above the No. 14 level, 21,151 tons of ore of an average value of £1 6s. 5d. per ton, and 50,308 tons below that level, of an average value of £2 per ton. This latter will be available for the mill on completion of the new winze.

PRESTEA BLOCK A, LTD.

The Company was registered in 1903 to acquire from the Prestea Mines, Ltd., and the Appantoo Mines, Ltd., portions of the Essarman and Intermediate concessions in the Prestea district, near the Ancobra river, Gold Coast colony. The authorized capital is £1,150,000 in 1,150,000 shares of £1 each; 1,049,876 shares are issued and fully paid. There is a loan from the Central Mining & Investment Corporation, Ltd., and the Fanti Consolidated Mines, Ltd., of £150,000. The report for the year ended December 31, 1912, gives the total milled as 172,319 tons of ore. The gold recovered realized £296,382, or 34s.4.79d. per ton. The expenses were 28s.10.9d. per ton.

The ore reserves were estimated at 835,014 tons with a value of 44.4s. per ton. The operations for the year resulted in a profit, before charging depreciation of £38,345 1s., of which £14,254 has been appropriated to writing off the debit to that amount in the profit and loss account at the rate of 31s. to December 1911, and the balance, £24,091, has been allotted to depreciation of plant, machinery, and buildings.

Concentrates

Most of these are in reply to questions received by mail. Our readers are invited to ask questions and give information dealing with the practice of mining, milling, and smelting.

THE FLOTATION PLANT at the Wallaroo & Moonta mines, South Australia, is recovering 95% of the copper content of the crude ore.

A TOP TUMBLER for a dredge in the Philippine Islands, being manufactured in Victoria, Australia, has five sides instead of the usual four-side design. It weighs about 7 tons, and similar tumblers have given good results.

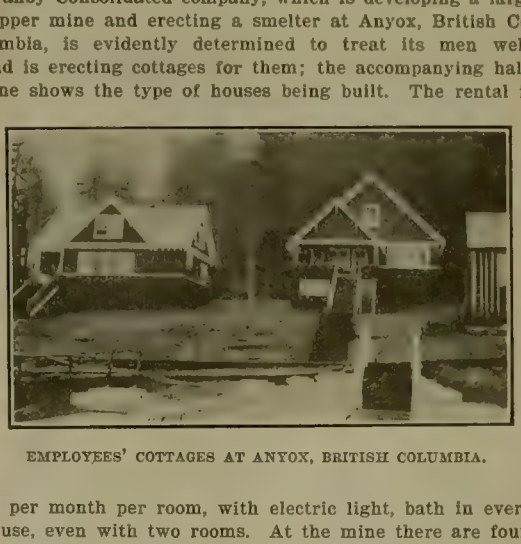
PECK CENTRIFUGAL MACHINES are in use for concentrating slime at Anaconda. Experiments are being conducted with two types, one discharging from the top and the other from the bottom. Each machine includes two concentric vertical cylinders driven at different speeds. The discharge is intermittent and effected by decreasing the speed of one cylinder.

THE USE of asbestos-protected metal for the roofing and siding of buildings in the construction of steel plants was recently given great impetus by an unfortunate accident in the gas-producer building of one of the largest steel plants in the East. Several men were struck by tiles loosened from the purlins by an explosion. Several men were killed and others seriously injured in this manner. Asbestos-protected metal has already been standardized as a roofing and siding for various classes of buildings in steel mills, sixteen steel companies being continuous purchasers. The American Steel & Wire Co. was the first of this number to purchase asbestos-protected metal, having commenced its use some five years ago.

COMPARING the results obtainable with a jet and a surface condenser, J. H. Ledeboer, in the *Proceedings* of the Australasian Institute of Mining Engineers, summarizes as follows: (1) The possible vacuum depends in every case on the hot-well temperature. The lower this is the higher the possible vacuum. (2) In a mixing condenser this highest possible vacuum can be reached without difficulty, and it can be maintained in practice with little trouble. (3) The hot-well temperature in a surface condenser will always be higher than in a mixing condenser, supposing there is the same steam consumption and same cooling water. This difference may be from 5 to 15° in ordinary practice. (4) As a result, with a surface condenser (without hot-well cooler) under the same circumstances the vacuum obtainable in a mixing condenser cannot be reached. (5) If the surface condenser is fitted with separate cooler, the hot-well temperature may be reduced and give better results. (6) In the last-mentioned case feed-water of a higher temperature can be had than in the hot-well by pumping the condensed water with a special pump, draining it off before it reaches the hot-well, and pumping the air with a separate dry-air pump.

IN Agricola's 'De Re Metallica' is the following on milling: Some people build a machine which at one and the same time can crush, grind, cleanse, and wash the gold ore, and mix the gold with quicksilver. This machine has one water-wheel, which is turned by a stream striking its buckets; the main axle on one side of the water-wheel has long cams, which raise the stamps that crush the dry ore. Then the crushed ore is thrown into the hopper of the upper millstone, and gradually falling through the opening, is ground to powder. The lower millstone is square, but has a round depression in which the round, upper millstone turns, and it has an outlet from which the powder falls into the first tub. A vertical iron axle is dovetailed into a crosspiece, which is in turn fixed into the upper millstone; the upper pinion of this axle is held in a bearing fixed in a beam; the drum of the vertical axle is made of rundles, and is turned by a toothed drum on the main axle, and thus turns the millstone. The powder falls continually into the first tub, together with water, and from there runs into a second tub which is set lower down, and out of the second into a third, which is the lowest; from the third, it generally flows into a small trough hewn out of a tree trunk. Quicksilver is placed in each tub, across which is fixed a small plank, and through a hole in the middle of each plank there passes a small upright axle, which is enlarged above the plank to prevent it from dropping into the tub lower than it should. At the lower end of the axle three sets of paddles intersect * * * and the whole is turned by a toothed drum. * * * Thus the paddles, of which there are three sets in each tub, turn round, and agitating the powder, thoroughly mix it with water and separate the minute particles of gold from it, and these are attracted by the quicksilver and purified. The water carries away the waste. The quicksilver is poured into a bag made of leather or cloth woven from cotton, and when this bag is squeezed the quicksilver drips through it into a jar underneath. The pure gold remains in the bag. Some people substitute three broad sluices for the tubs.

EMPLOYEES of large mining companies should have every facility given them to live in comfortable homes, especially if the properties are in outlying districts. The Granby Consolidated company, which is developing a large copper mine and erecting a smelter at Anyox, British Columbia, is evidently determined to treat its men well, and is erecting cottages for them; the accompanying halftone shows the type of houses being built. The rental is



EMPLOYEES' COTTAGES AT ANYOX, BRITISH COLUMBIA.

$3 per month per room, with electric light, bath in every house, even with two rooms. At the mine there are fourteen 4-room and four 5-room cottages completed. The old bunkhouse has been renovated and will house 35 men. A two-story bunkhouse, 30 by 120 ft., with basement containing lockers, showers, and tubs, is ready for 110 men. The mess has a capacity of 250 men, with cold-storage plant. All buildings are connected with water and sewer systems sufficient for present and future needs.

THE BLACK GOLD obtained in parting in gold assays is regarded by many and mentioned in some books as an allotropic form, on account of its color and slight increase in density. The color of parted gold depends on the proportion of gold to silver in bullion, according to E. C. Woodward, of Colorado Springs. In the bullion assay, where the proportion is 2½ to 1, the gold is left as a solid yellow mass. As the proportion of silver increases, the gold is left more finely divided, in a black spongy mass, or even scattered in fine black particles. If this black spongy mass is boiled in strong acid, it shrinks, and often shows a distinctly yellow color. A gentle heat or a moderate pressure will condense the black sponge and change its color to yellow. In a strong light, a yellow tinge can generally be seen, and the blackest gold he has prepared, dried in the sun, or even undried, showed an unmistakable gold color under the microscope. Victor Parchl, in 'Chemistry of Colloids,' states that the density of bodies increases with progressive division. Rose gives the specific gravity of rolled gold as 19.33; parted gold, 20.30; and precipitated gold as finest powder by ferrous sulphate as 20.72. From these facts it seems certain that black gold is simply gold in a state of fine division.

Motor Trucks

The advent of the motor truck into the mining field has met with such success that it has come to be looked upon as a necessity in the operation of some properties. In localities distant from the railway and where muleback transportation or wagon haulage was the only means of handling supplies and mine products, the motor truck has found a place and proved itself a most efficient and convenient means. The advantages of the motor truck over the old methods are numerous, and when reduced to the ton-mile basis, with everything considered, have shown a decided saving over the old methods. In numerous instances mining companies have gone to great expense in the construction of roads over which motor trucks could be operated, and even with this great outlay of capital in road construction for no other purpose than to replace the mule or wagon, experience has shown that the substitution of the modern for the ancient means of transportation has not only greatly expedited the handling of supplies and products, but has materially decreased the freighting charges.

Among the companies manufacturing motor trucks, the Moreland Motor Truck Co., of Los Angeles, California, has recently issued a bulletin descriptive of the trucks being

MORELAND TRUCK.

manufactured by this Company. The catalogue is both attractive and instructive, and presents the merits of the trucks in a novel manner by means of blueprint reproductions. These plates show the construction in detail and will appeal to the mechanic who is more interested in the construction of the chassis than the color of paint on the body. The Moreland trucks are designed to operate with California No. 1 distillate, a product peculiar to the Pacific Coast, and which, it is claimed, assures a saving in fuel cost of at least 50% over that of gasoline-operated trucks. It has been the aim of the Company in the building of motor trucks not to see how cheap they can be made, but to construct trucks that will handle the greatest tonnage in the most economical way. Quality has been the first consideration, and it has been the purpose to put the best material available into their making. While the trucks are designed to operate on distillate, any low-grade hydro-carbon or gasoline can be successfully used. The trucks are guaranteed to operate with California No. 1 engine distillate at a saving in fuel cost of 50 to 60% over any gasoline truck. It is also claimed that the distillate gives an increase of approximately 20% in power. From a small beginning, this Company has grown to one of importance in the motor truck field, and its products have come to be recognized as one of the standards of motor truck construction.

The production of zinc and zinc-lead ores in 1912 increased about 1,340,000 tons over the output of 1911. A considerable portion of the zinc and zinc-lead ore is used in the manufacture of pigments.

THE total mineral production of Australia to date is worth approximately $3,840,000,000, of which gold was responsible for 70%, coal 9%, silver and lead 8.5%, copper 7.5%, and tin 4 per cent.

Recent Publications

ANNUAL REPORT OF THE DEPARTMENT OF MINES FOR AUSTRALIA FOR 1912. Presented by H. S. King, is compiled from reports from officers controlling the various subdepartments throughout the state of Western Australia. P. 265. Ill., maps, charts. Perth, 1913. Although somewhat belated, these annual reports are of great interest, and under the various chapters are given a summary of the past year's work, details of minerals mined, area of mining leases, men employed, accidents, state aid to mining, reports from district officials, legislation, inspection of machinery, school of mines, report of the state mining engineer, report on state mills, geological survey report, reports of the machinery inspector and inspector of explosives, and 115 pages of statistical matter. The mineral output of the state amounted to £5,760,207, being £345,646 less than 1911. Gold accounted for a decrease of £374,690, while there were increases of £24,703 in coal, £15,358 in tin, and £7563 in lead ore. Gold accounts for 94.58% of the total mineral output, the total to the end of 1912 being £109,298,872, and total mineral output of £113,326,510.

Mining companies paid £814,256 in dividends. During the year all mines treated 2,688,868 tons of ore, the average value being 39.64 shillings per ton. The area held under mining lease for all minerals was 56,602 acres; 14,961 men were employed; copper exports were £60,537; six coal mines produced 295,079 tons, and silver produced was 138,039 oz. During the current year, 1913, the gold yield of the state took an upward turn, after nine years' decrease. From time to time, extracts will be made from this report and published in these columns.

U. S. Bureau of Mines, Washington, 1913:

COAL-MINE FATALITIES IN THE UNITED STATES. July statement compiled by Albert H. Fay. P. 19.

SANITATION AT MINING VILLAGES IN THE BIRMINGHAM DISTRICT, ALABAMA. By Dwight E. Woodbridge. Technical Paper No. 33. P. 29. Ill.

THE TITANIFEROUS IRON ORES OF THE UNITED STATES. By Joseph T. Singewald, Jr. Bulletin 64. P. 145. Ill., index.

METALLOGRAPHIC TESTING. Bureau of Standards Circular No. 42. P. 16. Department of Commerce, Washington, 1913.

Abstracts of the above publications appear from time to time on the statistic or other pages of this journal.

ECONOMIC MINERALS AND MINING INDUSTRIES OF CANADA. By the staff of the Mines Branch, Department of Mines. P. 77. Ill., map. Ottawa, 1913.

Catalogues Received

CYANIDE PLANT SUPPLY CO., London, England. Supplements 23, 24, 25, 26, and 27, with 28, 16, 3, 16, and 48 pages, respectively. Illustrated. 6 by 8 in. These contain additional data on the Brown or Pachuca agitator, the Komata tube-mill liner, Neal pebble-retaining discharge for tube-mills, Cooper roller bearings for tube-mills and other machinery, and tube-mill data, such as speed, correct charge of pebbles, rate of feed, and economical size of feed.

CHALMERS & WILLIAMS, Chicago Heights, Illinois. Catalogue P (first edition), 'Adjustable Quick Discharge for Tube Mills.' 20 pages. 6¾ by 9 inches. Illustrated.

ALLIS-CHALMERS MANUFACTURING CO., Milwaukee, Wisconsin. Bulletin No. 1084, 'Steam Turbines and Generators.' 52 pages. 7¾ by 10½ inches. Illustrated.

ORENSTEIN-ARTHUR KOPPEL CO., Koppel, Pennsylvania. General catalogue No. 900. 84 pages. 8 by 10½ inches. Illustrated.

INGERSOLL-RAND CO., New York. Bulletin No. 8011, 'Little David Riveting Hammers.' 8 pages. 6 by 9 inches. Illustrated.

NATIONAL TUBE CO., Pittsburgh, Pennsylvania. 'National Spring Plug Cock.' 4 pages. 5 by 7½ inches. Illustrated.

THE WM. POWELL CO., Cincinnati, Ohio. 'Powell Grease Cups.' 16 pages. 3½ by 6¼ inches. Illustrated.

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EDITORIAL

THE presidential election in Mexico, or, to be more exact, the straw vote, does not seem to have cast any oil on the troubled political waters of our southern neighbor. Sr. Huerta still holds the tiller and the red flag of the *revolucionarios* is as much in evidence as before this latest political farce was enacted.

STANDARDIZATION of metallurgical and mining terms has recently received the approval of the council of the Chemical, Metallurgical, and Mining Society of South Africa. It is gratifying to know that this society has black listed such terms as 'mullock,' 'lasher,' 'kokopan,' and others, and gone on record for the differentiation of the spurious from the standard in the good cause of sound diction. There is still hope that the English speaking miners will some day speak one language, and not, as were the workers on the Tower of Babel, be impeded by words and idioms both spurious and confusing.

THE Russian Government, through the Ministry of Trade and Industry, is preparing a new law for regulation of gold mining, under which a progressive rental will be required for all claims granted for the exploitation of gold. According to the duration of the concession a minimum production will be required of the gold placers. A regulation will also be included whereby, if the concession is not exploited within a given time from the date upon which it was granted, the claim will revert to the government. It is hoped that this measure will be the means of doing away with the speculation in gold placers.

THE 'high plane' strike of the coal miners of the state of Colorado appears to have degenerated into a condition of mob violence and bloodshed. Martial law has been declared in the disturbed districts and the stand which has been taken by the Governor toward the suppression of lawlessness does not augur well for those strikers who would carry their cause by force of arms. By what process of reasoning those responsible for present conditions hope, by the present course, to gain the concessions demanded, is beyond our ken, and we have yet to record a victory for organized labor where the psychology of the mob came into play.

TIME indeed brings changes, often rapid ones. The memory of gloomy prophecies of a rubber famine is still green, yet in a recent issue of the London *Financial Times* a correspondent strongly urges the formation of a Rubber Association to promote the use of rubber and find new uses, on the

ground that at the present price to which that commodity has declined, few of the rubber producing plantations can make even a reasonable profit. All of which inspires many reflections, above all, that the output of any commodity increases rapidly under the stimulus of higher prices. One result of the change is to seriously disturb Brazil's finances, since a large part of the revenue of several Brazilian states was derived from an export tax on rubber. With high prices and a practical monopoly of the field, this did very well, but now there seems to be serious danger ahead for the rubber growers along the Amazon.

RAILROAD construction in Nicaragua is about to receive an impetus through the $3,000,000 loan which was recently made in New York by the government of that country. The proposed extension is from Rama to Lake Nicaragua, where it will connect with the railroad on the west coast. The proposed road will be of direct benefit to the mining industry by affording better transportation facilities. Mining progress in Nicaragua, like in all of the other Latin-American countries, has been impeded by lack of railways, and any new construction will be welcomed by operators. It is understood that the Nicaraguan government hopes to place another and larger loan in this country soon for financing other lines which will make additional territory available for exploitation.

INVESTIGATION of the strike, conducted by a committee of the Copper Country Commercial Club of Michigan, has resulted in such fair and equitable conclusions that it is hoped that their publication may help toward an amicable understanding. The committee has come to the conclusion that the mine managers will not recognize the Western Federation of Miners; that no minimum wage applicable to all mines in the district can be established; and that the one-man drill has come to stay. It has further concluded that the question of establishing an eight-hour working day ought to receive the serious consideration of both men and operators, and also that some attempt ought to be made to provide an adequate method by which the employee can have free access to the management for the purpose of presenting grievances without fear of discrimination or discharge. At a meeting subsequently held, at which there were present representatives of each of the companies mentioned in the report, it was agreed that they were willing to act upon the recommendations that were presented and that each manager would establish and have in operation an eight-hour working day for underground employees on or before January 1, 1914. It was also agreed that arrangements shall be made whereby the matter of grievances will be adjusted and every complaint investigated with all possible speed. In the current edition we publish that part of the report pertaining to the one-man drill from which the thoroughness and fairness of the committee may be judged. It is to be hoped that the publication of this report will clear the atmosphere and correct false statements that have been circulated regarding the actual conditions in the Lake Superior district.

NO RECENT occurrence is so profoundly significant of the new spirit of the time as the legacy left by Benjamin Altman, who died in New York but a few days ago. Starting from humble beginnings he built up during his lifetime a large department store business, from the profits of which he accumulated an art collection valued at $15,000,000. On his death, though possessed of numerous relatives and though a member of a race popularly supposed to be peculiarly clannish and grasping, he left his art collection to the people of the city of New York and his huge and profitable business to the Altman Foundation, which is directed to administer it for the good of its employees and of such charities as the Foundation may think worthy. No member of the Foundation is to receive compensation for his services and the corporation thus becomes essentially a public institution. During his lifetime Benjamin Altman was the leader in the movement for providing better working conditions and better compensation for employees in department stores. His efforts were deprecated by sincere men who honestly believed that such methods were incompatible with the profitable operation of the business, yet his profits continued to increase and he lived to see the day when such methods were acknowledged as good business, tending to higher efficiency. To those whose faces are still toward the past his life is commended for an example. Everywhere there are sincere men who see in workmen's compensation, safety laws, and other forms of labor legislation only undue aggressions against the vested rights of capital. To all such we commend the idea of the evolution of industrial and social liberty.

SAFETY can never be absolute in mining. There will always be some loss of life in this as in other industries, but it may be possible to greatly reduce the number and severity of accidents. Many are discouraged over the fact that some of the worst accidents have happened in some of our best equipped mines, as at Stag Cañon. In this, however, we think the correct attitude is that taken elsewhere by Mr. J. A. Holmes, who reasons that these disasters should but bring us to realize that our work has barely begun. The brave helmet men who were crushed under a roof-fall while exploring the mine in advance of regular workers, were on the skirmish line in more ways than one. They will not have died in vain if lessons from this great disaster lead to greater safety in mines yet to be worked. Complete and immediate success can no more be fairly anticipated in this than in other lines of endeavor, but steady persistent work will minimize the loss of life. American mine operators have been quick to realize the value of the newer mine-rescue apparatus and they have been generous in their purchases; it is a serious question whether the men have been equally willing to submit to the discipline, to do their part in the day by day vigilance that alone will prevent loss of life. None are readier or bolder to attempt saving a fellow worker when in actual peril, but to prevent his being imperiled is another matter. The cause of the Stag Cañon disaster is yet unknown, and for the present one can but urge upon both men and operators the necessity for constant watchful-

ness. The sympathy of the whole mining world goes out to the men and their families and to Dr James Douglas and his capable hard working staff. There are few properties at which one could be equally sure that everything possible had been done to forestall and prevent disaster.

Electric Smelting of Copper Ores

With the growing importance and availability of electric power, especially hydro-electric power, and the continual improvements in the design and construction of electrometallurgical apparatus, the smelting of copper, and more especially zinc, ores by electrically generated heat is a possibility which may well engage the attention of those who are concerned with metallurgical progress, as well as with the payment of present dividends. The authors of the paper presented in the current issue on the application of the electric furnace to Western metallurgy have been engaged by the Bureau of Mines to make a detailed study of this subject, and the results of their work will be more fully set forth later in publications of the Bureau. As is both natural and right, Messrs. Lyon and Keeney have adopted an optimistic viewpoint, and in the interest of obtaining a well rounded view of the situation, it will be well to call attention to the factors unfavorable to the immediate development of an industry in which the heat for smelting is generated from electrical energy.

In the computation of the cost of electric power for smelting, those who take an optimistic view commonly reckon that electricity may be obtained at a cost of 0.15 cent per kilowatt-hour, or about $10 per horsepower-year. As compared to the extraordinarily low cost for the production of electric power which has been attained in some parts of Europe, this may seem a liberal allowance to the advocates of electric smelting. As a matter of concrete fact, however, the cost of hydro-electric power, in the mountain districts of California, is $50 per horsepower-year to consumers of moderate amounts, and even consumers who will take a steady load of 10,000 horsepower have to pay at the rate of at least $16 per horsepower-year. In his interesting paper on hydro-electric development in Montana, Mr. Max Hebgen makes the statement that the coal necessary to develop by steam power the 49,500 kilowatts now produced by the Montana Power Company and its subsidiaries would cost $45 per horsepower-year. It is unfortunately probable that the use of electric energy for smelting will have to be developed under unfavorable conditions, rather than those which are most favorable, and it is only fair to state that there is every evidence that electric smelting will have to be upon the basis of a power cost which is nearer one cent per kilowatt-hour than the figure usually cited. On the basis of a theoretical computation in which it is assumed that the thermal efficiency of a coke-fired blast-furnace is 50 per cent and the efficiency of the electric furnace is 70 per cent, it is deduced that coke and electric energy are on a par at $7 per ton for coke and $10 per horsepower-year for electric energy. With electric power at the more probable cost of $30, this corresponds to $21 per ton for coke, and even this figure neglects the cost of electrodes, which is estimated at 30 cents per ton of charge smelted. The cautious manager hopes for the best conditions and prepares for the worst, and upon this basis it is difficult to believe that, except under unusually favorable conditions, electric smelting can be done at a cost which will permit of its wide use, for the present at least.

Other conditions than those of cost are of importance in the regular conduct of smelting work, however, and it may be pointed out that the barring down of crusts is a normal action in copper blast-furnace smelting as usually practised. This is almost incompatible with the use of refractory linings in the construction of a smelting furnace. The assumption that the thermal efficiency of an electrically heated furnace will be 20 per cent greater than that of the ordinary copper blast-furnace will require experimental demonstration before it can gain general acceptance. It must not be overlooked that in experiments which have been conducted, the volatilization loss was 1 per cent of the copper present when smelting native copper concentrate containing about 30 per cent copper. In the other experiments, the volatilization loss is not given beyond the statement that it is low. It must be remembered that our knowledge of slag composition and slag losses is based upon practice in which the average temperature within the furnace is lower than is likely to be the case in electric smelting, where the heat generated is concentrated in a comparatively narrow zone between the electrodes, rather than distributed throughout the zone of combustion, as in the blast-furnace. What difference this will make in practical operation can only be determined by much experiment, in which the Bureau of Mines is properly taking the initiative.

Just as smelting in the blast-furnace, utilizing only the heat of the sulphur in the charge, is theoretically possible, but in practice the use of coke to increase the tonnage handled per day is an economic advantage, so the use of electric energy will be conditioned upon the profit obtainable from its use, and profits can only be determined by introducing all working conditions in experiments upon a working scale. Considerations of space prevent fuller discussion here, but we will be glad to accord space in the 'Discussion' column for the views of our readers.

It is unquestionable that if the early experiments which painfully led up to the present converter practice and pyritic smelting had been made by an organization like the Bureau of Mines rather than under the irrelevant difficulties at Toston, Butte, and elsewhere in Montana and Colorado, progress would have been more rapid than was actually the case. Promising experiments have often been dropped because some structural feature unexpectedly failed and the management was unwilling to incur the expense of reconstruction. We congratulate the Bureau upon being both able and willing to undertake the work necessary for the development of an exact knowledge of the possibilities of electric smelting.

The Rand Banket—Part III Continued

By C. B. Horwood

Emmons, in discussing metasomatism, states that the interchange is not necessarily molecule by molecule in such manner as to preserve the original form, structure or volume of the replaced substance.[112]

Van Hise[113] assumes a change in volume and maintains that "the volume of the original compound is to the volume of the compound produced, directly as their molecular weights and indirectly as their specific gravities." The latter part of this statement means that the weight of the compound produced is the same as that of the material that has undergone dissolution. If this be so, the process is not a simple molecular one as between molecule and molecule; if molecular at all, the exchange implies the principle of multiple proportions. In the case of the Rand conglomerate, the microscope shows clearly that quartz[114] has been replaced by iron pyrite and gives no indication of any mechanical process, or of any intermediate stage, either of open space or due to a two-stage chemical process. The molecular weights of these two substances are 60.4 and 120 and their specific gravities are approximately 2.7 and 5.0 respectively. Thus, according to the first portion of Van Hise's statement, the volume of the original compound is to the volume of the compound produced as 60.4 is to 120. We know that this was not so, for if it had been, the spaces originally taken up by the pyrite 'pebbles' would have been double that previously occupied by the replaced material; and whatever subsequent contraction had taken place, the microscope would have revealed some signs of the enormous pressure originally exerted by the new mineral against the host mineral. It has not done so.[115]

Change in Size of Pebbles

According to the second part of his statement, these volumes are as, say, 5 to 2.7. This would mean that the original volumes of the pyrite 'pebbles,' not allowing for any subsequent contraction, were only about half the volumes of the material replaced. This is evidently not so, from the fact that the fibrous silica, which is of later growth than the pebbles, only exists in comparatively small quantities round portions of some of the pebbles, and the microscope reveals no indication of any substance, or falling in, of the matrix round any of the pebbles. Moreover, in this example the two parts of his formula contradict one another; as according to the first part of it the volume occupied by the pyrite should be greater than that previously occupied by the replaced substance; and the second portion of his supposition requires that the pyrite should fill less space than was filled by the material replaced. Thus no great importance need be attached to his statement as a whole.

Sullivan,[116] in summarizing the conclusions to be derived from his own experiments in attempting to apply chemical methods to the investigation of geological processes, and especially that of the secondary deposition of ores, was rather more cautions than Van Hise. Though he was not discussing exactly the same subject, it relates sufficiently to it, however, to be worthy of reference here. As before-mentioned, he states: "The natural silicates precipitate the metals from solutions of salts, while at the same time the bases of the silicates are dissolved in quantities, nearly equivalent to the precipitated metals." He adds: "Where exact equivalence is wanting, it is attributable either to solubility of the mineral in pure water or to the precipitation of basic salts." He evidently regarded equal volumes, before and after, as the general rule.

Metasomatic Changes

Posepny[117] considered that metasomatic interchange took place without alteration of volume; for example, he stated that "after the expulsion, atom by atom, of the original material, the resulting deposit must be massive, showing no crustification."

Lindgren,[118] in dealing with metasomatism, distinguishes between three kinds of reactions: those in open space; those in yielding material; and those in rigid rock, where the new mineral is forced to make room for itself by solution of the host mineral. In the latter he concludes that "the volume of the replacing mineral equals that of the mineral replaced." He maintains that the chemical equations written to express such replacements are of little value because they give relations by weight instead of volume, and that "such replacement proceeds independently of molecular weight, molecular volume, and specific gravity." Further, that it does not take place, molecule for molecule, nor by a given proportion between the molecules dissolved and precipitated. However, he thinks it is molecular, or at least submicroscopic, inasmuch as there are constant chemical reactions taking place in the contact films of solutions; but that the process proceeds in one operation, solution and precipitation following so closely that no solution spaces are discernible under the microscope.

[112] Emmons, S. F., 'The Genesis of Certain Ore Deposits, *Trans.* Amer. Inst. Min. Eng., Vol. XV (1886), p. 128.

[113] 'Metamorphism,' U. S. Geol. Surv. Mon., Vol. 47 (1904), p. 209.

[114] The portion replaced is often not all pure silica, but the small percentage of silicates it contains would not affect the argument.

[115] Increase of volume as a result of metasomatic interchange has never been recorded (see J. D. Irving, *loc. cit.*) Further, since, as shown later, the mineralizing solutions were introduced after the conglomerate had been subjected to the enormous pressures that tilted them into their present positions, and after the intrusions of the big longitudinal or strike dikes, it is difficult to imagine how the metamorphosed beds could have then been sufficiently yielding to have allowed such great expansion to have taken place.

[116] Sullivan, E. C., *loc. cit.*, p. 64.

[117] Posepny, F., *loc. cit.*, p. 16.

[118] *Loc. cit.*, pp. 525 and 534. For a lengthy and interesting discussion on replacement, see 'The Nature of Replacement,' by Waldemar Lindgren, *Econ. Geol.*, Vol. VII (1912), No. 6.

Volume v. Specific Gravity

Further investigation may show that the volumes do somewhat depend on the specific gravities of the two materials. Possibly the molecular volumes of the two substances also affect the question. The molecular volumes of quartz and pyrite are 22.8 and 24; there is so slight a difference between them that, judging from the particular occurrences under consideration, it might easily be that the volume of the pyrite is to that of the replaced material either inversely, or directly, as their molecular volumes. If so, the evidence indicates that the changes in volumes are inversely as their molecular volumes.

Thus the opinions of Emmons and Van Hise are that replacement is not necessarily by equal volumes. Sullivan thinks the change is by equal, or nearly equal, volume. Posepny was of the opinion that the change took place by equal volumes. Lindgren concludes that where it takes place in rigid rock it does so by equal volume.

The truth is, that this subject, which is not only deeply interesting but is one of great value in the study of many problems in economic geology, has not in the past been given the attention that its importance warrants. Few facts are available; and it should afford a good field for further research, which is much needed.

Classification of Pebbles

From the foregoing it is clear that the so-called 'pebbles' of the Rand banket are replacement products, which may for convenience be divided under the three following headings:

1. Those that have been formed by the replacement of the matrix of the banket.
2. Those that have been formed by replacement of the matrix and pebbles indiscriminately.
3. Those that have been formed by replacement of the pebbles of the banket.

Those falling under the first two headings may be termed metasomatic concretions; and those coming under the last heading may be termed metasomatic pseudomorphs.[119]

In all cases they have been formed by the process known as 'replacement' or 'metasomatism.' To the former class the term 'concretion' is applicable, inasmuch as they have been formed from within outward; the microscope shows that in the case of each such 'pebble,' growth has usually taken place from several independent centres rather than from a single one. The other term, 'metasomatic pseudomorph,' is used to distinguish such replacements from the better known and more usual type of pseudomorph, which latter has been formed by the independent growth of one substance in the likeness, or in the crystalline form or habit, of another; the likeness not having in any way been, so to speak, forced upon it by any metasomatic process.

As regards the substance attacked, it has been shown that pebbles of quartz, quartzite, and hard cherty-looking slate or slaty-quartzite are replaced. Another substance commonly replaced is the matrix of the banket; this contains sericite and other matter containing alumina, so that where this has been replaced, both quartz and silicates of alumina have been replaced. The frequency with which partly replaced angular, indurated, slaty-quartzite pebbles occur as compared with all kinds of wholly replaced 'pebbles' or with other intermediate partly replaced forms, has already been mentioned and indicates that these pebbles are more readily replaced that pure quartz pebbles.[120] Also pyrite 'pebbles' that

[119]The term 'metasomatic pseudomorph' signifies a replacement product in which the original form (and generally speaking the original volume, or approximately so) of the substance replaced is preserved. The term was first used by Naumann, and, as Lindgren points out, it was the first introduction of the word 'metasomatic' in technical literature. See 'Mineralogie,' Naumann-Zirkel, 10th Ed., Leipzig; also, 'Metasomatic Processes in Fissure-Veins,' by W. Lindgren in 'The Genesis of Ore Deposits,' 2nd Ed. (1902), pp. 501-502.

[120]The writer pointed this out elsewhere (see 'The Mode of Occurrence and Genesis of the Carbon in the Rand Banket,' *Trans.* Geol. Soc. So. Af., Vol. XIII, 1910, p. 74), and also that the solutions containing the pyrite had evidently worked their way in along the original lines of the stratification; and, further, that since there seemed a much greater tendency for these pebbles to have been subjected to the process of replacement than for the quartz pebbles, that the pyrite evidently more readily replaced aluminum silicates than pure silica; also, that it is the more aluminous bands in these pebbles that are the most readily and the first to be replaced. Young, in discussing this paper (*Proc.* Geol. Soc. So. Af., 1911, to accompany Vol. XIII of the *Trans.*), opposed these opinions. However, the above facts demonstrate their truth. Sullivan has shown that the natural silicates precipitate the metals from solution. Silicates are far more soluble and readily attacked than ordinary quartz; not only are they soluble in sulphuric acid, while quartz is not, but we know that in nature the feldspars (double silicates) in granite are readily attacked and that they are sometimes replaced by cassiterite, while the quartz is unattacked. Lindgren has pointed out (*loc. cit.*) the frequent development, by replacement, of cubes of pyrite in shale; also, he directs attention to the frequent development of pyrite in fine-grained compact argillites, after the hardening and metamorphism of the rock, at a time when it was exposed to mineralizing solutions that were producing ore deposits in adjacent fissures. The writer admits that there is one particular silicate (chloritoid) in the banket that seems, on first consideration, to have been less liable to metasomatic change than the quartz; this is merely an exception, and does not affect the general argument. However, the chloritoid is a secondary mineral, probably deposited as a consequence of the same agencies and about the same time as the pyrite. The way in which the pyrite and chloritoid are often intergrown and interlocked suggests simultaneous growth (see W. H. Weed, 1903, *loc. cit.*, p. 554). It is suggestive that chloritoid also occurs in some of the dikes. The writer had a slide cut from a specimen of a small dark-green basic dike from the North Randfontein mine, and was astonished to find that it contained a considerable amount of chloritoid; and his determination of this mineral was supported by W. W. Watts and C. Gilbert Cullis who afterward examined the slide. Young (*loc. cit.*) maintains that those portions of the pebbles that were the more easily replaced were not aluminous but merely finer grained, and that the smaller the grains of quartz the greater the extent of the sub-capillary spaces along which the mineralizing solutions found their way. Van Hise ("The Genesis of Ore Deposits," 2nd Ed., 1902, p. 780) has explained that the difference between pervious and impervious strata is "that pervious strata have openings of capillary or supercapillary size, while the openings of impervious strata are subcapillary." The fallacy of Young's latter argument is therefore at once apparent; especially is this so when one considers that it was the conglomerate beds (that is, beds having openings of supercapillary size) which the solutions chose, as offering lines of least resistance, for channels of maximum

have been formed by replacement of the matrix, or of the matrix and pebbles, seem to be far more frequent than those that have only replaced quartz pebbles. These facts, taken in conjunction with the further fact that by far the greater number of the pebbles of the bankets are of quartz and that the proportion of the angular slaty pebbles present is very small, shows that pyrite more readily replaces silicates, such as those of aluminum and the alkalies than it does quartz.

Original Substances

The substances that have been replaced, in the order of replacement observed, are slaty quartzite, the material of the banket matrix, ordinary quartzite, and pure silica in the form of quartz pebbles. The three first consist of quartz together with a small proportion of silicates, chiefly those of alumina and alkalies.[121]

Posepny remarks that the original substance of most pseudomorphs was composed of soluble minerals such as carbonates, sulphates, chlorides, etc., hence also metamorphic or metasomatic deposits are especially frequent in soluble rocks like limestone and dolomite.[122] The new material has usually replaced a more soluble substance. In the cases just considered, a material that under ordinary conditions is more soluble has replaced the less soluble. The existence in the banket at the Meyer & Charlton mine of calcite pebbles that were pseudomorphs after quartz pebbles, has already been noted.[123] This was a case in which some of the quartz pebbles of the banket were replaced by a material still more soluble than iron pyrite. Pyrite nodules occur in the chalk of the Upper Cretaceous formation of England, many of which have been formed, or partly so, by the replacement of the silica of sponge spicules. Another example (well known on account of its bearing on the formation of flints) of a substance, less soluble under ordinary conditions, having been replaced by a more soluble is that of the particular kind of sponge known as *stauronema*.[124] The hydrated silica (or opal) of which its skeleton was originally composed has, in many cases, been replaced by carbonate of lime. By this discovery it was proved that the opal of organic skeletons may enter into solution in sea-water.[125] Confirmation was obtained by the existence of intermediate stages in which parts of skeletons had escaped solution, and the residual silica, deprived of water, was recognized under the microscope. However, chemists and geologists at first, despite the evidence, were loath to accept the facts, showing that so insoluble a substance as silica had been replaced by so soluble a one as calcium carbonate. The difficulty was largely due to the distinction between the hydrated, more soluble form of silica and quartz not being sufficiently borne in mind. Even when this is considered, the difficulty still remains of the far less solubility of hydrated silica than of carbonate of lime. There is, however, no doubt about the facts.

Replacement of Quartz by Pyrite

Petrologists have long been forced to recognize that quartz can be metasomatically replaced by pyrite.[126]

Pyrite is readily soluble compared with such substances as silicates, and still less soluble quartz. However, for the metasomatic changes just described to have occurred in the banket it is evident that under the conditions then existing, the silicates and quartz were more soluble than the pyrite, consequently the two former went into solution, while the latter was precipitated. This knowledge may help to disclose what those conditions were. The fact that quartz and quartzite pebbles have been replaced, as well as the quartz and silicates of the matrix, indicates that the solutions that dissolved them and that also contained the replacing material were chemically active, suggesting that they were at high temperatures and under great pressures.[127]

circulation. They served the part of fissures in which gold, pyrite, and carbon were deposited, as well as chloritoid, and also the secondary silica of the bankets, which is equivalent to the quartz gangue of normal fissure-veins.

[121]For analyses of quartzites and slates in the Witwatersrand beds, see 'Notes and Analyses of Typical Transvaal Rocks,' by C. B. Horwood, *Trans.* Geol. Soc. So. Af., Vol. XIII (1910).

[122]Posepny, F., 'The Genesis of Ore Deposits,' 2nd Ed. (1902), p. 15. Published by the Amer. Inst. Min. Eng. (1902).

[123]Denny, G., *Jour. Proc.* So. Af. Assn. Eng., Vol. II, No. 1 (1903), p. 9.

Kuntz, J., *Trans.* Geol. Soc. So. Af., Vol. VI, Part IV (1903), p. 74. Kuntz was careful to point out that they occurred near a break, which latter was now partly filled by calcite and from which a great amount of water was still flowing. Also, that these calcite pebbles diminished in number as distance from the break increased; and that as they gradually diminished in number and finally almost ceased to occur, pebbles could be found consisting partly of calcite and partly of quartz, the process of replacement becoming more and more incomplete the farther the distance from the break. Compare this description with that of the occurrence of the pyrite 'pebbles' at the Crown Reef mine, the break there being marked by the presence of a dike along which the mineral-bearing solutions ascended. In that case the pyrite 'pebbles' decreased in number and finally almost ceased as distance from the dike increased.

[124]Sollas, W. J., *loc. cit.*

[125]The silica obtained, both by this pseudomorphic process and by direct solution of sponge spicules, is then available in solution for the formation of flints by means of, first, a directly opposite process to that described above, namely, the replacement of the carbonate of lime organic skeletons by crystalline silica; and then, second, the deposition of silica by which the silicious chalk with mingled remains of sponge spicules, opaline and crystalline, are cemented together; and finally, the pores of the flints are closed by the continued deposition of silica. (See Sollas, *loc. cit.*)

[126]Naumann-Zirkel, 'Mineralogie,' 10th Ed., Leipzig.

Lindgren, 'Metasomatic Processes in Fissure-Veins,' in 'The Genesis of Ore Deposits,' 2nd Ed. (1902), p. 502.

[127]In this connection, it should be borne in mind that when these changes occurred, what, owing to great denudation, is now the surface may have been many hundreds of feet below what was then the surface. In which case it is easy to understand that the temperatures and pressures prevailing in what was then deep-seated ground, but which has now been brought within the reach of the miner, may have been great. Lindgren (*loc. cit.*, p. 528), in discussing metasomatism, states that "the replacement is effected by liquid or gaseous solutions which penetrated the pores, cracks, or fissures of the rock. If, as often happens, a perfect cube of pyrite is embedded in a grain of quartz or feldspar, close examination will rarely fail to discover a minute veinlet or fissure leading up to the crystal and through which the solutions found their way. At high temperature many fine-grained rocks seem to be comparatively easily permeable by solutions."

Under such conditions it is readily conceivable that the quartz may have been converted in silicic acid, which even under ordinary temperatures and pressures, is somewhat soluble in water. It may be that under high temperatures and great pressures it is more soluble in water than iron pyrite. The study of these replacements certainly demonstrates that it was more soluble than the pyrite in the mineralizing solutions, whatever they were, to which these changes are due. The secondary pyrite of these replacements, and the secondary pyrite in the banket generally, indicate the action of ascending deep-seated solutions.[128] Vogt has shown that sulphides are actually soluble in silicate magmas, especially at high temperatures, and that they are among the first minerals to crystallize.[129] The pyrite and gold were among the earliest minerals to be deposited in the bankets from the circulating mineral solutions; and chloritoid,[130] which is intimately associated with the pyrite and gold, was one of the earliest non-metallic secondary minerals; the final precipitate which ultimately sealed up the conglomerate to the further passage of solution, was silica. The latter was deposited as the secondary silica of the banket, and is comparable to the quartz of normal gold veins. From the abundance of this silica it may be inferred that the solutions (gaseous or liquid) must have been derived, or given-off, from a silicate magma, or rather, from that upper portion of a basic magma in which silica was predominant.[131] This explanation certainly helps to account for the dissolution of the silica and the precipitation of the pyrite.

Summary.

Thus, the study of the pyrite replacement in the Rand banket, where the new mineral has had to make room for itself by solution of the host mineral, leads to the following conclusions:

That the pyrite 'pebbles' of the banket occur as metasomatic concretions and also as metasomatic pseudomorphs; and that the small particles, grains, or crystals of pyrite scattered through the matrix, and frequently occurring in the pebbles, are also of metasomatic origin.[132] When the 'pebbles' were formed, there was no increase of volume. The original internal structure of the replaced mineral is often faithfully preserved and can be seen in thin sections under the microscope. Thus the interchange took place by equal, or approximately equal, volumes. Many of the 'pebbles' underwent contraction, the relative amount of which was small and was satisfied by cracks, either quite irregular, or definitely oriented, producing radial or concentric structures; or by shrinkage spaces round portions of the circumferences; or by both. These became filled with secondary fibrous crystalline silica. The habit of this silica suggests that its deposition was simultaneous with the contraction of the pyrite, the fibrous structure being due to tensile stresses set up by the contraction of the latter during the crystallization of the silica. This leads to the further conclusion that there was no interval in which open spaces existed. The metasomatic changes by which so insoluble a substance as quartz[133] has been replaced by such a soluble one as pyrite[133] indicate the agency of chemically-active solutions: the radiate and concentric structures, so often exhibited, are just such as would result from the contraction on cooling of a heated body; and the replacing substance is a sulphide,[134] and sulphides are generally deposited from ascending deep-seated solutions; these three considerations, and lastly the mode of occurrence generally, and in particular the association of the 'pebbles' with dike intrusions, all suggest that these pyrite bodies are the result of the work of solutions (either liquid or gaseous) at high temperatures and under great pressures ascending from great depths.[135]

(To Be Continued.)

Public lands restored to entry in September covered an area of 750,000 acres, of which 525,747 acres were in Montana and 214,742 acres in New Mexico.

Gold output of the St. John del Rey mine, Brazil, was worth $168,000 in September, an average of $11.16 per ton.

Unfilled orders of the Steel Corporation at September 30 were 5,003,785 tons.

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[128] T. A. Rickard, in his paper, 'The Formation of Bonanzas in the Upper Portions of Gold-Veins' (in 'The Genesis of Ore Deposits,' published by the Amer. Inst. Min. Eng., 2nd Ed., 1902, p. 737) writes: "Thanks to Prof. Van Hise and Mr. Slichter, whose work he utilizes, we have now arrived at a comprehensive conception of the underground circulation, which emphasizes the conclusion that sulphide ores are generally deposited by ascending waters."

See, also, Posepny, *loc. cit.*, p. 107.

[129] Clarke, F. W., 'The Data of Geo-Chemistry,' U. S. Geol. Surv. Bull. No. 491, 2nd Ed., pp. 317-318.

[130] Hatch and Corstorphine, 'The Petrography of the Witwatersrand Conglomerates,' *Trans.* Geol. Soc. So. Af., Vol. VII, Part III (1904), p. 142.

Young, R. B., 'Notes on the Auriferous Conglomerates of the Witwatersrand,' *Trans.* Geol. Soc. So. Af., Vol. X (1907), pp. 19-20.

See, also, 'Further Notes on the Auriferous Conglomerates of the Witwatersrand,' by R. B. Young, *Trans.* Geol. Soc. So. Af., Vol. XII (1909).

[131] Arrhenius, S., 'Worlds in the Making' (Harper Bros., 1908), pp. 16 and 20. Apart from this consideration, however, the cooling of the neighboring dikes would be sufficient to account for a great deal of silicification. Spurr has stated that "upon the cooling of an igneous intrusive rock, however, what might be called a forced segregation takes place. As the rock becomes solid, those materials which are 'left over' are expelled, and find their way into the neighboring rock, or along the fissures of the igneous rock itself. These 'left-over' materials consist chiefly of water, which is usually highly silicious, and contains a great variety of other mineral matters in solution, and also, very commonly, an unusual quantity of gases." ('A Consideration of Igneous Rocks and Their Segregation, etc.,' by J. E. Spurr, *Trans.* Amer. Inst. Min. Eng., Vol. XXXIII, 1905, p. 323.)

[132] There is also perhaps a little pyrite in the pebbles that was in the material of which they are composed before the banket was formed.

[133] Under ordinary conditions.

[134] Sulphide ores are generally deposited by ascending waters. See T. A. Rickard, *loc. cit.*; Posepny, *loc. cit.*, p. 107.

[135] It will do no harm to remark again that Lindgren, in discussing metasomatism, writes: "The replacement is effected by liquid or gaseous solutions which penetrated the pores, cracks, or fissures of the rock"; and also, "at high temperature many fine-grained rocks seem to be comparatively easily permeable by solutions." (W. Lindgren, *loc. cit.*, p. 328.)

Lessons of the Year in Our Mining Industry

By J. A. Holmes

*Our mining industry, already larger, is also growing more rapidly than that of any other great country. During the past century the value of our mineral products for each ten years has almost doubled that of the preceding decade. And while this large increase will probably continue, though at a diminishing rate, the steadiness and continuity of this growth is but one of the evidences that for many years to come the industry will continue to grow in magnitude and national importance.

Importance of Mining

During the year there has come to be a more general recognition of mining as one of the two (agriculture being the other) great foundation industries of the nation. All products of the mine become at once articles of interstate commerce, which no state can reserve unto itself, but which must serve a higher or a larger purpose, namely, the welfare of all the states; and under the recent decisions of the highest courts of the land, mining is thus recognized as a great national industry.

But notwithstanding these facts, and the fact that this most hazardous of our great industries, including with it metallurgical operations, gives employment to more than 2,000,000 men; contributes to our national wealth yearly, products valued at more than $4,000,000,000, which furnish more than two-thirds of our total freight tonnage, out of which we build and operate our railways and steamship lines, our telephone and telegraph lines, our buildings and our highways, develop heat and light, and operate our factories, and which in a thousand ways contributes to the welfare and the very life of the nation—this great national industry, of such vital importance to all the people, is receiving but tardy and inadequate recognition and aid from the legislative and administrative branches of the general government.

Speculative and Dishonest Features

The speculative and dishonest features of mining are disappearing. We are getting farther away from Mark Twain's definition of a mine. Great ore deposits like those now being developed at Juneau, Alaska, extensive areas of gold-bearing gravel, or the coalfields are, preliminary to mining operations or the sale of stock, being prospected today with such care and thoroughness that mining operations may be entered upon with as much certainty of results as would be true of an investment in a building, a manufacturing plant, or farming. Only the investor need see to it that he is dealing with honest and experienced men. The enforcement of postoffice regulations, and various state laws, enacted at the request of the American Mining Congress, is doing much to check the dishonest mine promoter; and with these agencies the Bureau of Mines is coöperating as far as it can do so. The opening up of large low-grade orebodies, heretofore generally and necessarily ignored in our great mining states, is another phase of mining development which will yield more certain returns on the capital invested, and will, therefore, give greater safety to the small as well as to the large investor in mines, and this development will also give greater stability to labor conditions.

The discovery and development of these large low-grade orebodies, as is true of iron and coal, bring about conditions which are not such as to interest or encourage the ordinary prospector. But with the needed discovery of more efficient methods for working these low-grade ores, the interest in them will increase; new prospecting methods will be developed; new prospectors will traverse the hills; and in many regions a new life for mining, more stable and more permanent, will result. In the placer regions of Alaska the old-time prospector still has his fields of activity. Every year he enjoys a new stampede. Now and then he makes a stake, and usually he reinvests all, or a large part, of his savings, in another find. It is the poor man's field, with a future as well as a past. In recent stampedes, however, there has developed a practice which threatens to seriously interfere with, if it does not destroy, prospecting of the old type; that is the practice, which I believe to be both undesirable and contrary to the spirit of the law, under which wealthy individuals and large corporations rush their well equipped hired men to a new discovery to stake claims, each in his own name, and then immediately transfer such claims to their employers.

Safety and Rescue Work

It is as to mine safety that the year's experience teaches the most important lessons. The decided progress in reducing the loss of life in coal-mining during the past few years gives encouragement as to what may be further accomplished along this line. Mine-owners, miners, and mine inspectors all deserve commendation for their good work during the year in behalf of mine safety, mine rescue, and first aid work. But we should all realize that we have but begun the good work. The recent awful disasters in Wales and Germany, and that at Stag Cañon in this country, indicate the need of new and greater efforts to prevent the occurrence of similar disasters during the new year upon which we are now entering. We must take no chances. Let no man think that his mine is safe. Most of the disasters have occurred in our 'best mines.' We must give safety the benefit of every doubt. Every mine-owner, and every miner in his employ, should coöperate in a determined effort to prevent even the smallest of accidents; for it is often the small accidents that inaugurate large disasters. Let no man be careless where the lives of men are at stake. Both operators and miners should and will welcome the most rigid inspection and enforcement of law

*Address before the American Mining Congress, Philadelphia, October 24.

by the state's inspectors. With all efforts for greater safety, the Bureau of Mines will cooperate to the fullest possible extent.

There has been progress in the movement for the prevention of waste in mining and metallurgical operations. The Bureau has been endeavoring to collect reliable data as to the nature and extent of such waste, and possible methods of lessening or preventing the same. That this waste is large, all admit; but few, however, appeared to realize what now seems to be the case: that the aggregate value to the nation of the sum total of all the waste of mineral products may be said to approximate a million dollars per day. The special efforts of the Bureau will be along the lines of finding out what part of this waste is preventable under existing conditions, and how this waste prevention may be brought about to a larger extent each year as new and more favorable conditions develop. Already some progress has been made, the most notable example being the saving during the first year of natural gas and oil having an aggregate value equal to many times the total cost of the Bureau from its inauguration to the present time. The results of pending inquiries and investigations indicate the possibility of much larger future yearly waste prevention in connection with both mining and metallurgical operations.

Appropriation for Metal Mining

Since the last meeting of the Mining Congress a new organic act for the Bureau of Mines has been enacted by Congress. The duties and purposes of the new Bureau have been enlarged to the full scope asked for by its friends; and at last metal mining has been recognized in federal legislation as an important branch of the mining industry. Meanwhile, also, Congress has appropriated $100,000 for investigations and inquiries relative to safety and waste in the mining and treatment of ores and other mineral substances. These inquiries and investigations, relating to all mineral resources other than coal, are now in progress in a considerable number of states where mining, quarrying, and metallurgical operations are under way. The other special appropriations for the work of the Bureau are $135,000 for testing the coal and oil used by the general government; and about $360,000 for investigations of mine explosions and other accidents in coal mines.

I am aware of many criticisms of the Bureau in different parts of the country because of its failure to do numerous things of which there is serious need, and which if done would aid greatly in better safeguarding the health and lives of miners, and would be generally helpful in the prevention of waste, as well as in the general development of the mining industry. I know, however, that while agreeing with our critics, these things ought to be done, and that they come within the scope prescribed by Congress for the Bureau, members of the Mining Congress all realize the inadequacy of our appropriations for doing even the many things needed and that have to do directly with the saving of life. It is more unfortunate, however, that our inability to do many of these things at the opportune time tends to discredit all our work and even the movement for greater safety among the miners, who appreciate less fully the cost of such investigations and whose good will, confidence, and coöperation is essential to the success of all our efforts.

But while the situation is at times profoundly discouraging, there is nevertheless good evidence of progress. The movement for safety has appreciably reduced the loss of life in coal mines during the four years since our investigations were begun. The coöperation of both mine-owners and miners with the Bureau in this work is now more effective than ever before. In the work for the prevention of waste, the saving during the first year has exceeded in money value many times the total cost of the Bureau. Congress at its last session authorized an appropriation of $500,000 for new laboratories for the work of the Bureau at Pittsburgh. And it is hoped that in the near future this recognition and aid for the mining industry from the federal government, so much needed and so long demanded by the American Mining Congress, may be more nearly commensurate with the sacrifices and national importance of the industry.

Mining in Sweden

According to the annual report recently issued by the Bureau of Commerce and Industries (Kommerskollegium) of the Swedish government, 300 iron mines were being worked during 1912. The total output of these mines was 6,699,226 metric tons of ore, of which 4,266,821 tons came from the mines in Norrbotten, the northernmost part of Sweden. Thirty-four refining plants were in operation and 1,215,318 tons of raw ore was treated, yielding 520,710 tons of *slig* or refined ore, valued at $1,300,000. Compared with the production of 1911, this was an increase of about 39%. The production of briquettes of refined ore was carried on at 17 different works, the combined output of the year amounting to 288,553 tons. The production of pig iron amounted to 699,816 tons, thus showing an increase during the year of 10.3 per cent. At Hoganas, 3979 tons of 'iron sponge' was produced. During 1912, according to the report, the Swedish steel plants produced 63,900 tons of bessemer ingots, 238,850 tons of martin ingots, and 4850 tons of cast martin steel. The total production of forged iron and steel amounted to 509,244 tons valued at $21,560,600.

With regard to the mining of other metals, results in 1912 were reported as, 2877 tons of silver-lead ore, 3059 tons of copper ore, and 50,000 tons of zinc ore. The coal mines in southern Sweden produced 360,291 tons of coal of different qualities, 135,773 tons of fire clay, and 58,846 tons of clinker clay. The value of the coal output was estimated at $750,400. Of the precious metals, 67,300 pounds of gold was obtained and 2114 pounds of silver. The copper ore mined yielded 4352 tons.—*Daily Consular Report.*

There were 58 gold mines operated in the Orenburg district of Russia in 1912, from which was mined about 170,000 tons of ore yielding approximately 43,000 oz. of gold.

The Voice of the Prospector

The fact of the approaching extinction of the prospector has been urged so persistently, indeed so many autopsies have been held over his still quivering form, that possibly a few words from the prospector himself may be in order. We abstract a few from among a number of recent letters received from our friends who are out on the dusty trails that lead, as we all hope, to some golden Golconda.

One man, writing from Idaho, reflects the cheerful spirit that overcomes obstacles: "I raise milch cows, purchase calves, breed them when ready and sell them when they are fresh; I keep 40 to 50 and it keeps me in a tolerably good grubstake—about $175 to $200 per ton. If only there were tons enough! I have mined more or less for 25 years. I am looking for a paying mine of my own and I will find it some of these times.—W. C. F." We sincerely hope he may, as also C. M. M., who writes from Oregon that he is a "lifelong prospector 70 years old, badly battered, but still hopeful." L. S. writes that he is starting on a prospecting trip, and as his subscription will expire while he is gone, sends a draft now. Our business manager says that one who is so careful about small business matters can hardly be the 'dreamy unpractical cuss' that many have pictured the prospector.

Prospector and Prospects

G. M., writing from Utah, has the following pertinent remarks to make: "Just a word about the prospector and prospects. My opinion is, that the reason there are so few genuine prospectors in the field and so few new mines being found is not because of the attitude of the Forest Service, but because the old-time mining camp storekeeper is almost a thing of the past. I mean the ones who would put up a grubstake or carry a lessee for a year or two without demanding a note with two or more signatures before he could get a sack of flour. There is also that vast army of mine and mill workers who delighted to take a chance on a prospect or invested their cash in mining stocks; they are out of the game altogether, for with the high cost of living it keeps them busy making both ends meet. We all know that with rare exceptions men of large means do not care to buy up or develop a prospect, probably the mining industry would flourish if they bought up good prospects and developed them, but I suppose that would not be good business (too much chance)."

J. W. A., who is at work in the Southwest, says: "Believing that Mexico's present trouble is Arizona's big opportunity, I have been trying to induce some of these American and English mining men to come here and put churn-drills at work on a large leached capping that I firmly believe is a disseminated deposit, but I find a prospector's letters do not count for much, yet he found all of the mines we have today. By the way, would it be possible for you to call attention of Eastern mining men and people looking for good mining properties to the fact that there is as good mining ground in Arizona that has never been scratched as was ever found in Mexico, and there are no revolutions in Arizona to interfere with the business of mining?"

The same problem, why it is difficult to sell a good claim, is touched upon by F. P., who is owner of an Arizona property that we have known of as producing high-grade ore at intervals since 1893. He says: "As owner and developer of a group of mines, upon which I have concentrated my energies for the past 22 years and which is for sale, it would be of great interest to me if you could throw some light upon the machinations of the great mining companies in their negotiations for a purchase. How is it, that after proceedings are broken off with one of them, a deal with another company when affairs have progressed apparently to a climax is suddenly blocked? Does not this point to a mining trust?" The question raised is too large to discuss here. Answering briefly, we can state with assurance that there is no mining trust. Engineers and mining men do exchange information and the knowledge that a property has been examined with unfavorable results by one, often becomes the common property of many. In general, we believe the difficulty that F. P. has met is due to lack of consideration of the poor by the rich rather than any deliberate combination. The very wealthy men get the notion that anything worth while is bound to come to them in time and that they can afford to prolong negotiations or to throw up options with a view to bearing the price; that in general, if Tom does not get the property, Dick or Harry will, and the next may be Tom's turn. Occasionally both lose, and we can name a number of cases where Dick paid more than Tom's option called for. If it is any consolation to F. P., we can assure him that he is not the only sufferer. We know excellent engineers who have been caught with valuable options in this same way; and that, too, by men for whom they had long worked and who had always followed their advice promptly when the relation was the usual one of client and adviser. However, we had not intended to be drawn into the matter, purposing rather to present to others the prospector's own point of view as to the existing situation. True to his tradition, he is still yielding to the lure of the pick and pack; a little older, a little wiser, recognizing more clearly perhaps the difficulties to be met, but with an abundant store of the cheerful optimism which has made the West and will renew it time and again.

Gold and silver production of the Hauraki Peninsula, North Island of New Zealand, during the first seven months of 1913 totals $2,450,000. The August returns from the principal mines are as follows:

	Tons.	Value.
Komata Reefs	*200	$ 1,400
New Zealand Crown	1,468	11,000
Talisman	4,280	110,000
Waihi	14,735	105,000
Waihi Grand Junction	8,800	72,000
Waihi-Paeroa Extraction	†11,450	17,300

*Closing down.

†Treatment of tailing from Ohinemuri river.

The Waihi company has paid dividend No. 80, bringing the total paid to $21,873,600.

Coal mine fatalities in the United States in July totaled 1437, as against 1419 in July 1912.

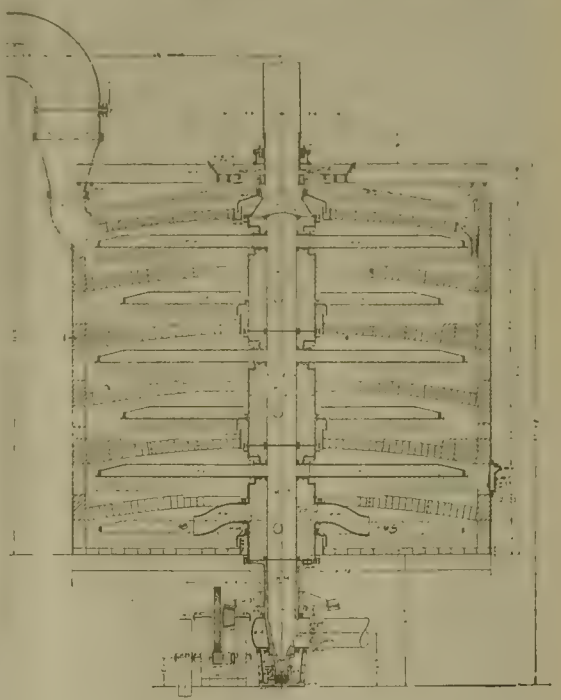
The Herreshoff Roasting Furnace

In the new smelting plants of the Arizona Copper Co., at Clifton, and the Calumet & Arizona Copper Co., at Douglas, Arizona, the roasting of concentrate preparatory to smelting in reverberatory furnaces is done in 6-hearth Herreshoff roasters. As the Herreshoff in its original form was a modification of the MacDougall roaster to meet the conditions required in the roasting of pyrite to yield SO_2 for the manufacture of sulphuric acid, its use in copper smelting practice is of great interest. Eight 21½-ft. roasters have been built for the Arizona Copper Co. and 12 of the same size at the Calumet & Arizona plant. The most notable features of these are: the use of air-cooled rabbles; the return of the air thus heated to the lowest hearth, thereby increasing the thermal efficiency of the roaster and allowing the roasting, without the use of fuel, of concentrate lower in sulphur than is the usual practice; and the use of rabbles so designed that a single casting will operate in any position on the rabble arm, thus doing away with the necessity for keeping a variety of teeth in stock.

Furnace Construction

The accompanying illustration shows the construction of the furnace. The outer shell is made of ⅝-in. steel plate three courses high, the outer diameter being 21 ft. 7¼ in. The horizontal seams are 3-in. lap, riveted with ¾-in. rivets, with 5-in. pitch. The vertical seams are butt joint, triple riveted, with butt-plates, 5/16 by 16½ in., inside and out. This shell is 19 ft. 5 in. high and is lined with 8-in. fire brick. There are six superimposed hearths, the top of the furnace being also used as a drying hearth. Each hearth is made of a single arch of 6 or 8-in. fire brick (as shown in illustration), the spring of the arch being 10½ in. The hearths for outside discharge have 54 openings, 18 by 14 in. each, around the periphery; those with inside discharge have an 8-ft. diameter circular opening at the centre. The central opening on the other hearths is merely large enough to permit rotation of the central shaft, which is 42 in. diameter. Each hearth is provided with six doors on the outside, except the topmost, which has but four. Each door is 24 by 16 in. and is fitted so as to make a tight joint.

The central shaft is made in three sections, each approximately 6 ft. long. These are fastened together with tongue-and-groove joints, and bolt heads and nuts are protected by pockets which can be filled with refractory material. The rabble arms are similarly connected with the central shaft. Within the shaft is an 18-in. steel tube, bolted to nozzle outlets at each arm. Air under pressure is forced through this tube, passes to the outer end of the rabble arm, and back to the central shaft. The rabble arms are connected in parallel so that each arm receives its due quota of cool air. The central web which causes the air to pass to the end of the arm before returning also greatly adds to the strength of the arm. The heated air is taken off at the top and brought back through channels in the outside walls to the lower hearth. The heat which it has absorbed is thus transferred to the lowest hearth and by decreasing the cooling effect of the air admitted for combustion allows the roasting without extraneous heat of material much lower in sulphur than would otherwise be the case. On the other hand, material with a given sulphur content will yield more heat and will therefore roast faster than without heat conservation. The rabble teeth are so cast that the lug at the top which fits against the arm is at different distances from the centre line on the right and left side. When a uniform series of teeth are placed upon the rabble arm this causes each tooth to assume a different angle, according to its distance from the centre, and the increased work which the inner teeth have to do is thus automatically compensated. The



THE HERRESHOFF FURNACE.

outermost rabble is kept in place by a single drop-pin. This is of special design to provide for the feed from the hearth above, as shown.

Path of Ore Through Furnace

The ore is fed upon the upper drying hearth from hoppers. Just beneath each hopper is a steel plate and the ore is caused to feed by a rotating finger which passes between the hopper and the plate. The ore thus drawn out falls upon the top of the furnace, and is worked to the periphery by a set of rabbles. These are simply dropped into place on the rabble arm and can be removed or put in place without stopping the furnace, thus permitting easy changes in the rate of feed. This is also controlled by cast-iron sleeves at the end of the feed hoppers. By raising or lowering these, the rate of feed may be altered as desired. The dry ore passes down to the first hearth through a series of hoppers at the

outer edge which are provided with adjustable plugs to prevent the escape of gases. The space between the top of the furnace and the central shaft is closed with a sand seal, while on the lower hearths the calcine serves as a seal. The gases escape from the furnace through two exits, having a combined area of 18.8 sq. ft. The flues which convey the gases to the stack are so arranged that the flue-dust is automatically returned to the lower hearth, thus eliminating the labor cost of handling flue dust. The rabble arms are driven at one revolution per minute by a 72-in. bevel gear. The pulleys and gearing are so mounted on an A-frame that they can be removed for repairs without disturbing the rest of the furnace. The equipment for the roasters at these two plants was furnished by the Pacific Foundry Co., and they were erected under the supervision of C. H. Repath and A. G. MacGregor, who designed the plants.

General Chemical Co.'s Plant

The largest installation of Herreshoff roasters now at work is at the Edgewater, New Jersey, plant of the General Chemical Co., where eighteen 16-ft. furnaces are at work roasting Spanish pyrite for the production of SO_2 for acid manufacture. The operating conditions are scarcely comparable, since in this case it is necessary to secure a gas high in SO_2 and a calcine low in sulphur rather than the larger tonnage desired in copper-smelting practice. Thus a 16-ft. roaster handles only 5 to 6 tons per day, reducing the sulphur content from 46% to 1½%. The ore is crushed to pass 4 mesh before roasting, and the calcine is briquetted for use in iron smelting. Operating under these conditions, it has been found that only one arm has broken in the past six months with 18 roasters in use. A crew of six men per shift is sufficient for this number of furnaces, including the wheeling of the pyrite from the storage bins to the feed hoppers of the furnaces. Broken rabbles can be replaced in a few minutes, but in the case of a broken rabble-arm a delay of 4 to 7 days is the result, since it is necessary to allow the furnace to cool slowly to the temperature at which a man can enter to loosen the bolts. Some experiments have been made in the developing of a detachable arm, but it has been found that delays from the breaking of rabble-arms are so infrequent that the advantage thus gained is practically neutralized by the increase in construction cost and the difficulty of obtaining an air-tight joint. The total cost of upkeep on these roasters as used at Edgewater, amounts to 10c. per ton roasted. This amount may be expected to vary with the quality of gas, the temperature, tonnage, time of year, and other factors.

Two blast-furnaces are working at the Tanganyika Concessions property at Katanga in Central Africa, and during the first eight months of the year the copper output was over 4000 tons. During July and August the yield was 1900 tons. Fine ore is being briquetted; the first group of Coppee coke-ovens is being built; and the 'technical committee' of the Union Miniere du Haut Katanga is planning a large increase in copper production.

Milling Operations at the Eldorado Banket Mine, Rhodesia

The following figures are from the annual report of the Company for the year ended March 31, 1913:

Crushing plant:	
Number of stamps in operation	20
Running time of stamps, days	342.58
Duty per stamp per day (estimated) tons	5.25
Chilean mills in operation	2
Running time of Chilean mills, days	331.89
Duty per Chilean mill per day (estimated), tons.	77.15
Grinding pans in operation	8
Running time of grinding pans, days	333.89
Average assay value of ore milled, per ton	$12.93
Total gold content of ore milled, ounces	56,290
Yield in fine gold from stamps and Chileans, ounces (72.61%)	29,646
Yield in fine gold from grinding pans, ounces (27.39%)	11,181
Total yield in fine gold from mill, ounces	40,827
Yield per ton milled, dwt	9.366
Percentage of assay value	72.599
Cyanide plant:	
Tonnage treated	88,209
Gold content, heads, before treatment, ounces	15,625
Gold content, tailing, after treatment, ounces	3,565
Theoretical extraction, per cent	77.18
Actual extraction, per cent	77.32
Recovery by:	Percentage of gold content.
Stamps and Chileans	62.65
Grinding pans	19.87
Cyaniding sand	13.59
Cyaniding slime	7.65
Total	93.76
Left in sand residue	3.94
Left in slime residue	2.33
Difference	0.03
Total	100.00
Working costs:	Per ton.
Mining	$2.32
Ore transportation and crushing	0.16
Milling	0.85
Fine grinding	0.44
Cyaniding (including accumulated sand)	0.60
General charges mine	0.40
General charges Bulawayo	0.19
Total (excluding development)	$4.96
Development	0.72
Total cost (including development)	$5.68
Gold production, 52,908 oz. fine gold	12.40
Working profit	$6.88

The profit on all operations was $576,000, and two dividends of 72c. per share each were paid. The ore reserves of the mine are estimated at 74,826 tons, averaging $16.40 per ton.

At the Lena Goldfields property, Siberia, 691,011 cu. yd. of gravel was mined and hoisted from October 1, 1912, to August 20, 1913. During the period, 695,943 cu. yd. was washed, yielding gold worth $4,896,000.

In 1912, according to figures gathered by the U. S. Geological Survey, 143 of the cities of the country having a population of 35,000 or more spent $919,809,054 in building operations.

Handling Ore From Stock Pile at Miami

The Miami Copper Co. accumulated 18,000 tons of good ore in a stock pile in a gluch in the course of its preliminary work, and recently it was proposed to bring this ore from the stock pile to the overhead bins at the mill. After considering various methods of handling the material it was decided to install a new type of cableway excavator known as the Shearer & Mayer. The decision was based on the following advantages claimed for this excavator: it will operate over a span of 500 ft.; it will dig, elevate, and convey in one operation; the line of operation can be readily changed; no power is required to return the empty bucket, as the latter returns by gravity; no time is lost in dumping, as the bucket is dumped by a continuous forward movement.

The excavator as erected consists of a ¾-cu. yd. capacity scraper bucket, suspended from a carriage which travels on an inclined track cable. The bucket and carriage travel down this inclined track cable to the point of digging when the track cable is slackened and the bucket is thus allowed to come in contact with the ore as shown in Fig. 1. The bucket is filled by pulling it into the material by means of a pull cable attached to the front. When it is filled, the track cable is pulled taut by means of a tension mechanism. By tauting the track cable the bucket is lifted clear of the pile and it is then hauled up the inclined track cable by means of the pull cable. At the point of dumping, an adjustable button on the track cable is provided. A traveler block coming in contact with this button dumps the bucket automatically.

A two-drum hoist operates this excavator. One drum operates the tension mechanism and the other the pull cable which loads the bucket and pulls it up the inclined track cable and also dumps the bucket. Fig. 2 and 3 show the loaded bucket traveling up the inclined track cable. Fig. 4 shows the loaded bucket entering tipple. The cableway excavator was put in operation early in June, and from the time it was put in operation to June 30, it handled approximately 10,000 tons. It frequently handles 300 tons per 8-hour shift. The machine has been found admirably adapted for this class of work. The excavator was designed and furnished by Sauerman Bros. of Chicago.

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

Possible Applications of Electric Furnaces to Western Metallurgy

By Dorsey A. Lyon and Robert M. Keeney

*As has been repeatedly pointed out, the electric furnace was not developed for the purpose of competing with the combustion furnace in the domain of ordinary metallurgy, but rather to do for metallurgy what it is not possible to do with the combustion furnace, either because of existing local conditions or because a higher temperature or method of heating is required than it is possible to obtain in the combustion furnace. Only those applications of the electric furnace which are strictly within the domain of metallurgy, and where the electric current is used as a thermal agent only, will be discussed here. Also, there will be discussed the use of the electric furnace in the smelting of ores, having in mind especially those conditions which are to be found in the western part of the United States. With the exception of the production of aluminum, iron, and ferro-alloys, electric furnace metallurgy is largely in the speculative or experimental stage at the present time.

The Electric Furnace for Smelting Iron Ores

As is well known, of the coke charged into an iron blast-furnace, only about two-thirds is used for producing the heat necessary for carrying on the process, while the other one-third is used as a reducing agent. Therefore, if the electric furnace is used for the smelting of iron ores, only enough carbon has to be supplied to unite with the oxygen of the ore; in other words, to reduce it, and for this reason the smelting of iron ores in the electric furnace is of much importance to the western coast states, for there are found comparatively large iron-ore deposits, but not suitable blast-furnace coking coals, and so the cost of coke makes ordinary blast-furnace smelting prohibitive. However, it is necessary to supply carbon in some form as a reducing agent, and even though only one-third as much carbon is required for this purpose as is required in ordinary blast-furnace practice, it may be impossible to obtain this smaller amount at such a cost as will permit of the use of the electric furnace.

So far only coke and charcoal have been tried to any extent as reducing agents in the reduction of iron ores in the electric furnace, and of these only charcoal has proved satisfactory. This has been shown by repeated trial runs at Trollhättan, and has been forcibly demonstrated by the fact that the plant at Hardanger, Norway, where coke was used as a reducing agent, after being in operation for about nine months was forced to close, due to the fact that nowhere near the same amount of pig iron could be produced per kilowatt-year of electrical energy expended as can be produced when charcoal is used. That this is true is doubtless due to the fact that coke is a much better conductor of electricity than is charcoal, especially after it becomes hot. For this reason, when using coke the resistance of the charge becomes lowered, and, as the smelting in the electric iron reduction furnace is done by the heat produced by the resistance which the electric current meets with in passing through the charge between the electrodes, more electrical current (amperes) is required to produce the same amount of heat. Likewise, as stated by Crawford, the electrical conductivity of coke "is so good that much of the current passes between the electrodes in the upper part of the furnace. The smelting zone is thereby raised, and the furnace runs hot on top, with attendant melting of the arches of the roof of the crucible, and cold at the bottom. Further, the coke, because of its density and high crushing strain, does not break down like charcoal as the burden descends, hence less surfaces of carbon are exposed to be oxidized by the ore, and there is a less intimate mixture of the two.[1] Reduction of the ore takes place more slowly, the silicon in the iron is lowered, the consumption per ton increases, and the efficiency of the furnace is reduced."

Situation Requirements

Inasmuch as either charcoal or coke are the only practical reducing agents known at the present time, that is, for use on a large scale, and as it would seem from what has just been stated that it is impractical to use coke, this necessarily limits the electric iron reduction furnace to the use of charcoal. Hence it is necessary that such a furnace be situated in close proximity to a well timbered region, where charcoal as well as electric power can be produced at a low cost. If this be true (and it undoubtedly is at the present time), it is unfortunate, especially as regards the situation in southern California and in other of our western states, where there are quite large iron deposits of first-class ore, but where coke is too expensive to permit of ordinary blast-furnace smelting, and where the use of charcoal for electric furnace work is entirely out of the question, as there are no forests to furnish the wood necessary for its production. On the other hand, crude oil is generally more or less plentiful and comparatively cheap in such districts, especially in California. Aside from its possible use in connection with electric furnace work, those interested in the subject have for years been considering the possibility of using crude oil as a reducing agent. That the carbon and the hydrogen of the oil will reduce iron oxides is self-evident, but as yet no one seems to have been able to solve the problem as to how to bring the ore and the oil together at the proper temperature. As a result of a preliminary investigation conducted by the metallurgical department of the U. S. Bureau of Mines on the possibility of using crude oil as a re-

*Abstract from a paper presented at the meeting of the American Electrochemical Society, at Denver, Colorado, September 1913. Published by permission of the Director of the U. S. Bureau of Mines.

[1]This intimate mixture is, of course, very necessary where the reduction is almost entirely performed by solid carbon, as is the case in the practice at Heroult, California.—The Authors.

ducing agent, it seems as if about the only manner in which crude oil may be used for this purpose is to first convert it into a fixed gas and then introduce this into the crucible of an electric furnace, thus preheating the gas to such a temperature that it will effectively reduce the iron oxides as it passes up through the shaft of the furnace. Be that as it may, it is to be hoped that ultimately a suitable process may be devised whereby oil may be used as a reducing agent, and thus broaden the field for the possible application of the electric furnace in the reduction of iron ores; for it is apparent that the electric furnace is limited for such purposes at the present time to those localities where charcoal and electric power are comparatively cheap.

That the electric furnace has been successful in the smelting of iron ores in those districts which are favorable to the same is shown by the fact that ten furnaces of the Swedish type (a total capacity of about 22,000 kilowatts) have been erected in Sweden, Norway, and Switzerland. In this country there is one electric furnace iron plant of two furnaces, with a total capacity of 5000 kilowatts, at Heroult, California. The type of furnace used in California is different from that used in Sweden, due to the fact that a different grade of iron is desired from that which is produced in Sweden; that is, in Sweden a metal is produced which is low in silicon and carbon and which is particularly well suited to steel making, whereas in California the demand is for a soft gray foundry iron.

As to the quality of pig iron produced in general in the electric furnace, the engineers in charge of the experimental work at Trollhättan made the following statement in their final report: The silicon content does not vary more than in an ordinary blast-furnace. The phosphorus content is lower than with the same quality of charge in an ordinary blast-furnace; this is due to the lower consumption of charcoal. The percentage of sulphur is, however, slightly higher in the electric furnace. The quality of the electric pig iron has been highly commended. It acts particularly well in the open-hearth furnace, and steel made from it is certainly not inferior to steel made from ordinary pig iron.

Ratio of Concentrate to Ore

It has been found that the proportion of concentrate ought not to exceed 20% of the ore charged. This figure, however, does not appear to be final, as in a later constructed and somewhat modified furnace of the same type at the Hagfors Iron Works, 25% of concentrate is used without any difficulty. The power consumption per ton of pig iron varies in proportion to the iron content in the ore. A poor ore and pig iron high in silicon and manganese require more power than a rich ore and pig iron low in silicon and manganese. For such iron the power consumption averages only 2067 kw. hours per ton of pig iron; that is, there is obtained 4.22 tons of pig iron per kilowatt year, or 3.10 tons per horsepower year. The charcoal consumption per ton of pig iron varies from 20 to 24 hectolitres (56 to 68 bushels), depending on the quality of the charcoal and the charge. Coke has been found to be unsuitable for this furnace unless mixed with charcoal. The consumption of electrodes at Trollhättan has been reduced to less than 3 kg. (6.6 lb.) per ton of pig iron. At Hagfors it has amounted to as much as 6 to 9 kg. (13.2 to 19.8 lb.). This discrepancy is explained by the fact that the electrode consumption is increased in proportion to the higher power consumption for a poorer charge, and is further increased by the more efficient circulation of gases and higher CO_2 content in the gas. The lower electric load per unit of surface at the Hagfors furnaces also contributes to the higher electrode consumption at this plant. The cost of repairs is lower than there appeared at first to be reason to expect. In the manufacture of pig iron containing silicon and manganese the cost of repairs is higher than in producing pig iron with low contents of those elements. At the plant of the Uddeholm company at Hagfors, the gas from the furnaces has been used with very good results for heating the open-hearth furnaces.

Possibility of Smelting Copper Ores in the Electric Furnace

No copper ores are being treated on a commercial scale at the present time in the electric furnace in this country. It is reported, however, that in Norway trial smeltings of copper ores with an electric furnace of 1000 hp. and an estimated producing capacity of 2000 tons per annum have been conducted at the Ilen Smelting Works, Trondhjem, and it is the intention to smelt copper ores regularly at this plant in the electric furnace.

More or less experimental work has been done upon the subject, and, as a result of this work there seems no good reason why copper-bearing ores cannot be as successfully treated in an electric furnace as in a combustion furnace. In all furnaces of the latter class which are used for the treatment of copper ores the fuel used takes no part in the reactions which are necessary for obtaining the desired product, unless it be in the reduction of oxide ores which are smelted alone, that is, without an admixture of sulphides, which is practically an unheard of thing in this country at the present time. For example, in the reverberatory furnace the fuel acts only as a heating agent; in blast-furnace smelting, if what is known as ordinary blast-furnace smelting is used, the coke added to the charge is for the purpose of supplying the heat necessary to raise the charge to such a temperature as will permit of the necessary reactions between the oxides, sulphates, and sulphides present, and to scorify the resultant mass and thus permit of the separation of the slag and matte. In semi-pyritic and pyritic smelting the necessary oxidation of the sulphides and iron is brought about by the oxygen of the air entering the tuyeres, and the coke used is simply for the purpose of supplying the amount of heat necessary for the successful carrying out of the process, which is not supplied by the oxidation of the sulphur and the iron present in the charge at the time it passes through the tuyere zone of the furnace. Such being the case, there seems to be no reason why the smelting of copper ores could not be done as well by electric heat as by that derived from the combustion of coke, especially if local conditions warrant it. As a result of experimental work which has been done by ourselves in connection

with tests which have been made by the U. S. Bureau of Mines, and judging from results which have been obtained by others, it appears perfectly feasible, both metallurgically and commercially to use the electric furnace for the smelting of copper ores.

Lead Ores

The smelting of straight lead ores in the electric furnace has never been attempted either commercially or on a large experimental scale, largely because of the ease and cheapness of smelting by combustion processes. For the smelting of ordinary lead ores, it has no especial application, but in the treatment of complex lead-zinc-silver ores the electric furnace might be profitably used. The roasted ore could be treated in an electric furnace operated at a temperature such that the lead reduced by carbon melts and collects the precious metal values and the zinc is volatilized and condensed.

Electric Zinc Smelting

The use of the electric furnace in the metallurgy of non-ferrous metals has had greater application for the treatment of zinc ores than in the metallurgy of any other of the non-ferrous metals except aluminum and ferro-alloy manufacture. Since 1885, when an electric furnace for the treatment of zinc ores was patented by the Cowles Bros., experimental work has been conducted on the subject. The commercial application of the process, however, has not resulted to any great extent because of the difficulty of condensing the zinc vapor produced under the smelting conditions of the electric furnace. The cause of this difficulty has not yet been definitely determined. With few exceptions the experimental work has not been conducted on a very large scale, and so it may be said that the electric smelting of zinc ores is still in the experimental stage. The special field for electric furnace work in zinc metallurgy is due largely to the low thermal efficiency of the present zinc retort which is given by Richards as only 7%. With the efficiency of the electric furnace varying from 50 to 75%, the difference in the heat necessary for the smelting operations is so great as to permit of a higher cost of electrical energy than is permissible in many electro-metallurgical operations.

Electric Furnace Method of Zinc Smelting

Processes for the electric smelting of zinc ores are of two general classes—first, reduction of zinc oxide and its compounds by carbon and carbon monoxide, and, second, decomposition of zinc sulphide by metallic iron. Examples of the first method are the DeLaval and Johnson processes, and of the latter the Cote-Pierron and Imbert-Thomson-Fitzgerald processes. Reduction of zinc oxide with carbon is based upon the reactions

$$(1)\quad ZnO + C = Zn + CO$$
$$(2)\quad ZnO + CO = Zn + CO_2$$
$$(3)\quad CO_2 + C = 2CO$$

The use of iron is according to the reaction

$$(4)\quad ZnS + Fe = Zn + FeS$$

In neither of these processes does the electric current perform any other function than heating. Due to the fact that alternating current is supplied to the furnace, there is no electrolysis. The process may be performed in either an arc or resistance furnace. One essential difference between the reduction of zinc oxide by carbon in an electric furnace and in a retort is that the retort process is intermittent and the electric process may be continuous. In the electric furnace the charge is added at intervals, as necessary, and the slag is tapped or allowed to run continuously from the furnace without disturbing the operation of the process. The reduction by carbon or carbon monoxide occurs just as in the retort, with the exception that because of the rapidity of reduction in the present designs of electric furnaces, the third reaction does not take place apparently as well in the electric furnace as in the retort, resulting in a greater amount of carbon dioxide in the zinc vapor, which has a bad effect on the condensation. This results in the production of a large amount of blue powder. Various attempts have been made to reduce this, the principal one being the passing of the vapor through incandescent carbon before entering the condenser.

Operations of Smelting

The smelting process consists essentially of two operations, namely, concentration of the zinc to a rich oxide followed by reduction in another furnace. Oxide ore, flux, and carbon used as a reducing material, are charged into the furnace, where most of the zinc and some of the lead are volatilized and condensed partly as metal and partly as blue powder and oxide, containing 54% zinc and 20% lead. This is really a concentration powder, for the blue powder is now mixed with ore and recharged, when a larger percentage of the metal volatilized is recovered as metal. The remainder of the lead, which carries some silver, is reduced to metal in the smelting hearth and is tapped with the slag. Some lead, zinc, and silver passes into a matte and some into the slag. The furnaces are of a modified Siemens type with a shallow hearth, and covered with a roof. A carbon block bottom forms one electrode, while the other passes vertically through the roof. In some furnaces the ore is charged through the roof, in others at one side of the electrode, while others have been designed having a continuous side feed. The consumption of electric current in the experimental run at Trollhättan averaged 2078 kw.-hr. per ton of ore smelted, which does not include resmelting the powder. Two tons of powder were re-treated per ton of ore smelted. A comparison of the resistance furnaces at Trollhättan with the arc furnaces at Sarpsburg shows that while one was as good as the other for the carrying out of the desired reaction, the energy consumption was 70% more in the arc furnace than in the resistance furnace. The consumption of electrodes was also higher in the arc than in the resistance furnace, being 89.2 lb. per ton of ore at Sarpsburg and 69.3 lb. per ton at Trollhättan.

Experiments of Johnson

One of the most persistent investigators of the possibility of smelting zinc ores in the electric furnace is W. McA. Johnson,[2] who has conducted experi-

[2] *Met. & Chem. Eng.*, Vol. X (1912), p. 537.

ments on a large laboratory scale for several years. Johnson's furnace has vertical upper carbon electrodes and a conducting hearth of carbon. Ore is fed in through the roof of the smelting chamber. There are several tap holes at different levels. The zinc vapor passes through a flue into an adjacent column of carbon which is heated by the passage of the electric current. During the passage of the vapor down through the hot carbon, the carbon dioxide is supposed to be reduced to monoxide. The vapor then passes into a condenser, where most of the zinc is condensed as metal and some as blue powder. The furnace is operated continuously. The ore is pre-heated by gas to 900°C. before entering the electric furnace.

Except for a few statements, the information printed about the work done by Johnson does not clearly show the extent to which he has carried condensation without the formation of blue powder, but the use of a column of hot carbon to reduce the carbon dioxide in the vapor seems to have assisted in lowering the percentage of blue powder formed.

Present Status of Electric Zinc Smelting

From what has been said concerning the work at Trollhättan and the results of others, it is evident that the difficulty lies almost entirely in condensation of the zinc vapor to a metal rather than blue powder under the peculiar conditions of the electric furnace. The electric furnace, mechanically or electrically, presents no great difficulties to solve, because all of the troubles formerly experienced have been solved in the construction of large pig iron, steel, carbide, and ferro-alloy furnaces. The problem, then, is one of a metallurgical nature, and is caused by the different conditions and greater speed of smelting in the electric furnace than in the combustion retort. The opponents of the electric smelting of zinc ores, who as a rule appear to have no knowledge of the great development of the electric furnace itself in the treatment of other ores, often state that, while the retort is the weak part of the old system, so is the electrode the weak point of the electric method. Admitting that the retort is the weak part of the retort method, and judging from large scale electrometallurgical work on other ores, it cannot be conceded that the electrode is an exceptionally weak part of electric smelting. It is only fair to assume that the designer of an electric zinc furnace should stand upon the accumulated knowledge and take the results of others when the metallurgical problems of electric zinc smelting have been solved. One editorial writer in the *Engineering and Mining Journal* of December 14, 1912, goes so far as to say, in reference to retorts and electrodes, "nobody can say which will be the weaker." Actual figures would show that, rather than "nobody can say which will be the weaker," the retort at the present time is the weaker.

If the failure of the electric furnace in smelting zinc ores is not due to the electric furnace or the electrodes, what then is the metallurgical condition which causes condensation difficulties and has retarded the commercial application of the process? The difficulty is, of course, due to a difference in the smelting conditions of the electric furnace as compared with the retort. Both physical and chemical conditions influence the formation of blue powder. Some powder forms under certain conditions of pressure and temperature. As to just what these conditions are has not yet been solved. It is a problem for the physical chemist.

By the use of electrodes of large cross-section it is probable that concentrated heating could be reduced so that, rather than a very high temperature at one place, there would be a uniform comparatively low temperature all over the charge. This was found to be the case in the smelting of iron ores both at Heroult, California, and Trollhättan. Or the current could possibly be distributed more evenly by flat electrodes of rectangular cross-section.

Complex Sulphide Ores

The electric furnace has a possible field in Western metallurgy at places where there are complex sulphide ores of lead, zinc, copper, gold, and silver. With the solution of the zinc condensation problem it is not unreasonable to suppose that ores of this class can be electrically smelted so as to get a fair recovery of the metals and at least the precious metals contained. Also, owing to the fact that practically as high a temperature as desired may be obtained in the electric furnace, it would be possible to smelt complex ores which have high gold and silver contents, but which are too low in base metals, such as lead and zinc, to make their recovery worth the additional expense of concentration. In the blast-furnace 10% of zinc in the charge causes sticky slags, and with a much higher percentage the operation of the furnace is very irregular and difficult. These slags could be fused readily in the electric furnace. In such a case, if the ore contained copper and zinc the ore could be charged into an electric blast-furnace using matte as a collecting agent for the gold and silver.

Gold and Silver Ores

In the smelting of gold-silver ores carrying no lead or copper, to form either a lead bullion or a copper matte, but containing iron sulphide, the electric furnace might be used in connection with an air-blast for oxidation of the iron sulphide, and an iron matte as a collecting agent for the gold and silver. The value of iron matte as a collecting agent is still largely a matter of personal opinion, but from the pyritic smelting which has been done with iron as a collecting agent, and from our experiments using iron matte in the electric furnace, it is evident that a fair recovery can be made in this way. As in the case of electric copper smelting, the electric furnace treatment of these ores is still in the speculative stage.

It seems probable that mines in isolated districts, where fuel is usually high and where the power operating the mine or mill is often hydro-electric power, could in many cases melt their cyanide precipitates more economically in electric furnaces than in combustion furnaces. The construction of a small Siemens type of furnace is simple and inexpensive. By operating the electric furnace when one of the units of the mill was down for repairs, or on the mine shift when little hoisting or drilling was being

done, no additional electrical installation would be necessary. This simply means that power which under ordinary conditions is wasted would thus be utilized.

Application of the Electric Furnace to the Smelting of Rare Metal Concentrates

By rare metals in this instance is meant such metals as chromium, tungsten, molybdenum, and vanadium. Chromium is not rare in the sense of the size of its ore deposits, but its metallurgy is so closely allied with the electric smelting of other more rare ores for the production of ferro-alloys that it may in this instance be considered as a rare metal.

The smelting of concentrates of tungsten, molybdenum, and vanadium ores for the production of either the metals or their ferro-alloys presents problems different in one marked respect from the smelting of copper, lead, or zinc ores, namely, the temperature necessary for completion of the reduction reaction is so high, or the melting point of the product is so great, that the operation could not be performed metallurgically or economically in a blast-furnace, reverberatory furnace, or a crucible. Tungsten is reduced from the trioxide at a temperature of 1500°C., and vanadium from vanadate of iron or calcium at about the same temperature. The melting point of tungsten is 2800°C., molybdenum 2000° C., and vanadium 1750°C. All of these temperatures are high compared with the reactions usually performed in combustion furnaces. Of course, the melting point of the ferro-alloy would not be as high as that of the pure metal, and becomes lower with increased percentage of iron.

The only rival of the electric furnace for high temperature metallurgy is the thermit reaction, which is more expensive. The electric furnace soon after its introduction into the manufacture of ferro-alloys rapidly superseded combustion furnaces for this work in all instances except the manufacture of ferro-manganese. It was found to be especially fitted for the smelting of rare metal ores to produce ferro-alloys because of the ease with which high temperatures were maintained.

The Manufacture of Ferro-Alloys in the Electric Furnace

The growth of the ferro-alloy industry in Europe has been rapid since 1899, but comparatively slow in the United States. There are about 25 plants engaged in the electric furnace manufacture of ferro-alloys in Europe, as compared with two plants making the alloys in the electric furnace in the United States. In addition to these there are three companies using methods other than electric furnace methods in the United States, and one electric furnace ferro-silicon plant in Canada.

There are several reasons why the growth of the ferro-alloy industry has been more slow in America than in Europe. Hydro-electric power is not so cheap here and not so favorably situated for the receipt of raw material and sale of product. The water-power sites cannot be developed as cheaply as many of the foreign sites, where the cost per kilowatt per year varies from $10 to $20, as compared with $20 to $40 in the United States.

A considerable proportion of the ferro-alloys used in the United States are imported, for, although there is a duty, local manufacturers are not able to supply the whole demand. About one-half of the ferro-manganese and ferro-silicon used in the United States is imported, as well as a large part of the ferro-tungsten. More ferro-titanium and ferro-vanadium are manufactured here than abroad. The ferro-chrome production just about supplies the domestic demand.

In Europe the industry of ferro-alloy manufacture in the electric furnace is in excellent condition commercially, with the demand for alloys steadily increasing. Because of the race between foreign countries in the building of large navies, there is great demand for ferro-chrome. The sale of ferro-alloys in Europe, especially ferro-silicon and ferro-chrome, is accomplished by the various plants combining in a syndicate, with each plant receiving a certain portion of the total market demand, according to the plant capacity.

Conclusion

In general, then, it may be said that, aside from the smelting of iron ores, the manufacture of aluminum and the production of ferro-alloys, the electric smelting of ores is still in the experimental stage. It will probably never replace existing processes where the conditions are favorable to the latter, except in so far as it may permit of the development of a process which may be more efficient than an existing process. For example, in the retort process of zinc smelting, a furnace temperature of from 1400 to 1500°C. is required. This is the temperature on the outside of the retorts, whereas the actual temperature inside the retorts is from 100 to 200° less than this. Therefore, in this respect an electric furnace would offer the advantage that the full temperature of the furnace could be had just where it is needed; that is, where the work is to be done. For that reason, even though the electric current may cost more than coal for an equivalent heat value, the electric furnace may nevertheless be found more efficient and hence in the long run more economical than the combustion furnace, especially if the current can be used in the manner just indicated. However, as has been repeatedly stated, it does not seem to be necessary to consider the electric furnace as a competitor of the combustion furnace, but as affording the metallurgist a furnace which will enable him to treat certain ores and to work out certain processes in a more advantageous manner than it is possible to do in the combustion furnace, or to treat ores in certain districts where, owing to local conditions, it would not be commercially feasible to treat such ores.

Coal output of the Liege district of Belgium in 1912 amounted to 6,184,330 tons, an increase of 421,030 over that of the previous year. There were 74 active mines, and the price of coal averaged $3.30 per ton. Employees numbered 37,878, who averaged $289 per year in wages. There were 21 blast-furnaces in operation, yielding 973,840 tons of pig iron worth $13.70 per ton. Two mills produced 20,100 tons of lead, and silver valued at $947,273.

Progress at the Hidden Creek Copper Mines

*The work finished during the past year in connection with the development of the Company's Hidden Creek mine, at Anyox, consisted of 8857 linear feet of raising, sinking, driving, and cross-cutting, with 18,342½ ft. of diamond-drilling. This work was done on the 150, 230, 385, 530, 630, and 700-ft. levels. In addition to this 3090 cu. yd. of rock was removed underground in the widening of the 150-ft. level at the ore chutes, and in the excavation of the crusher room on the 230-ft. level, according to the report of O. B. Smith, superintendent of mines. The total development work now done at the mine is as follows:

Class of work.	Feet.
Surface trenching	2,255
Driving and cross-cutting	13,905
Sinking and raising	2,946
Diamond-drilling (72 holes)	37,518

The above work has developed 7,759,550 tons of 2.2% copper ore, containing 20c. per ton in gold and silver. The bulk of the estimated ore lies above the 385-ft. level, only 394,100 tons below this level being included. There are huge quantities of 0.5 to 0.7% ore surrounding the higher-grade ore of No. 2 orebody, but are not figured in the total.

All work on the 150 and 230-ft. levels is at present in connection with the loading, crushing, and storage arrangements. The 150-ft. adit was driven 416 ft. and the raises driven to the crusher level or 230 feet. The raises give a storage of 2500 tons of crushed ore ready to be loaded on the smelter trains. On the 230-ft. level the crusher room was excavated and three raises, which have a total capacity of 2500 tons, driven to the surface. The 385-ft. adit track has been continued 1500 ft. from the portal so that cars on this level can dump directly into any one of these raises. This work is now practically completed.

Drifts were driven along the No. 1 orebody to the north and south of the main adit on the 385-ft. level. A raise was driven to No. 20 drift of the 530-ft. level to serve as an ore-pocket for ore from the latter level. The adit was continued toward No. 2 orebody and has reached a length of 1678 feet. The adit is now in low-grade rock and should be expected to cut No. 2 main orebody in a short distance. Near its end another raise was driven to No. 40 drift of the 530-ft. level for a pocket for the ore of No. 2 orebody.

The ore in No. 1 orebody on the 530-ft. level north of the main adit was blocked out by drifts and cross-cuts. The blocking out of the ore in No. 2 orebody was continued in No. 70, 80, and 90 drifts and No. 40A cross-cut. On this level 35 raises were started, and timber for the chutes placed.

Drifts were driven in No. 2 orebody on the 630 and 700-ft. levels to the north and south of the main adits.

The mine is now ready to handle the 2000 tons per day needed to supply the smelter. The result of the drilling and underground development during the past year has been particularly gratifying, and the mine is in excellent condition.

Regarding the 2000 ton smelter being erected, of which the accompanying half tone shows some of the steel work, the assistant general manager, F. M. Sylvester, writing on September 7, says:

"Viewing the progress of the construction work on the new plant, it appears to me that the men in charge are doing remarkably well and that good progress is being made, especially when due consideration is given to the excessive cost of labor and material, the rains, and generally adverse conditions under which they are working, and that, except for unusual contingencies happening, to delay, all will be ready to try out the plant at least by the first of the year. It is not likely that all of the work in connection with building the plant will be completed, but barring unusual delays, all of the essential construction should be completed and ready for operation, as at least 90% of the machinery equipment is on the ground, the foundations are completed, so that the installation of this machinery will begin at once; in fact, a start has been made on one of the furnaces now. In view of the status of the work at present, I therefore feel warranted in saying that the plant will be ready to begin operations by the first of the coming year.

NEW SMELTING PLANT, ONE BLAST-FURNACE IN CENTRE.

*Abstract from annual report of the Granby Consolidated Mining, Smelting & Power Co., Limited.

Ores of tungsten and tin have been discovered practically all over the Tavoy and Mergui districts of Burma, India, and a large number of concessions are being worked. Wolframite is the main object of exploitation, cassiterite being a sort of by-product, although at times the tin ore forms a larger percentage of the alluvial deposits than the wolframite. It is practically impossible at this stage of development to give any figures showing what percentage of wolframite or cassiterite occurs in the lodes, as very little lode mining has been done, but judging from the abundant alluvial deposits scattered over the hillsides near the lodes and by the appearance of the lodes themselves, there is ample justification for prospecting some of the lodes by adits. It is said that work of this nature is being carried out on several concessions. Natives earn up to 48c. per day. The total cost of producing and delivering a ton of 68% ore in England is $313.76, and when the price is $7.30 per unit of tungstic trioxide, there is a profit of $180 per ton. —*Daily Consular Report.*

Pig-iron output in September was 2,505,927 tons.

The One-Man Drill

*It is claimed by the Western Federation of Miners and its members that the one-man drill, so called, has placed a burden upon the miners in the copper mines of Michigan which is not commensurate with the wages paid. Drilling originally was done by hand. As the mining industry developed, a power drill was introduced which was operated by two men. The introduction of the first power drill met with the same resistance which is now being offered to the one-man drill.

Increase of Cost with Depth

It may be stated generally that in the Lake Superior copper district the average copper content of the rock decreases with depth. This has been the history of the district, and the cost of mining increases proportionately with depth. The Michigan copper mines are operating on rock containing lower copper content than the other copper-mining districts of the United States, and the Michigan copper mines are operating at greater depth, and consequently at greater cost, than the other copper mines of the United States. In order to compete, it is absolutely imperative that the mines of Michigan should be operated with the closest economy. The operators in Michigan have attempted to practise their greatest economy in the way of improved machinery and equipment, and the greatest step that has been made in this direction in recent years is the installation of the one-man drill. The standpoint of the operators in regard to the one-man drill cannot be given any more clearly than in quoting from a statement made by the superintendent of one of the mines, as follows:

"The necessity for further close economy in the operation of our mine forced us to go into the market for a more efficient drilling machine, and, if possible, a machine that could be operated with one man as compared with two, which was standard practice. After about 18 months of experimenting the present machine was adopted. Our intention was to divide the benefits accruing to us from the use of the one-man machine with the men; this benefit to take the form of higher wages to machine operators (called miners). That this plan has been carried out is shown by the following table, which shows the increase in wages to the men operating one-man drills over wages made when operating two-men drills.

COMPARATIVE STATISTICS ON ONE-MAN DRILL AND TWO-MAN DRILL, CALUMET & HECLA AND SUBSIDIARY MINES, FOR THE YEAR ENDED DECEMBER 31, 1912.

	2-man drill.	1-man drill.
Shifts	350,012	54,758
Labor cost	$1,024,801.84	$ 193,935.81
Supplies	291,526.14	94,058.24
Total	1,316,327.98	287,994.05
Average wage per shift	2.83	3.34

"The miner's wages largely depend upon the efficiency of the man, as our work is all on the bonus system, and is so arranged that increased efficiency is of mutual benefit to the employer and the employee. We have a fixed contract which is not cut as the efficiency of the employee increases. It is also one of our rules that in case a man does not make what is called a fair rate, he is paid off at a rate of not less than $65 per month, but this ruling affects a very small portion of our employees. In fact, for the month of June this year, it was not necessary to use this minimum wage for a single employee. The one-man drill has resulted in a decided increase in efficiency, which, with further experience, will increase and will result in not only lower costs, but in higher wages to the men. What is more, the drill is popular with the good miners and any sentiment against it is made from without. Any attempt to return to the two-man drill would be a backward step in industrial progress and would work untold hardship to this district in its competition with other copper-producing districts. It is as little to be thought of as the elimination of any other labor-saving device. If copper mining in Michigan is to be a progressive and permanent institution, our methods must be shaped anew to be able to work deposits of a still lower grade than have been worked up to the present time, and the one-man drill and the further possible increase in the efficiency along this line is the most important step now before us."

The committee talked to a number of miners who were operating the one-man drill, and in no case found any specific objection to its use. In a few instances the men claimed that it was difficult to set up in some places, but the committee found that it is a practice among the miners for one man to help another whenever necessary. The one-man drill operators interviewed invariably admitted that they are making more money on the one-man drill than they were on the two-man drill, and not in a single instance did the committee find a man that would give up his one-man drill to go back to the two-man drill. The committee found in some cases men who said that two men should be on the drill, but when requested for their reasons and asked of what assistance the second man would be in operating the drill, they were unable to give any except that the assistance would be given to set up the drill in the morning and to take it out of the way before blasting. The committee, on one of its trips underground, saw one man set up his drill in nine minutes, but from what the committee has been able to ascertain, the average time required by the miners to make their places of work safe by barring down loose rock, preparing the place for the drill, and setting up the drill seems to be about one and one-half hours.

Influence on Labor

The claim has also been made to the committee that a great many men would be thrown out of work by the adoption of this drill, but mining men and engineers in this particular district claim that the installation of this one-man drill will permit mining companies to work poorer ground than has ever before been handled in the district, and that instead of throwing miners out of employment, it will create a demand for more miners.

On its trips underground, the committee took oc-

*From a report upon the strike situation by the Copper Country Commercial Club.

casion to ascertain whether or not the mining companies were operating in accordance with the law passed at the recent session of the Legislature in reference to the one-man drill, namely, the act providing that men operating these machines should not be stationed more than 150 ft. from the place where other employees were at work, and the committee found, as a matter of fact, that the mining companies generally were operating in accordance with this act.

The committee made some inquiry as to how the one-man drill is received by miners in other copper districts, especially the Bisbee district of Arizona, and quotes from a letter received by it under date of September 29, 1913, from one of the mining engineers of the property of the Calumet & Arizona mine:

"The Company has in operation at the present time 100 one-man drills, which is 90% of the total number of drills now on development work. Sixty-five of these drills were purchased during the last four months. The miners have no complaints to make relative to these drills, and in the majority of cases prefer these to any larger drill. The one-man drill will no doubt replace all other larger drills in the near future. I cannot understand why the Michigan miners should object to the drill when the Bisbee miners can find no fault whatever."

Deep Mining in Australia

According to the annual report of the Victorian Mines Department, there were 15 mines with shafts over 3000 ft. in depth at Bendigo, and several over 2000 ft. deep on other goldfields. Those at Bendigo were: Victoria Quartz Reef, 4614 ft.; New Chum Railway, 4318; Lazarus New Chum, 3682; New Chum & Victoria, 3579; North Johnson's, 3498; Great Extended Hustler's, 3493; Carlisle, 3460; Lansell's 180, 3365; Clarence United, 3310; Ironbark, 3250; Victoria Consols, 3114; New Chum Consolidated, 3099; Eureka Extended, 3060; Princess Dagmar, 3020; and Johnson's Reef No. 2, 3020 feet.

No fewer than 53 shafts at Bendigo are over 2000 ft. deep. The following were the deepest mines on some of the other principal goldfields: Long Tunnel, Walhalla (incline), 4051 ft.; Long Tunnel, Walhalla (vertical), 3450; Magdala, Stawell, 2425; South German, Maldon, 2225; Lord Nelson, St. Arnaud, 2405; and Jubilee, Scarsdale, 2014 feet.

Costs at the El Oro mine, Mexico, where 253,434 tons of ore and 180,274 tons of old tailing were treated during the year ended June 30, 1913, were as follows:

	Per ton mined.	Per ton treated.
Mining	$2.08	$1.22
Development	1.42	0.83
Milling		0.18
Cyaniding		0.78
Water-supply		0.02
General expense		0.20
Taxes		0.21
Total		$3.44

Idle-car surplus at October 1 was 10,374 cars.

Discussion

Readers of the MINING AND SCIENTIFIC PRESS are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment. Insertion of any contribution is determined by its probable interest to the readers of this journal.

Water in Veins

The Editor:

Sir—My attention, as a reviewer, has been called to that most excellent summary of existing knowledge concerning secondary enrichment contained in Bulletin 529, U. S. Geological Survey. This is the essay on 'The Enrichment of Sulphide Ores,' by William Harvey Emmons. Nothing could be more timely, and nothing could so well emphasize the practical application of geology to mining or of science to mineral discovery. My cordial appreciation of the excellence of Mr. Emmons' presentation of the subject is expressed elsewhere, in *The Mining Magazine* for October; in this trespass on your space I desire to present a more personal, and yet, I trust, not useless aspect of the matter. In outlining the main facts known about the distribution of water in the upper parts of lodes, Mr. Emmons refers more than once to Messrs. J. F. Kemp and J. W. Finch as having emphasized "the shallowness of the zone of meteoric circulation." This is true, but not completely true. Readers of this journal will recollect more than one effort of mine to "emphasize" this phase of the subject. In the course of a paper entitled 'The Cripple Creek Volcano,' written in 1899 and published in February 1900, I referred to the dryness of deep mines, in the following words: "Experience goes to show that the water encountered in mines is the drainage from the surface. Deep mines are usually dry ones. I may instance the deepest metal-mines, the Calumet-Hecla and the Tamarack, in the Lake Superior region, and the 180, New Chum-Victoria, and neighboring shafts at Bendigo, in Australia." (*Trans.* Amer. Inst. Min. Eng., Vol. XXX, page 377).

The idea was elaborated in an article entitled 'Water in Veins—a theory' (*Engineering & Mining Journal*, March 14, 1903), in which was brought forward the idea of a water zone, as against the indefinite saturation in depth currently accepted in geological literature. The water-level had been recognized by the miner long before the geologist wrote concerning it; what I did was to point to the fact that there was also a lower limit. This is much more irregular than the upper one, but no less recognizable. Again, in the *Mining and Scientific Press* of June 27, 1908, in discussing a paper by my friend Professor Kemp on 'Waters Meteoric and Magmatic' I brought the idea forward, with diagrams illustrating the conditions supposed to obtain in that outer portion of the earth penetrated by mine workings. Numerous facts concerning the deep mines and the dry condition of their bottom workings were adduced. I returned to the charge in 'Geology Applied to Mining.' See *Mining and Scientific Press*, April 2, 1910, page 281. Finally, in discussing 'The Persistence of Ores in Depth' in the *Mining and Scientific Press* of August 24, 1912, I

laid stress on the importance of recognizing this water zone as a factor in ore deposition. Mr. Emmons speaks of 'emphasis' being placed on "the shallowness of the zone of meteoric circulation." May I claim to have been emphatic?

You, Mr. Editor, will appreciate, I trust, that this is not a plaint for the recognition of a writer, but a demand for the recognition of a geological idea. That sundry geologists, most of them personal friends, should have overlooked the contributions of one whom they probably regard as an amateur, because he was an engineer and is now a journalist, is not surprising; but that keen students of the subject, and authoritative expositors of it, should persistently ignore an explanation of one of the fundamental factors in ore deposition, is anomalous. If the 'water zone' idea as suggested and explained by me is fallacious, it ought to be smashed, lest it mislead the few who may take my writings seriously; if the idea is sound, it should be acknowledged and utilized by those who are building a comprehensive theory of ore deposition. In short, in the conventional terms of social intercourse, I say to my friends: R.S.V.P.

T. A. Rickard.

London, September 30.

Mining Law and the Prospector

The Editor:

Sir—In the *Press* of August 12, 1911, there appears an article by G. O. Smith on the revision of the mining laws from which it seems that a man without title or many ciphers to his worldly accumulations is not worthy to pass judgment on revision. Let those gentlemen, who argue this, land in a new mining district with their hard-earned life's savings, ambition, and no fear of work, put in ten or twenty years and those savings, and then they can talk revision of the laws from a prospector's point of view. I would like to see some editor stick up for the rights of the forerunner of the mining industry, the original discoverers, those pioneers who endure the hardship and isolation. I have spent forty years of my life in this district, thirteen years at hard work, and have some good quartz claims. Mr. Smith would have the Government relieve me for not developing these claims more rapidly. Some people seem to fear that the world will come to an end before everything is developed. As to the apex law, my vein dips something like 75 degrees; why should not I or any man get the benefit of his own discovery and perseverance? Mr. Smith says not; that it has caused lawsuits (retarding development again); but anything can cause a lawsuit. It is the courts that need revising, in my estimation, that the poor may get just and equal rights. Our mining laws are easily understood by ordinary intelligence, and I am thankful that I live and lived in a period when the mining laws give the poor such liberal inducement; it's like a touch from the big-hearted and far-seeing Lincoln. The best words President Taft said while in the White House were: "Our mining laws are good enough." For surely our mining laws are the best in the world for the prospector and producer, with no license, gold commissioner, or government to impose on him. I would like to hear of some prospector who can find fault with the laws. Fault is usually found by some who want more fancy jobs created. There are few experts, mining men, and I fear a very few editors who have prospected and paid their own way. I have read many articles by those wishing a revision and more complicated laws, and it would seem the 'big interests' may want laws more to their advantage and in some way to cut the little fellows out entirely.

Archie Huntoon.

Galena, Washington, May 19.

[That the prospector's viewpoint is an important one goes without saying, and we take pleasure in printing this note from one who by actual experience has come to know the significance of our mining law as applied to the prospector. However, we cannot agree with the inference that any contemplated changes in the mining law will work to the detriment of the prospector. On the contrary, it is the purpose of reform to aid and abet both prospecting and the prospector, whether he be the lone pioneer of the industry who goes forth into the wilderness in search of gold or the prospecting corps of a large corporation.—Editor.]

Transportation Problems in Bolivia

The Editor:

Sir—In reply to the letter of Lester W. Strauss, in the *Press* of October 4, 1913, I beg to state that Mr. Strauss is right in saying that the Peruvian oilfields near Lake Titicaca have been abandoned, as I find this in the records of the *Boletins de la Sociedad de Ingenieros.* There are no coal and oil lands in Bolivia. According to the *Monografia de la Industria Minera* in Bolivia, by Pedro Aniceto Blanco, the leasehold per hectare of mineral land is 2 Bolivianos (80c. U. S. cy.) per half year. The narrow gage railroad (of 30 in.) was built by the Huanchaca company from Antofagasta to Pulocayo and then continued from Uyuni to Oruro. From there the gage was changed to 1 metre and maintained for all future railways and is called in Bolivia—the Bolivian Standard gage. About 'Carana,' that unfortunately was the engravers' blunder, changing Charana to Carana. The La Paz-Arica line runs from Viachi to Charana on the frontier of Chile, and there is also a line projected from Oruro to Charana. Corocoro has also been misplaced and ought to have been on the Arica line, between Viachi and Charana, as Mr. Strauss mentions.

G. W. Wepfer.

Berkeley, California, October 6.

Indian Gold Production

The group of mines at Kolar, State of Mysore, yielded as follows in September:

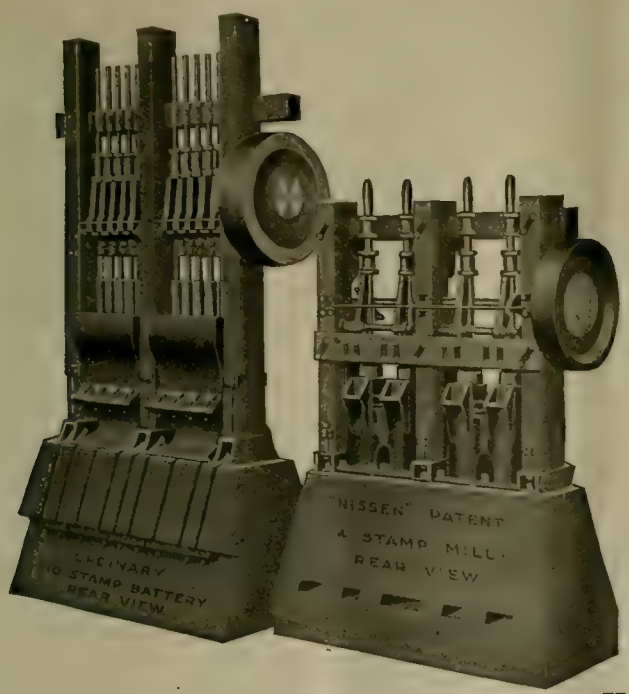
	Tons.	Ounces.
Balaghat	3,550	1,419
Champion Reef	18,332	11,411
Hutti (Nizam's)	2,225	1,820
Mysore	24,691	18,881
North Anantapur	2,000	918
Nundydroog	7,500	6,662
Ooregum	12,901	8,028

Special Correspondence

LONDON

INTERESTING TESTS BETWEEN THE ORDINARY GRAVITY AND NISSEN TYPE OF STAMPS AT CORNISH MINES.—THE ANANTAPUR GOLDFIELD OF INDIA.

In making comparisons between the efficiencies of various methods of treating ore, it is seldom that competitive experiments are made side by side on the same ore. This is particularly the case in connection with comminution. An engineer will praise the Chilean mill for its work done on certain gold ores and allege that the results are better than from ordinary stamps; but as he did not test the two concurrently, or give exact detail of the constitution and physical characteristics of the ore, his statistics fail to convince. The method pursued by Edward S. King, in connection with the crushing of Cornish tin ores, affords a pleasing contrast. The problem in tin-dressing is to form as



NISSEN AND ORDINARY STAMPS.

little slime as possible, for it is next to impossible to concentrate this class of material. It has hitherto been held by Cornish managers that the best way to prevent sliming is to use as light a stamp as is otherwise advisable, and in the modern installations of stamps the limit of 1050 lb. has rarely been exceeded. Mr. King, however, desired to pursue investigations on another tack, and sought to test a machine designed specially with the object of hastening the discharge from the mortar-box. He accordingly has installed two Nissen stamps. Many Cornish engineers were aghast at the idea of using a stamp weighing 2000 lb. on tin ore, but Mr. King admitted the logic of Peter Nissen, when claiming the greatly increased screen-area and direct splash of the pulp on the screen as potent factors in reducing the formation of slime. In order that the tests should be conclusive, a 5-stamp mill containing ordinary stamps of 1050 lb. each has been erected by the side of the Nissen stamps, and the two sets are to be fed from the same bins. The latter stamps have been at work for some time, but the former are only now being completed. Comparative tests have however been made between the Nissens, which, I ought to say, are at the Carn Brea mine, and the standard stamps at South Crofty, the mine immediately adjoining. Josiah Paull, the manager of the South Crofty, being desirous of testing the two types before deciding on plants to be erected at the Tresavean mines near Redruth, for which he is consulting engineer, sent shipments of both ores to the Nissens at Carn Brea and to the South Crofty plant. The result was that, with the Nissens only 33% of *minus* 200 mesh was produced, as compared with 39% with the ordinary stamps. Other features of the Nissen, such as capacity and power required, satisfied Mr. Paull, and he decided to recommend their adoption at Tresavean. He has since then recommended them for the Garlidna, an old mine that is being opened in the Wendron district. At the Carn Brea mine other novelties are to be introduced in connection with tin-dressing. One is the use of the Card table, a machine that has given satisfaction at the Mount Bischoff tin mine in Tasmania, and the other is the adoption of the Cobbe-Middleton pan for regrinding middling. The latter is also a machine that was developed in Australia. It will be remembered that at the Geevor mine, near Land's End, Deister tables and Hardinge regrinding mills have been installed. The results of the two systems will be followed with interest.

The Anantapur goldfield in India has at last provided a return, if only a small one, on the capital outlayed. The district was first brought to the notice of the British public in 1906, when a company called the Anantapur Gold Field Limited was floated by John Taylor & Sons. The property acquired consisted of old workings of a similar nature to those at Kolar, in the Mysore State, 200 miles to the south. The Kolar goldfield did not give immediate results, and for two or three years there was a doubt whether to continue or not. Subsequent history during the past twenty-five years is sufficient evidence that perseverance has in this case provided a reward. The results achieved at the Anantapur deposits have been fairly promising, though progress has been slow and no large body of ore has so far been disclosed. Experience in connection with the Kolar district has kept shareholders in buoyant mood, though it must be said that the other Indian enterprise of John Taylor & Sons, outside Kolar, that is to say at Dharwar, in the Bombay Presidency, might have depressed their spirits, seeing that the venture has been an entire failure and has been suspended. After a few years' work, Anantapur deposits were proved to be sufficiently promising to warrant development on a larger scale. One block was sold to a new company called the North Anatapur Gold Mines Limited, and another was taken up by the Nundydroog company, one of the Kolar group, to be subsequently formed as the Jibutil Gold Mines Limited. The North Anantapur has now issued a report for the year ended June 30 last, announcing a small profit. It should be said that the North Anantapur company was formed in 1908, and that in 1911 additional capital was required for development and completing the payment for the plant. The present issued capital of the company is £74,268 in £1 ordinary shares and £20,000 in 20% preference shares, the latter being issued in 1911 to provide the additional funds. During the year ended June 30 last, 22,827 tons of ore yielded gold worth £35,867, and the profit was sufficient to provide £2,000 for the owners of the preference shares, being at the rate of 10%. Development has continued to maintain the reserve of ore, the figure on June 30 being 44,000 tons, as compared with 42,000 tons a year ago. It is stated that the main ore-shoot, out of many, is longer at depth, being 335 feet long at 550 ft., as compared with 282 ft. at 450 ft. and 135 ft. at 300 ft. depth. A winze below the 550-ft. level is even more promising, as the lode is proved for the 70 ft. of depth so far sunk to be 5½ ft. wide and to assay 2½ oz. gold per ton. Shareholders are enthusiastically living in hopes that development in depth will prove as profitable at Anantapur as at Kolar.

The interim report of the Rio Tinto Copper Co., operating the largest copper and sulphur mine in Spain, for the six months ended June 30, states that mining in the open-cuts and underground, has been of a normal character. The copper output was a trifle lower than usual. A dividend of 2s.6d. per share was paid on the 5% preference shares, and one of 40s. per share on the ordinary shares.

NEW YORK

THE MEXICAN SITUATION.—HOLLINGER RESERVE MINE.—FEDERAL MINING & SMELTING CO.'S ANNUAL MEETING, AND ANSWERS TO CHARGES BROUGHT AGAINST THE DIRECTORS.

Mining circles here have had no great sensations except such as are evoked by the precarious situation in Mexico. The general feeling seems to be a determination to support the Government in any difference it may have with foreign nations. The utterances ascribed to Sir Lionel Carden have been repeatedly denied. All sorts of views are current, one that European nations are about to force the hand of the United States and bring about intervention. It has just been announced from Washington that a new policy is being framed for the solution of Mexico's difficulties, which will demand the elimination of Huerta from Mexican politics. However, as the situation is not solely dependent upon one man, but rather a diseased condition of the greater part of the country, no immediate solution is anticipated.

The Lewisohn interests (General Development Co.) have taken a year's option on the Hollinger Reserve property at Porcupine, Ontario, under the terms of which they agree to perform a stipulated amount of work monthly, and in return receive treasury stock of the Hollinger Reserve Mines, Ltd. At the end of the year the General Development Co. will practically control the mine. Work at present is confined to sinking the shaft to the 300-ft. level. The citizens of Porcupine are jubilant over the advent of this strong group in the district, and the, in many respects, disappointing results of exploration to the present are forgotten in the hopes for the future.

The annual meeting of the Federal Mining & Smelting Co. was held in New York on October 20, results of the past year being given in the general mining news of this issue. A. M. Strode, of Mullan, Idaho, near where the mines are situated, asked questions relative to the New York office of the Company; how often the books are audited; where the funds are kept; and whether a secret fund for political purposes is maintained in Idaho. The chairman of directors, Francis K. Brownell, stated that the New York office cost about $820 per year; the books are audited monthly in New York and yearly at Wallace, Idaho; funds are kept in New York, $25,000 at Wallace, and $25,000 at Spokane, Washington; no political fund is kept, but admitted that the Company holds an interest in the *Press Times* at Wallace, with the Bunker Hill & Sullivan and other companies in the district. There was also a denial that the Federal company was affiliated with the United Stores Co., compelling employees to purchase stores from that concern. The Federal company also owns 50% of the stock of the Green Hill Cleveland company and has received $245,000 in dividends therefrom plus $90,000 more, there being about $125,000 in this Company's treasury. Its operating profit during the past year was nearly $500,000, and the contract for selling the ores was similar to that made for the ores from the Federal mines which are sold to the American Smelting & Refining Co. This was in reply to a charge that Messrs. Day and Brownell were acting more for the latter Company than the Federal. Sidney Norman, representing the minority common stockholders of the Federal company in New York, who are suing to have the selling contract with the American Smelting & Refining Co. annulled, was also present, and asked several questions regarding the prices received by the Company for its products during the year. Among other things, he tried unsuccessfully to ascertain the exact price received for the Company's lead during the past twelve months. He had computed roughly that under the contract the Federal had lost about $347,000. In reply, Mr. Brownell stated that even if Mr. Norman's statement and figures were true, which was not admitted, there would be no more cause for abrogating the smelting contract than if the reverse had happened; that is, if the contract was made so favorable to the Federal, that the smelting company might desire to have it annulled. He also stated that any engineer representing the minority holders would be permitted to inspect the property.

PHILADELPHIA

DETAILS OF MEETING OF THE AMERICAN MINING CONGRESS.

The American Mining Congress held its annual session at Philadelphia from October 20 to 24, inclusive. The headquarters for the meeting were at the Bellevue-Stratford hotel. The session opened on Tuesday afternoon by an address of welcome by the representative of the Mayor of Philadelphia to which D. W. Brunton, the president of the Congress, made an appropriate response, and was followed by B. F. Millard for Alaska, W. H. Fluker for Georgia, C. J. Norwood for Kentucky, J. R. Burton for New York, H. N. Lawrie for Oregon, Isadore Broman for Texas, Niell Robinson for West Virginia, and Joseph M. Carey, ex-governor of that state, for Wyoming. At the evening session the president delivered a thoughtful address which, unfortunately, there were but few present to hear. The poor attendance at all the sessions of the Congress was doubtless due to the fact that E. T. Connor, who had been most effective in arranging for the Congress, was seriously ill in the hospital. In addition the meeting was naturally considered to centre around the coal-mining industry, and the lack of concerted action in that industry does not make for enthusiasm. The morning session on Tuesday was devoted to a discussion of taxation of mining property, the principal papers being by R. V. Norris, H. M. Chance, and D. L. Webb; B. W. Vallat and J. W. Malcolmson taking part in the ensuing discussion. The situation in Pennsylvania is complicated by the fact that the state constitution provides only for uniform taxation of all property on an assessed valuation, so that the problem becomes really a discussion of the valuation of mining property for the purpose of taxation. The difficulties of arriving at such a valuation were pointed out, and Mr. Malcolmson pointed out that taxation in South Africa is on the basis of net profit, while in Mexico it is based on the gross output. The drawbacks of each of these bases were pointed out, and Mr. Malcolmson urged that a proper and equitable basis would take all three into account. The morning session was concluded by a paper on uniform requirements for official mine reports by S. A. Taylor, who pointed out that the various reports called for by the various statistical bureaus of the Government involved much unnecessary labor and by slight readjustment essentially the same information could be furnished at much less expense. In the afternoon the delegates and their friends were taken for an excursion on the Delaware river, in order to see the shipbuilding yards and other points of local interest, concluding with a visit to the League Island Navy Yard, where the delegates were allowed to inspect the battleship *Minnesota*. The evening session consisted of an address on mine-rescue and recovery work, by J. W. Paul, which was discussed by George S. Rice. R. W. Gunnell talked on the use and abuse of explosives, and the evening was concluded by a description of the coal resources of Alaska by W. R. Crane. On Wednesday resolutions were introduced, the committee on Alaska affairs made its report, and an excellent paper on 'The Industrial Corporation and Scientific Research' was presented by D. B. Rushmore. In the afternoon E. B. Kirby presented the report of the committee on revision of the mining law, the report essentially agreeing with that of the similar committee of the Mining and Metallurgical Society. This was followed by the 'Plain Talk' by George Otis Smith, Director of the U. S. Geological Survey, as printed in the *Mining and Scientific Press* last week. A discussion of the effect of federal administration of the public lands on the mining industry by J. F. Shafroth, senator from Colorado, followed. It was directed principally against Government ownership of 9,425,000 acres of coal lands in Colorado, valued, he said, at from $500,000,000 to $1,000,000,000. Mr. Shafroth urged the sale of these lands to citizens or to corporations for $400 per acre. In this manner, he said, they would be developed, and would produce enough coal to last the entire world 300 years. The evening session was devoted to the address by C. R. Van Hise on 'Big Business and Industrial Prosperity,' of which a summary will be printed next week. Mr. Van Hise took the attitude of the best informed thinkers in concluding that the collective

good of the public is not, as at first supposed, to be secured by forcing the most vicious form of individualism in unrestricted competition, but is rather to be secured by collective action for the common good. Thursday's session was opened by an interesting talk on the mining exhibit at the Panama-Pacific Exposition by C. E. van Barneveld, its director. E. W. Parker followed with a highly important paper on the cost of coal production, in which the fact that coal mines at present generally pay less than 2% on the investment, due to unrestricted competition and unequal legislation, was brought out. A paper by J. W. Boileau on 'What is the Matter with the Coal Industry?' was read, and A. J. Moorshead, in the following discussion, laid the blame upon the operators for their selfishness and lack of coöperation. Those who have attended the past sessions of the Mining Congress must have marveled to hear a speaker advocating federal regulation of the mining industry to secure 'a common law for a common industry for the common good,' and be loudly applauded. It is most significant that, in many fields of mining, operators are coming to feel their interests can be best secured by federal rather than state regulation. The afternoon session was devoted to a paper on gold-mining in Georgia, by W. H. Fluker; a most important paper on the radium situation in this country, by C. L. Parsons, of the Bureau of Mines; and an equally important address by M. D. Foster, chairman of the House Committee on Mines and Mining. In the evening a smoker and vaudeville entertainment, followed by a supper, was given. This brought out the only large attendance of the session, and is a sad commentary on the interest of those present in Philadelphia, since the papers presented unquestionably surpassed those at any preceding Congress. The morning session on Friday was given up to report of the ways and means committee, which brought out the discouraging fact that there are only about 450 members of the Congress who pay yearly dues, the rest of the attendance being made up of delegates, and that the organization owes the salary of the secretary, J. F. Callbreath, for a long period in arrears. The committee on standardization of electrical equipment in coal mines made a brief report, the principal address of the morning being by William B. Wilson, Secretary of the Department of Labor, who discussed on a high plane arbitration as a factor in the mining industry. His remarks met with vigorous opposition by some of those present. The afternoon session was devoted to the consideration of resolutions, of which there were too many for even a summary. Those on blacklisting and on monopoly in the mining and smelting field attracted most attention. The session concluded on Friday afternoon. A resolution offered by Sidney Norman, of Washington, which refers to the "dishonest operations of the financially powerful" as a great menace to the mining industry, was adopted. Through this resolution the Congress went on record as favoring the institution of universal state laws that will provide protection to minority stockholders by making directors more definitely responsible for their welfare and constituting infraction of such laws a felony, punishable by fine and imprisonment. It pledges itself to support legislation necessary to put such laws into effect, and suggests that the Department of Justice investigate "scandals recently disclosed regarding securities listed on the New York Stock Exchange," to the end that responsibility may be properly placed and the offender brought to justice.

VICTORIA, BRITISH COLUMBIA

PLACER MINING AT SIBOLLA CREEK, RESULTS AND PROSPECTS.

Information relative to what is known as Sibolla creek, in the southwestern part of the Skeena district of British Columbia, has been received from Telkwa, which is situated at the junction of the Telkwa and Bulkley rivers, the later being a tributary of Skeena river, into which it flows near Hazelton. Sibolla creek is about 120 miles southwest of Telkwa, and west of the lake country in which are Francois, Ootsa, Tahtsa, and numerous other lakes. The Coast range forms, in that part of its length, the divide between the lake country on the east and the head of Gardner canal on the west. The newly reported placer-gold field can be reached by (1) Gardner canal, thence eastward up Kemano river and over the Coast range, from the west (though as yet this route has been little used) (2) trail south from Telkwa; or (3) west from the route of the Grand Trunk Pacific railway line at Fraser lake and thence by Francois and Ootsa lakes.

A report on the new district contains the following:

Of ten days spent at the Sibolla Creek placer field, three were occupied in sampling the gravel above Discovery claim, on the creek, and this resulted in finding colors in only one pan out of four. No coarse gold was shown. Below Discovery, at the first three claims, the result was similar, and after that, to No. 19 below, the colors became more numerous, and not more than one-quarter of the total pannings was barren. A shaft was being sunk at that time by S. White, I. McCulley, Dave Mackenzie, Billy George, and Louis Koltas, in an effort to reach bedrock, and after 12 ft. of a 6 by 6-ft. shaft had been sunk, a windlass erected, and the hole timbered, the water flowed in so great volume that work on all the creek claims was stopped. Attention was

MAP OF BRITISH COLUMBIA.

then given to the bench claim of Leo McLaughlin and partner, on the north limit of No. 3 below Discovery, but at the time of writing, bedrock had not been reached. Colors were consistently present all the way down the shaft, which was then 15 ft. deep, timbered, and equipped with a windlass. Prior to leaving the field, most of the prospectors going out turned over all their spare supplies to those two men, who then had provisions for two months. The only other party on the ground properly equipped is that of George Barrett and Joseph Bussinger, who has a good outfit, including a rocker, and provisions for four months. They are staked on the bench and should reach bedrock in the big flat without being seriously impeded by water.

The bench north of Sibolla creek had all been staked, but as far as could be seen, no effective development had been done, except an 8-ft. hole sunk on the Newsboy claim, in which colors were present after the first three feet. The wash there is deep and at the bottom of the hole the conglomerate gravel, slightly cemented, is moist and full of air spaces; 'pay' is not likely to be found until a strata more dense and less coarse shall have been reached. On the bench due west of the camp some promising ground was seen; this is marked with dry water courses and is sedimentary in character. The gravel is fine and heavily cemented, but no 'pay' was found, though colors were fairly plentiful, with a large proportion of white iron and some black sand. A dozen claims had been staked on that ground.

Contrary to the first report, no contact of slate and porphyry was seen, but shale or coarse slate runs parallel with

the porphyry along the range and dips into it at an acute angle. The large rounded boulders so numerous in the wash are chiefly gray or blue granite, while rose quartz is plentiful in the gravel, with an occasional small specimen of gold in some of the larger pieces. The field shows no sign of having been an ocean beach but rather resembles the bed of a lake or, what is more probable, glacial detritus, and the characteristic surface boulders are spread over a distance of more than 12 miles, intersected by swamps mainly with a gravel bottom. Three beaver dams that have to be crossed before reaching Sibolla creek show evidences of considerable wear, and should rain fall this month (October) horses with packs will not be able to get through to the field; the water above the dams is low and the frost has been severe during the past week.

Andy Goodwill, one of the original locators, and partner had four packhorses and expect to spend the winter on No. 1 below Discovery, where the first coarse gold was recovered. C. P. Price, also one of the original locators, who is outfitting at Telkwa for a similar purpose, states that when coming out by a new route from the Sibolla country he discovered on the same range, about 12 miles to the north, a similar creek to the Sibolla, in which colors were plentiful. More than 300 claims have been staked, but with the exceptions above noted, no party of prospectors had been outfitted properly to reach bedrock in what is, to all surface appearances, a most promising field. If the men now on the ground fail for the present, in all probability the value of the field will not be determined until next year. The time actually occupied in going in from Telkwa was 6½ days, and in coming out, traveling light, 5 days.

In 1906, Herbert Carmichael, then provincial assayer for British Columbia and assistant to the provincial mineralogist, visited Kemano river; a short account of that visit was printed in the 'Annual Report of the Minister of Mines for British Columbia, 1906,' pp. H. 67-8. From that account the following notes have been taken:

"Kemano river flows into Gardner canal on the northeast side, 30 miles from the mouth of the canal. It is a stream of considerable size and is navigable for canoes a distance of 20 miles, but is so swift flowing as to require 'poling' or 'lining' all the way. At the mouth of the river there is a good harbor, with anchorage in not too deep water. The mountains, which rise abruptly to a height of 4000 or 5000 feet, seem to be entirely granitic and show very marked glaciation to a height of 2000 ft. or more. At 8 miles from the mouth of the river, Pintledanne creek flows in from the north. From this creek there is a good trail, with an easy grade, to Tahtsa lake, which in turn flows into Ootsa lake. The height of the pass is said to be 4000 ft. and the distance from Gardner canal to Tahtsa lake, 20 miles. This pass seems to afford an easy route to the Ootsa Lake country." Mr. Carmichael also gave brief particulars of a copper-bearing vein, he examined, on Pintledanne creek.

According to the last annual report of the Minister of Mines for British Columbia, in 1912 there were 445 free miners' certificates, and 303 mining claims recorded in the Skeena and Bella Coola mining divisions.

FORT WORTH, TEXAS

A Résumé of the Texas Coal-Mining Industry, and the Future Outlook as Seen by the Producers.

According to reports received by the Texas Commercial Secretaries and Business Men's Association from many of the important coal producers in this state, the demand for Texas coal this winter will be the heaviest in the history of the industry. Labor troubles in the Colorado fields, the results of which will probably extend far into the winter, have caused a curtailment in the output of that state during the past sixty days. The Texas mines will be, and are, materially benefited by these conditions, as a large portion of the consumers which formerly secured their coal from Colorado fields are looking to Texas for their winter fuel. Many future orders have been booked by the Texas mines for shipment to dealers in southern Colorado, Texas Panhandle, and other points in the Colorado trade territory. No authoritative estimate of the total production of the Texas mines has yet been made, but it is expected that the output of 1913 will greatly exceed that of 1912, which was the maximum annual yield, both in tonnage and value, and was the first time in the history of Texas coal mining that the production exceeded 2,000,000 tons. The annual consumption of coal in this state, according to the best available estimates, is valued at $7,500,000. According to figures just compiled by the U. S. Geological Survey, the 1912 output of Texas was 2,188,612 short tons, valued, at the mines, at $3,655,744. Compared with 1911, this is an increase of 214,019 short tons, or 10.8% in quantity, and $382,456, or 11.7%, in value. The bituminous mines which are situated in Eastland, Erath, Maverick, Palo Pinto, Webb, Wise, and Young counties, in 1912 produced 1,197,907 short tons, or 54% of the total production, and it had a mine value of $2,774,956. There were 990,705 short tons of lignite produced that year, with a value of $880,788. The lignite mines of Texas are situated in the counties of Bastrop, Hopkins, Houston, Lee, Leon, Medina, Milam, Rains, Robertson, Titus, Van Zandt, and Wood. The leading bituminous producing counties are Eastland and Erath, and in 1912 produced more than two-thirds of the bituminous output. Lignite is produced chiefly in Wood county.

In view of the optimistic prospects for an increased business, many improved methods of mining have been instituted in Texas mines recently, and in several instances machine mining has replaced old fashioned hand-pick methods. Of the total production of last year, 105,400 short tons was mined by machine, compared with 71,085 short tons mined in this manner in 1911. Five per cent of the total production is mined by hand, and it consists principally of bituminous. Another modern improvement in the Texas mines is the establishment of washing plants in the Eagle Pass district. In 1912 there were 25,600 short tons of coal put through this process, thereby greatly increasing its market value.

The scarcity of labor has, to a certain extent, affected the Texas output during the past sixty days, but as the crop-gathering season nears an end, and labor becomes available, practically all the mines are operating full time and in some instances double shifts are being worked. The coal and lignite mines of this state furnish employment to an average of about 5000 persons the year around. The total number employed in 1912 was 5127 men, who worked on an average of 230 days during the year. The average production per man for the year was 424 short tons, or 1.84 short tons per working day. Infrequency of labor troubles has contributed toward the rapid advancement of this industry, and fewer strikes are recorded for Texas than any other coal-producing state. Only four instances of idleness from this cause were reported last year, the longest period being ten days. Only 238 men were affected, and the average number of days lost by each man was seven. As a usual thing, the bituminous mines are worked 8 hours per day and the lignite miners average 10 hours.

The Texas mines are well equipped with safety devices and every precaution to safeguard employees' lives is used. Owing to the careful and systematic manner in which operations were carried on, only two fatalities are reported for last year. In one instance a miner lost his life in a shaft, while another was killed on the surface. There were no fatal accidents in the Texas mines during the previous year. Data compiled by the U. S. Bureau of Mines and published in a recent bulletin shows that Texas has one of the lowest mine death-rates of any coal-producing district in the world.

The history of coal-mining in Texas dates back to 1884, when 125,000 short tons was produced. The yield gradually declined each year until 1888, when the production again became normal. For the next thirteen years the annual output steadily increased, until the discovery of petroleum in the Beaumont fields in 1901. Following this discovery, the coal-mining industry of Texas received a temporary setback, but with the decline in production and the subsequent increase in the price of fuel oil, a few years later, interest in coal-mining was resumed and the industry from that day has thrived.

General Mining News

ALASKA

CORDOVA

The Dan Creek Mining Co., of New York, owns 700 acres of placer ground on Dan creek. A hydraulic plant was practically destroyed by floods in September 1912, but has been rebuilt. The main reservoir is three miles from the mouth of the creek, and over 100,000 ft. of 15 to 30-in. pipe and 650 ft. of flume carries the water to the penstock. Two 6-in. giants will be used, and a 5-in. giant for stacking tailing. The sluice-boxes are 1800 ft. long and 5 ft. wide. The Company also has a sawmill and repair shop, store, and bunkhouse. G. H. Birch is the engineer in charge. The Nelchina placer district has been briefly examined by G. C. Martin of the U. S. Geological Survey, who states that at present it is not possible to make any definite statements.

EFFECTS OF THE STORM AT NOME.

Some of the claims are worthy of development on a larger scale, but the stampede was not justified. The prevailing rocks are sandstones and shales underlain by volcanic beds and cut by numerous small dikes. The valley is 110 miles from Knik.

FAIRBANKS

The Newsboy mine produced gold valued at $8549 from 391 tons of ore crushed in the stamp-mill during September. Three feet of rich ore has recently been cut at 200 feet. L. M. Drury is superintendent.

JUNEAU

The Alaska Treadwell Gold Mining Co. will add to its equipment for electric drive four motors of 10, 35, 75 and 100 hp. respectively, switches, etc. Also there will be installed in the power-plant of the Alaska-Juneau mine a 937 kva. Curtis turbo-generator with 7-kw. motor-generator exciter set, three 333-kva. water-cooled transformers and a switchboard. The company has contracted with the General Electric Co. to furnish the equipment.

NOME

With the energy and money at their command, the residents of this recently damaged town are rebuilding, but more help is needed from the 'outside'.

The dredge at the mouth of Peluk creek was carried by a large wave 800 ft. from the beach up the creek, but suffered no damage. The American Dredge Building & Construction Co. of Seattle were the builders of this machine. The accompanying half-tone should give an idea of the effect of the storm at Nome. It started on October 1 and attained its maximum strength on the 5th, when the waves wrecked every building on the south side of Front street. With a few exceptions, merchants saved the most of their goods, but people at the east and west ends of the town lost everything. The town of Solomon, 30 miles east of Nome, was completely destroyed. The whole summer was marked by a shortage of water for placer mining.

ARIZONA

GILA COUNTY

(Special Correspondence.)—At the Miami copper mine actual development has been started for extraction of the Captain orebody. The sinking of the Captain shaft has been completed to the 420-ft. (main tramming) level, and a sump cut. On the 420-ft. level, 1894 ft. has been completed to date, and a number of raises have been started from this level to develop the ground. The first sub-level to be opened will be at 270 ft. and the work on this will begin at the Captain shaft. Diamond-drilling has been discontinued for the present. The daily output is averaging 3000 tons of ore, and the additions to the crushing plant are practically completed and will be operating within a week.

At the Southwestern Miami, drilling is proceeding at a satisfactory rate, and since the erection of coal bins at the terminus of the Live Oak branch of the railroad at a point a quarter mile north of the Company's plant, more steady and economical operation is assured. Hole No. 15 is now 1155 ft. deep; No. 16 is down 787 ft., and No. 17 449 ft. No. 15 and 16 are in silicified schist.

Miami, October 24.

(Special Correspondence.)—The Silver King mine, in the Superior district, will probably soon be reopened. At the Reymert mine, new boilers from El Paso are being installed for the new pumps.

Globe, October 23.

The General Engineering Co. of Salt Lake City, Utah, J. M. Callow manager, has received instructions from the Magma Copper Co., of Superior, to proceed at once with the design and construction of a 150-ton concentrating plant, to be built at the Company's mines, at Superior. This property is controlled by the Gunn-Thompson interests, and construction work is expected to start within thirty days.

The Inspiration Consolidated Copper Co., Miami, will place in operation in its power-station four large 2000-kva. water-cooled transformers, a 500-kw. 4-unit flywheel motor-generator set with controlling equipment, two 580-hp. motors, switchboard and accessories.

MARICOPA COUNTY

Quicksilver weighing 1500 lb. is being produced daily by the Sunflower Cinnabar Mining Co., 75 miles northeast of Phoenix, in the Mazatzal mountains. High-grade ore is being mined from four adits, and the product will be sent to the New York branch of a San Francisco firm.

MOHAVE COUNTY

At a depth of 200 ft. on the Lexington vein, a cross-cut has passed through 24 ft. of ore, 8 ft. of which is rich in gold. The ore is said to be similar to that from the Tom Reed mine, 1½ miles distant. The flow of water is 70,000 gal. per day at present. There are eight claims in the group, and H. E. Woods is general manager. The Bi-Metal

mine is being sampled by A. B. Richardson of the Mines Company of America.

PIMA COUNTY

(Special Correspondence.)—I. N. Kinzie, of Douglas, has purchased the Silver Hill group of claims in the district of that name, from R. R. Richardson and A. E. Crepin of Patagonia. Mr. Richardson formerly owned the Three R. mine sold to N. L. Amster.

Globe, October 23.

YAVAPAI COUNTY

On the Emporia claims, two shafts have been sunk 100 ft. apart, 205 and 175 ft. deep, respectively. Stoping above the 70-ft. level has opened a considerable tonnage of ore, while the 100-ft. level is promising. In addition to the sulphide ore opened on No. 1 level, there is also from 5 to 17 ft. of $8 oxidized ore. At the Home Run, 2 ft. of $60 ore has been developed by T. J. Laird.

A 10-stamp mill is to be erected at the Fortune mine on Big Bug creek, as the 900 ft. of underground work done has opened considerable ore. About 20,000 tons of old tailing at the Crown King, in the Bradshaw mountains, has been bought by N. H. Getchell, who will treat it by the 'Monell' process. The Lynx creek dredge is to be moved to a new site.

YUMA COUNTY

At a depth of 20 ft. in the Bouse McMahon claims, six miles west of Bouse, 18 in. of high-grade gold ore and 4 ft. of copper, gold, and silver ore has been opened. On the surface the vein trenched for 175 feet.

CALIFORNIA

AMADOR COUNTY

At the Plymouth Consolidated mine, according to a message sent to London by W. J. Loring, three days' work, 25 ft., on the 2000-ft. level, averaged $12 per ton, for the full size of the drift, for part of the width of the vein. Dividends have been paid by the following companies: South Eureka, 7c. per share, equal to $21,000, making this year's total $209,991; Bunker Hill, 2½c. per share; and Fremont Consolidated, 2c. per share, equal to $4000, making $36,000 for the current year. In the Kennedy Extension *v.* Argonaut suit, the latter has completed its direct testimony. The Rhetta mine and about 500 acres of ground surrounding it, at Plymouth, has been bonded by Mr. Williams, manager of the Mammoth copper mine in Shasta county, which is owned by the United States Smelting, Refining & Mining Co. Mining men in the district are much interested in the deal. The New London mine, which is adjacent to the Plymouth Consolidated, has been bought by Bewick, Moreing & Company.

BUTTE COUNTY

Three dredges at Oroville yielded gold worth $6090 during the week ended September 13.

NEVADA COUNTY

(Special Correspondence.)—On the 600 and 800-ft. levels, the old Oustomah ore-shoot which was lost on the 500-ft. level has been found again about 6 ft. back in the footwall. Stoping is being done on both levels with machine drills, and the 10-stamp mill is working full time. The main shaft is 1000 ft. deep and sinking to 1500 ft. has been commenced. The mine is in a satisfactory condition and is being profitably worked. E. C. Klinker is superintendent of the property, which is operated by the Grizzly Ridge Mining Company.

Nevada City, October 20.

SISKIYOU COUNTY

The Belgium Bohemian Mining Co. has cabled from Holland ordering the suspension of activities at the Hyland mine. It is stated that the added expense for operating the mine during the winter is heavy, and that the Company will reopen next spring. About 25 miners are affected by this action.

A number of employees of the Black Bear mine, near Sawyers Bar, narrowly escaped drowning when water broke through an old excavation on October 26 into the 400-ft. level. The water rose 60 ft. in the mine and did considerable damage.

TRINITY COUNTY

Ten men are driving the 1140-ft. tunnel, of which 350 ft. has been completed, for the Olmstead mine, near Hawkins bar on the Trinity river. Other men are building a flume from the headwaters of Cedar creek to the tunnel and to the mine. The ditch, flume, and tunnel will be 4½ miles long when finished next February.

(Special Correspondence.)—At the Enterprise property in the East Fork district, which has been operated for the past two years by R. A. Skinner and J. D. Day, under lease, which expired September 1, the mill is being overhauled and the water system improved prior to resumption of work in the mine, under a new lease for five years, which has been granted by the owners, an Eastern company. This is the result of the splendid showing made by Messrs. Skinner and Day through their careful management during the past two years. The mine is equipped with a 10-stamp mill, concentrating table, compressor, electric light plant, and pump. Water power is used.

The ore is largely free milling, mixed at times with high-grade galena.

Helena, October 24.

YUBA COUNTY

A meeting of the Tarr Mining Co., which has a property on the Yuba river, near Smartsville, was held on October 15, to make application to the Superior Court for a dissolution of the Company; but there were not sufficient shareholders present to carry the motion. The Company took a lease on the old Blue Point mine, at one time a fair gold producer, but on examination by an engineer condemned it as unprofitable. The mine has practically new equipment, and there are no debts to be paid.

COLORADO

CLEAR CREEK COUNTY

(Special Correspondence.)—The dismantling of the Pelican mill, so far as tearing out the old machinery, was completed on October 18, and on the following Monday J. B. Ballantine started work in installing the new Edison rolls and other equipment. It is stated that electrolysis will play a part in the separation of the various metals contained in ores to be treated here. This plant will be ready for work within 60 days.

Fifteen men are employed at the Pennsylvania mine, on the west side of Argentine pass. Some rich smelting ore has been opened, and there is a good tonnage of other ore for the mill. At the Capital mine, the 550-ft. station has been made, and a hoist installed on the 540-ft. level. The main raise is being driven by three shifts. The various lessees at this property, the Waldorf, Manhattan Union, Virginia City, and on Democrat mountain are keeping busy.

Georgetown, October 21.

GILPIN COUNTY

At a meeting held at Black Hawk recently, about 100 miners desired to secure tributes in the Phoenix-Burroughs mine, on Quartz hill. Ore worth $7 to $14 per ton in zinc, copper, and iron has been opened on the 100-ft. level of the Gunnell-Fagan lode. A new concentrating plant has been built at the London mine, at Twelve Mile. Lessees at the West Baker, Maryland Extension, Luzerne, and Keystone claims appear to be getting satisfactory results. The Frontenac Mines Co. closed its property a fortnight ago, but will resume early in November.

LAS ANIMAS COUNTY

One striker in the Forbes' camp was killed, two fatally wounded, one mine guard killed, and one wounded in the battle which took place at the Forbes tent colony between the strikers and deputies on October 17. This is the first serious engagement since the opening of the strike, and Sheriff Grisham has declared that the situation is beyond control. No one is allowed within the strikers' lines, and it is impossible to tell the number who were hit, but it is believed that more were wounded than the leaders will admit. No portion of the camp escaped the rain of lead from the machine gun. There are 11,232 men on strike who are losing $33,000 per day in wages, while the loss to the people in southern Colorado is about $115,000 per day.

Further trouble started on October 28 between 1200 strikers and 300 mine guards. Martial law has been proclaimed and the Colorado National Guard has gone to the scene of trouble. During the 35 days of trouble, the following summarizes the results: battles and skirmishes, 18; killed, 28; wounded and injured, 41; personal assaults, 6; buildings and bridges wrecked or damaged by dynamite, 11; property loss (estimated), $50,000; and loss in wages (estimated), $2,500,000.

THE SAN JUAN

The Brown Mountain smelter at Ouray is now treating nearly 100 tons of ore per day, of which 40 tons comes from the Wanakah mine. At the Sunnyside mines at Eureka, an electrostatic plant has been continuously in operation since February 1912. The tonnage treated here is about 20 tons per day, and 90% of the total feed passes a 150-mesh screen. Only a scrap or oversize screen is used, no sizing being necessary. The average assays of the products for a typical month are, heads: gold, 0.20 oz.; silver, 15 oz.; lead, 11.8%; zinc, 30%; and iron, 10.2%; pyrite: gold, 0.33 oz.; silver, 19 oz.; lead, 15.6%; copper, 3.6%; zinc, 12.6%, and iron, 26.1%; and zinc: gold, 0.14 oz.; silver, 5.3 oz.; lead, 3.6%; zinc, 41.3%, and iron, 3.7 per cent.

TELLER COUNTY (CRIPPLE CREEK)

A three years' lease on the Beacon hill properties of the Requa-Savage Gold Mining Co. has been let to K. Macdermid of Colorado Springs. This Company controls 4239 acres of ground, which will be prospected for the time being through the Common-Wealth company's shaft. Machine drills will be used by the lessee and a sub-lessee. The Requa-Savage has yielded $160,000 so far, paying $8070 in dividends.

IDAHO

SHOSHONE COUNTY

The town of Mullan is in an exceedingly prosperous condition, there being about 1000 men employed in the vicinity who receive over $100,000 monthly in wages. A 300-ton concentrating plant is being installed in the old Black Bear mill building a few hundred feet from the Frisco mill, for the purpose of treating ores taken from the Frisco mine, now being reopened. At a depth of 330 ft. good ore is being extracted from the Ray-Jefferson mine, the shoot being 200 ft. long. An intermediate adit will be driven 400 ft. lower. At the Goldback, east of Murray, a vein 17 ft. wide, containing 6 ft. of galena and blende and 11 ft. of quartz heavily mineralized with iron pyrite and galena, has been opened. The development is causing considerable interest in the district. The placer ground adjacent to Murray, including Prichard, Beaver, Trail, and Eagle creeks, has been examined by C. C. Moore and Wat. Moore, who have spent several years in Alaska. A detailed map of the copper district of the Coeur d'Alene has been prepared by John H. Nordquist of Wallace. During the year ended August 31, the Federal Mining & Smelting Co. obtained the following results:

Ore reserves (milling), tons	1,050,000
Ore milled, tons	637,900
Concentrate produced, tons	84,533
Metal content of concentrate:	
Lead, per cent	43.4
Silver, ounces	15.9
Gross earnings	$3,553,325
Operating profits	559,511
Other income	567,463
General expenses, new construction	293,526
Dividends on preferred stock	719,166
Surplus	114,282
Previous surplus	1,324,026
Total surplus	1,438,308

The Stewart Mining Co. reports as follows for the third quarter of 1913:

Gross value of mine and mill products	$335,032
Net earnings	205,116
Development and prospecting	14,681
Net income	190,435
Cash at September 30	451,852

Dividends and bonus paid October 8 were 10% and 2.5% respectively.

MICHIGAN

HOUGHTON COUNTY

During the previous week, Calumet & Hecla shipped 5040 tons of 'rock' daily, compared with over 9000 tons prior to the strike; Osceola, 2640 tons; Copper Range, 1200 tons; Quincy, 1200 tons; Centennial, 480 tons; and Allouez, 300 tons.

MONTANA

JEFFERSON COUNTY

The Cataract mining district, near Basin, is attracting attention, and a fair tonnage of ore is being sent to the smelters. The bulk of this ore comes from the Bullion, Crystal, Comet, Baltimore, and Ruby properties, also from a large number of smaller ones.

LINCOLN COUNTY

(Special Correspondence.)—The Triplex group of silver-lead ore claims, which is located near Troy, has been bonded to W. E. Schuck of Spokane for approximately $100,000, with a good cash payment. This property is near the B. & B. group, lately purchased by Leo Greenough of Spokane, and also the Big Eight group, recently purchased by the Federal Mining company of the Coeur d'Alene. Mr. Schuck intends to start a one-mile tunnel to develop the property at depth, and will extract the ore on the north side of Grouse mountain, which will bring the workings within six miles of Troy. Work is in progress on the placer claims south of Libby owned by William Criderman and C. E. Lukens, the intention being to install a hydraulic plant, which is to be ready for operation by next summer.

Libby, October 20.

NEVADA

The Nevada Tax Commission has cited several hundred mining companies throughout the state to show cause why an increase should not be made in their assessed valuation, and has cited nearly all the public utilities in the state for a similar reason, it being considered by the commission that they have been under-assessed.

ELKO COUNTY

The Contact mining district is said to be quite promising, and it is probable that a railroad will be constructed to it before long from the Oregon Short Line. The ore-bodies contain copper with a little gold and silver, and Henry Smith, manager of the Nevada Copper Mining, Milling & Power Co., states that the ore is high grade.

ESMERALDA COUNTY

The Goldfield Consolidated company is plaintiff in a suit to prevent the removal of $50,000 worth of tailing from the Camp Bird, Last Dollar, and Xmas No. 1 claims by the Old Sandstorm Annex Gold Mining Co. A restraining order was saved on the latter Company on October 20. The dispute will be heard at Carson City before the United States District Court.

September results of the Goldfield Consolidated company were as follows, according to the general manager, Albert Burch:

Ore treated, tons	27,979
Net realization	$177,875
Operating costs per ton:	
Mining (stoping and development)	$3.27
Shipping expense	0.20
Dump moving	0.12
Transportation	0.09
Milling	1.87
Marketing	0.07
General expense	0.33
Bullion tax	0.21
Flood damage*	0.14
Total costs	$6.30
Miscellaneous earnings	0.12
Net costs	$6.18

*The cloudburst occurred on September 13, and although

precautions had been taken in May, the lower levels of the Mohawk, Laguna, and Clermont mines were flooded, and considerable damage to the upper levels resulted from the flow of water through them. The total cost of the flood was $3886, including surface and underground, and on October 15 the last of the water was removed. Development covered 2985 ft. at a cost of $4.53 per foot, with little of importance to report.

STOREY COUNTY

Two air-compressors, formerly used at the Ward shaft, are being moved to the C. & C. shaft of the Comstock Pumping Association, to be used for the Starrett pumps in the Con. Virginia winze below the 2500-ft. level.

LYON COUNTY

During the week ended October 22, the Mason Valley smelter received 2245 tons of copper ore from the Mason Valley, 1163 tons from the Nevada-Douglas, and 818 tons from other mines in the Yerington district. The new mill at Pine Grove is working full time treating gold and silver ore.

NYE COUNTY

(Special Correspondence.)—At a depth of 790 ft. the Railroad Valley Co.'s No. 6 drill-hole had passed through 165 ft. of clay containing 30% of gaylussite, this making three holes in this deposit. No. 6 hole will be sunk deeper, and another will be driven south of it in search of potash. Gaylussite has been found in clays over five square miles of the valley. It is a new occurrence of this mineral, and is of some commercial importance as a source of soda in the event of a railway or other means of transport being available.

Railroad Valley, October 27.

During the week ended October 25, the mines at Tonopah produced 10,954 tons of ore worth $264,910. The North Star shipped 100 tons, half of which averaged $24 per ton. This came from a stope above the 1050-ft. level. Four to five feet of rich ore has been opened in a raise above No. 12 level on the Mizpah Fault vein in the Belmont. The mine generally is developing most satisfactorily. At the Extension, developing the Murray vein from the new shaft, 950 ft. deep, is opening large reserves of ore. On the 760-ft. level, the cross-cut passed 16 ft. of ore, 4 ft. being of good grade, while the east and west drift opened 277 ft. of the vein. On the 850-ft. level the vein is of similar size. Cross-cutting is in progress at 950 ft. During the quarter ended August 31, the Tonopah Mining Co. treated ore worth $717,275, yielding $641,814, with net earnings of $308,899. Dividends paid were $400,000; loans made, $100,500; exploration and investment, $23,837. Cash on hand at August 31 was $249,776.

NEW MEXICO

COLFAX COUNTY

About 260 miners were entombed in No. 2 shaft of the Stag Cañon coal mines at Dawson when an explosion occurred at the property at 3 o'clock on October 22. Five of this number, found on an upper level, were taken from the mine that night, and rescuers have arrived from all parts of the southern Colorado fields. The day shift working in No. 2 shaft numbered 280 men. The cause of the explosion is unknown. Mine-rescue cars from Denver and Trinidad, Colorado, are at the mine, and miners are driving through the cave-in caused by the explosion. Later reports state that all hope for further rescue is at an end, and fully 260 men have lost their lives.

The property is owned by Phelps, Dodge & Co., of New York, and during 1912 the coal output was 1,383,562 tons from five mines. Of this, 646,061 tons was converted into 319,221 tons of coke for the Copper Queen smelter at Douglas, Arizona. Only six lives were lost in 1912. A rescue station containing eight helmets and plenty of oxygen and potash is always ready for emergencies. The Stag Cañon Fuel Co. paid $414,927 in dividends in 1912.

The U. S. Bureau of Mines has just issued Bulletin 50, 'A Laboratory Study of the Inflammability of Coal Dust,' by J. C. W. Frazer, E. J. Hoffman, and L. A. Scholl, Jr., which should be studied by those interested in coal mines.

WASHINGTON

FERRY COUNTY

The San Poil Consolidated Co.'s cyaniding mill is now treating a daily output of 110 tons of ore from the San Poil and Knob Hill mines, and occasionally more than the rated capacity of 125 tons per day. A new Williams hammer-mill, with a thicker and stouter shell and larger and heavier hammers, replaced the first one and has been breaking all the ore to ⅜-in. mesh. The capacity of the new hammer-mill is over 10 tons per hour. A Taylor 6 by 8-ft. tube-mill has been installed to work with the 5 by 22-ft. Gates tube-mill.

KING COUNTY

The Seattle Assay Office has temporarily stopped receiving gold on account of an order from Washington, D. C. It appears that an appropriation for transport of uncoined gold has not been made. A similar situation arose seven years ago, and nearly $3,500,000 in gold was stored at Seattle awaiting funds for its removal to the mints.

CANADA

BRITISH COLUMBIA

Le Roi No. 2 company reports the shipment of 1644 tons of ore and 85 tons of concentrate in September. The smelter receipts were $33,404. Total costs were $16,100. The Josie drift was advanced 56 ft., 40 ft. averaging $12 gold and 5% copper over 13 in.; the Annie drift, 700-ft. level, was driven 92 ft., 10 ft. assaying $1.45 gold and 5.5% copper over 3 in.; in the Josie cross-cut and drift, 22 ft. averaged $7 gold and 1.25% copper over 18 in.; and the Hamilton vein west, 600-ft. level, averaged $9 gold and 0.87% copper across 25 in. The Van Roi mill crushed 587 tons of ore from development assaying 4.7 oz. silver, 1.9% lead, and 5.3% zinc during a 96-hour run, yielding concentrate worth $864.

ONTARIO

On November 15 the Crown Reserve company, at Cobalt, will pay a dividend amounting to $35,276, making a total of $5,437,538 to date. The McKinley-Darragh-Savage mines yielded 242,266 oz. silver in September, of which nearly 100,000 oz. came from the shoot in No. 40 vein on the 150-ft. level. A total of 5461 tons of ore was treated at the mill. A steam hoist of 1500 to 2000 ft. capacity has been ordered for the Beaver Consolidated shaft, which is down 800 ft. On the 460-ft. level a 4-in. vein of quartz and calcite was cut last week, the calcite assaying up to 6000 oz. of silver per ton. A new calcite vein, 1½ in. wide, has been cut on the 700-ft. level. Shortage of water has affected the power situation at Cobalt, and the 18 mills in operation have been stopping one after another for 24 hours. The Ontario Light & Power Co.'s hydro-electric plants are running 25% overload. A recent fall of snow should help considerably, as the snow melts at this time of the year. The steamship companies have reduced the rate for carrying silver to London from their recently fixed charge of $7 to $6 per 100 pounds. The Nipissing sent 85,055 oz. to New York, and the Buffalo 60,802 oz. to London last week.

MEXICO

SONORA

The El Tigre Mining Co., operating at Yzabel, reports for September that the stamp-mill crushed 5633 tons of ore, and the cyanide plant treated 5330 tons of current and 1835 tons of dump tailing. The revenue from this plant, shipping ore and concentrate, was $133,989, and estimated profit $58,562. On October 2 a dividend of 5c. per share was declared. At a meeting of the directors in Kansas City, Missouri, on October 16, it was decided to increase the monthly dividend to 6c. per share, as there is only $72,600 still outstanding of the total issue of $400,000 of bonds, and the present condition of the property justifies this action. The recently discovered orebody is to be called the Kelley vein. It is 150 ft. east of and parallel to the Tigre vein, and its course is north and south with well defined walls. High-grade ore has been opened throughout, and cross-cuts have been started in three places from the Tigre vein.

Personal

Professional men are invited to send news of their engagements and travels. Such news is interesting to friends.

C. W. Purington has returned to London.

S. H. Brady was in San Francisco last week.

J. A. Agnew has returned to New York from Peru.

J. Saxton is returning to England from West Africa.

H. S. Underwood has gone to Broomassie, West Africa.

Robert Holmes was a recent visitor to San Francisco.

Max J. Welch will be in Los Angeles during November.

W. W. Mein was in San Francisco last week and this.

Whitman Symmes was in San Francisco part of last week.

R. G. Thomas has sailed from New York for Northern Nigeria.

A. D. Foote and William Hague were in San Francisco last week.

A. 3. Howe has returned to Costa Rico after visiting San Francisco.

C. H. Rowlands is in London, having left Hostotipaquillo, Jalisco, Mexico.

C. H. Wray sailed from New York on October 22 for Northern Nigeria.

Leo Von Rosenberg was recently in the Ray and Globe districts, Arizona.

Arthur B. Foote was married October 23 to Jeanette S. Hooper at San Francisco.

Louis A. Wright passed through San Francisco on his way to Nevada this week.

John Power Hutchins was married to Miss Elisabeth McNear on October 15 in London.

L. M. Drury has been appointed manager for the Newsboy Mining Co. at Fairbanks, Alaska.

E. T. Borlase has left Rio Tinto for the mines and railways department of the Huelva Copper Co., Valdemusa, Spain.

F. W. Maclennan is the new mine superintendent for the Miami Copper Co., at Miami, Arizona, who succeeds N. O. Lawton, resigned.

J. G. Hopkins, Y. J. Pentland, and George Readman, directors of the Arizona Copper Co., are making an extended visit to the property at Clifton.

James Douglas left Globe, Arizona, on October 22 in his special car for Dawson, New Mexico, to personally look into the accident there at the Stag Cañon coal mine.

W. H. Tangye has resigned as superintendent of the Calumet & Sonora of Cananea Mining Co., and will leave immediately for California. Paul Probert has been appointed temporary superintendent. The mining operations are in charge of T. McGovern.

Henry N. Thomson has resigned as superintendent of the Tooele plant, of the I. S. & R. Co. in Utah, and William Wraith assumes the combined duties of manager and superintendent. He will be assisted by O. M. Kuchs, formerly head chemist at the plant.

Among those present at the American Institute of Mining Engineers' meeting held in New York on October 16 and 17 were John A. Church, A. S. Dwight, Karl Eilers, H. O. Hofman, Henry M. Howe, Robert W. Hunt, George F. Kunz, A. R. Ledoux, R. W. Raymond, W. L. Saunders, W. F. Staunton, Arthur L. Walker.

Among those attending the sessions of the American Mining Congress in Philadelphia last week were D. W. Brunton, John R. Burton, H. M. Chance, W. R. Crane, H. N. Elmer, Martin D. Foster, F. Lynwood Garrison, George H. Garrey, R. W. Gunnell, Hennen Jennings, E. B. Kirby, H. N. Lawrie, J. W. Malcolmson, C. M. Modderwell, A. J. Moorshead, R. V. Norris, Sidney Norman, C. J. Norwood, E. W. Parker, J. W. Paul, C. W. Parsons, P. J. Quealy, Thomas T. Read, George S. Rice, D. B. Rushmore, Carl Scholz, H. L. Smyth, L. H. Taylor, Jr., H. N. Taylor, Kirby Thomas, C. R. Van Hise, C. E. van Barneveld, B. W. Vallat, J. L. Warr, William B. Wilson.

Obituary

L. W. Powell, a mining operator prominently connected with various enterprises at Bisbee and elsewhere in the southwest, died at Los Angeles of heart failure, October 25.

William Nelson, editor of the *Salt Lake Tribune*, a paper which has long been noted for the excellence of its local mining news, died at the age of 74 at his home in Salt Lake City, October 26.

Robert M. Mein, who died in his home in Oakland, California, October 26, was a son of the late Thomas Mein, the well known California mining engineer, who was one of the South African pioneers. Robert Mein followed his father and brothers in the profession and both in America and the Transvaal was active in the work. He served as assayer in the Far North, as agent for Fraser & Chalmers on the West Coast, and in general consulting work. He was a capable, loyal, likeable young man who, dying at the age of 38, leaves many sorrowing friends.

J. P. Kimball, who died at Cody, Wyoming, a few days since at the age of 77 was one of the pioneer mining geologists of America. After graduating at Lawrence Scientific School and studying at Berlin and Gottingen, he became assistant to J. D. Whitney in his geological survey work in the Mississippi Valley and in making private examinations. Later he was professor of chemistry and geology in New York Agricultural College and connected with various iron-mining enterprises along the Atlantic coast. He was one of the first to study the mineral resources of Cuba and a pioneer in mine examination work in South America. He published little and the younger generation knew little about him, but he has left a record of clean honorable work.

John Coit Adams, assistant general superintendent for the Anaconda Mining Co., died at Butte, October 17, after a protracted illness. He was born in Honolulu in 1867 and after graduating at Harvard and the Massachusetts Institute of Technology came to Montana to become assayer at the Hope mine, at Phillipsburg. Later he went to the Bimetallic and became foreman of the mill. He left this position to engage in general expert work, and in 1896 removed to Butte as consulting engineer for H. L. Frank. In 1901 he became foreman at the Pennsylvania mine; from this he rose to superintendent of mines for the Boston Montana, and when the new Anaconda company was formed he was made assistant general superintendent. Mr. Adams was one of the best liked men in Western mining circles. Sound in his technology, seasoned by his experiences, he had a gift for handling men that made him especially useful and successful. It is said that during the bitterest days of the Amalgamated-Heinze contest at Butte, he retained the respect and liking of his opponents, despite the skill and energy with which he directed the fight.

The operation of a Frenier pump is essentially that of an air-lift, a certain amount of air being compressed at each revolution of the spiral. No increase in the capacity of the pump can be attained by an increase in the speed of the spiral, and no departure should be made from the determined ratio. There is no possibility of obtaining excess air pressure, and it is therefore imperative that the discharge should be free and unhindered. To this end the precaution observed in the lay-out of an air-lift installation should be rigidly observed, and all bends and elbows avoided in the discharge pipe. It is necessary that the air be allowed to escape as soon as the lifting is accomplished, and the best way to insure this is to provide a vertical discharge directly into the bottom of a short launder having a sharp fall. In operating a pump the pulp should be kept at a definite level in the box. Where it is impracticable to arrange for the pump to have its exact load, maximum efficiency and minimum of trouble will result by arranging an overflow exit from the box at a fixed pulp level. The excess pulp can then be handled by a separate arrangement such as a variable-feed self-operating air-lift, which will require power for operation in almost direct proportion to the excess pulp handled.

New York Metal Market Review

The feature characteristic of all the metals in October was dullness, and with the quiet trade came declining prices. Despite the absence of demand, however, copper recovered near the close of the month, because of foreign influences. Spelter declined steadily, but like copper showed a better tone late in October. Lead was reduced repeatedly and prices are regarded as too low for the good of the American consumer. Antimony has been without interest. Pig tin has been inactive, and less business is expected in the next few months. Aluminum has been adversely affected by the seeming slacking up in the automobile trade, or its slowness in getting started, and prices have declined a few points.

COPPER

Copper metal was strong at the beginning of the month, when it was quoted at 16.75c. per pound cash for electrolytic and 16.87½c. cash for Lake, but it eased off in the absence of buying, and by October 10 had dropped to 16.37½c. cash, with reports of even lower prices, which held for several days. At no time in the month was there any buying of importance and quotations of both first and second hands were almost entirely nominal. The large agencies consistently held to 16.75c. cash, for electrolytic, or 16.87½c. 30 days delivered, while for Lake they asked 17 to 17.25c. In the early part of the month there was a feeling on the part of consumers that prices had been forced up too rapidly; in other words, confidence was lacking. Even the report of the Copper Producers' Association for September, which showed a decrease in stocks of 8,520,943 lb. from those of the previous month; also that stocks on hand, 29,793,094 lb., were the lowest since the producers' records were begun five years ago, did not excite any great interest, so apathetic were consumers. The situation was attributed to the tendency, common in other metals and lines, to await the working out of the new tariff. One thing apparent was that consumers were well covered until December. To some extent, of course, the strong statistical position of the metal was offset by the falling off of domestic consumption in September, deliveries decreasing by over 7,000,000 lb. About the middle of the month, prices took an upward trend, despite the fact that important business was still lacking. The rise was due to advances in Standard copper in London and indirectly to a strike at the Rio Tinto mines in Spain. These influences caused the metal to again touch 16.75c. cash for electrolytic, and 17c. and over for Lake on October 21. On October 23 a slight weakness developed because of freer selling of standard copper abroad, but it was not enough to really affect metal prices, which, however, remained nominal. Exports to and including October 24 were 24,073 tons. The Waterbury average for September was 16.87½c. per pound.

SPELTER

Throughout most of the month spelter was in light demand, and the course of prices was downward until near the end, when the tone became better and a few points were gained. In the first few days of October, prices were around 5.75c. per pound New York and 5.60c. St. Louis, but successive reductions brought them down to 5.30c. New York and 5.15c. St. Louis. These low prices were reflected in lower prices for carload lots of sheet zinc at the mill, the quotation for which on October 24 was $7.50 per 100 lb. basis, less 8% discount, f.o.b. cars Peru, Illinois. On October 24 the New York price for spelter was 5.45c. per pound.

LEAD

The prices of lead in October also pursued a downward trend. It was quoted at the end of September at 4.65c. per pound New York and 4.50c. St. Louis, and on October 24 at 4.35c. New York and 4.20c. St. Louis, quotations which were susceptible to a little shading. At no time was business brisk. The American Smelting & Refining Co. on October 1 reduced its price 15 points to 4.60c. New York and 4.45c. St. Louis, a move which was expected in view of the extent to which outsiders had cut prices. They continued to undersell, and on October 8 the big interest announced another reduction, this time to 4.50c. New York and 4.35c. St. Louis. This cut was met also, and considerable eagerness to get business was shown. The hope that the market would steady at these figures was not gratified, and the outsiders again dropped a few points. On October 16 the large producers again made a reduction, coming down to 4.35c. New York and 4.20c. St. Louis. Outside producers followed, as at the new basis they could still compete with the large interest in New York and undersell in other parts of the country. The third decline did not steady the market, although at the lower prices small lot buyers came in somewhat stronger. The price last named held October 24. An interesting phase of the lead situation came up in connection with talk of a possible decline to 4.25c. or thereabout in New York. Students of the market declared that any such figure would mean danger of London coming into this market and buying heavily of domestic lead, thereby unsettling the market, causing a shortage and resultant higher prices, all to the detriment of American consumers. The price in London on October 22 was £20 7s. 6d. per ton, which is 4.45c. per pound. The discount of 2.5% which London allows in sales of lead, brings the price down 10 points, or to 4.35c. With 15 points allowed for freight, London could, under these conditions, come into this market and pay 4.20c.; therefore, it was pointed out that 4.20c. New York, and even 4.25c. New York, would be dangerous. London at the present time is not well supplied with the metal.

ANTIMONY

Activity in antimony was precluded by the large stocks in bonded warehouses which were open to entry at a reduced rate of duty when the new tariff law became operative. Prices dropped about ⅝c. per pound, making quotations toward the end of the month around 7.12½ to 7.25c. for Hallet's, 7.50 to 7.62½ for Cookson's, and 6.37½ to 6.75c. for Chinese and Hungarian grades.

PIG TIN

From the first of October until near the end, when this report was written, the market was quiet, with prices ranging between 40.12½ and 41.00c. per pound. The Banca sale on September 25 realized 116¼ florins, equal to 42.30c. delivered New York, but the price had little effect on the New York market, as it was felt that the high figure was obtained largely through manipulation of London prices. Deliveries in September were light, amounting to but 3100 tons. The total deliveries for nine months this year showed a decline of 3000 tons compared with the same period of last year. The total visible supply on September 30 was 12,943 tons, which was 302 tons below that of September 30, 1912. Total arrivals in September were 4234 tons. Arrivals in October up to and including October 24 were 2650 tons, and there was afloat on that day 2535 tons. The trade expects consumption by the tinplate trade to diminish in the next few months. Toward the end of October there was a slightly improved demand, but the anxiety of speculative holders to get out of the market kept prices down. It was predicted that on November 1 stocks on hand would be large.

ALUMINUM

Trade in this metal has not been active and the situation generally is unsatisfactory, all of which is attributed to the slower demand and perhaps delayed demand from the automobile manufacturers. Prices declined a few points and there were no recoveries. October 10 the metal was quoted at 20 to 21c. for prompt domestic and 20.12½ to 20.37½c. for foreign. By October 24 quotations were 19.75 to 20.25c. for prompt domestic and 20 to 20.25c. for foreign. All of these prices were for large lots, ton shipments, and 100-lb. lots ranging higher. The imports of aluminum in August were 1,336,835 lb. as compared with 576,252 lb. in the same month a year ago.

Up to the middle of October, withdrawals of gold by Egypt from the Bank of England totaled $36,000,000. Between January 1 and the opening of autumn the Bank imported from Egypt only $9,000,000 in gold.

The Metal Markets

LOCAL METAL PRICES

San Francisco is not a primary market for the common metals except quicksilver. The prices quoted below therefore represent sales of small lots and are not such as an ore producer could expect to realize. Ore contracts usually call for settlement on the basis of Eastern prices, less freight and treatment charges. The prices quoted are in cents per pound, except in the case of quicksilver, which is quoted in dollars per flask of 75 pounds.

San Francisco, October 30.

Antimony	12—12½c	Quicksilver (flask)	$40
Electrolytic Copper	17¼—17½c	Tin	44—45½c
Pig Lead	4.00—5.75c	Spelter	7—7½c

Zinc dust, 1400 lb. casks, per 100 lb., small lots $8.50—9.75; large $7.50—8.50

EASTERN METAL MARKETS.

(By wire from New York.)

NEW YORK, October 30.—The copper market is quiet, the buyers holding off and but little selling is reported. Report from Rio Tinto states that the management of this famous Spanish property is determined to fight the strike to a finish, and the present outlook for a speedy settlement is not very promising. The curtailment of production due to the strike at Rio Tinto and in the Lake Superior district it is estimated will amount to from fifteen to twenty million pounds per month. The lead and spelter market is firmer, and a slightly better condition is reported. A good demand for spot tin continues, the consumers doing but little buying in futures, owing to the wide fluctuations which have taken place in the tin market during the past year. A firmer market and higher prices are anticipated owing to the increased demand for tin plate.

SILVER

Below are given the average New York quotations, in cents per ounce, of fine silver.

Date.		Average week ending	
Oct.	23 60.25	Sept. 17	60.20
"	24 60.25	" 24	61.59
"	25 60.00	Oct. 1	61.68
"	26 Sunday	" 8	61.27
"	27 60.12	" 15	61.12
"	28 59.75	" 22	61.14
"	29 59.50	" 29	59.98

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	56.25	63.01	July	60.67	58.70
Feb.	59.06	61.25	Aug.	61.32	59.32
Mch.	58.37	57.87	Sept.	62.95	60.53
Apr.	59.20	59.26	Oct.	63.16	60.88
May	60.88	60.21	Nov.	62.73	....
June	61.29	59.03	Dec.	63.38	....

COPPER

Quotations on copper as published in this column represent average wholesale transactions on the New York market and refer to electrolytic copper. Lake copper commands normally from 1-5 to 1-4c. per lb. more. Prices are in cents per pound.

Date.		Average week ending	
Oct.	23 16.60	Sept. 17	16.44
"	24 16.60	" 24	16.41
"	25 16.60	Oct. 1	16.29
"	26 Sunday	" 8	16.27
"	27 16.50	" 15	16.11
"	28 16.50	" 22	16.38
"	29 16.50	" 29	16.55

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	14.09	16.54	July	17.19	14.21
Feb.	14.08	14.93	Aug.	17.49	15.42
Mch.	14.68	14.72	Sept.	17.56	16.23
Apr.	15.74	15.22	Oct.	17.32	16.31
May	16.03	15.42	Nov.	17.31	....
June	17.23	14.71	Dec.	17.37	....

The copper market strengthened a good deal during the week ended October 25. On October 21 there was a fair amount of buying for European account at 16⅞c. per pound, the price to which the seller had been adhering without recording any sales. On the 22nd domestic consumers came into the market and though sales were not large the full price was paid and sales on foreign account also continued in small amount. The sale of a carload of Copper Range metal at 16⅞c. was reported, but Calumet & Hecla is held at 17½c. The rest of the week was featureless except that by the 24th the market had been so cleaned of spot copper that it was at a premium, 17c. being the reported price. The market was dull but strong at the close of the week. Copper exports from New York for the week ended October 23 were 8852 tons, or 24,073 tons since the first of the month. Exports for the same period last year were 20,242 tons, so the European demand has evidently not slackened yet. The London market on October 24 closed at £74 10s. for spot and £73 12s. for futures, being up 10s. on spot and 5s. on futures. There is no sign of a 'runaway market.'

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.		Average week ending	
Oct.	23 4.35	Sept. 17	4.73
"	24 4.35	" 24	4.69
"	25 4.35	Oct. 1	4.61
"	26 Sunday	" 8	4.33
"	27 4.35	" 15	4.40
"	28 4.35	" 22	4.35
"	29 4.35	" 29	4.35

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	4.43	4.28	July	4.71	4.35
Feb.	4.03	4.33	Aug.	4.54	4.60
Mch.	4.07	4.32	Sept.	5.00	4.70
Apr.	4.20	4.36	Oct.	5.08	4.37
May	4.20	4.34	Nov.	4.91	....
June	4.40	4.33	Dec.	4.20	....

ZINC

Zinc is quoted as spelter, standard Western brands, St. Louis delivery, in cents per pound.

Date.		Average week ending	
Oct.	23 5.25	Sept. 17	5.59
"	24 5.25	" 24	5.50
"	25 5.25	Oct. 1	5.39
"	26 Sunday	" 8	5.24
"	27 5.25	" 15	5.28
"	28 5.25	" 22	5.10
"	29 5.25	" 29	5.25

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	6.42	6.88	July	7.12	5.11
Feb.	6.50	6.13	Aug.	6.96	5.51
Mch.	6.57	5.94	Sept.	7.45	5.55
Apr.	6.63	5.52	Oct.	7.36	5.22
May	6.68	5.23	Nov.	7.23	....
June	6.88	5.00	Dec.	7.09	....

Zinc and lead ore prices at Joplin, Missouri, at the beginning of November were much lower than for the corresponding period of 1912. Zinc sulphide is bringing $38 to $42, basis of 60% metallic zinc, with choicer grades selling for as high as $45 per ton. Lead ore sells for only $52. Calamine realizes $21 to $22, basis of 40% metallic zinc, with choicer ores selling for as high as $26. For the corresponding week of 1912 zinc sulphide brought $54 to $58, basis of 60% metallic zinc, with choicer grades selling for as high as $61. Lead ore brought $65.50. Calamine brought $26 to $29, with choice grades bringing as high as $34. Spelter at East St. Louis dropped to $5.15 to $5.25 per 100 lb. at the beginning of November compared with $7.40 for the corresponding time of 1912. Pig lead dropped to $4.20 compared with $4.80 a year ago.

QUICKSILVER

The primary market for quicksilver is San Francisco, California, being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending			
Oct.	1 39.50	Oct. 15	39.00
"	8 39.50	" 22	39.00
		" 29	40.00

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	43.75	39.37	July	43.00	41.00
Feb.	46.00	41.00	Aug.	42.50	40.50
Mch.	46.00	40.20	Sept.	42.12	39.70
Apr.	42.25	41.00	Oct.	41.50	39.37
May	41.75	40.25	Nov.	41.50	....
June	41.30	41.00	Dec.	39.75	....

TIN

New York prices control in the American market for tin, since the metal is almost entirely imported. San Francisco quotations average about 5c. per lb. higher. Below are given average monthly New York quotations, in cents per pound:

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	42.53	50.45	July	44.25	40.70
Feb.	42.96	49.07	Aug.	45.80	41.75
Mch.	42.58	46.95	Sept.	43.64	42.45
Apr.	43.92	49.00	Oct.	50.01	40.61
May	46.95	49.10	Nov.	49.92	....
June	45.76	45.10	Dec.	49.80	....

Owing to the tariff changes, the Roessler & Hasslacher Chemical Co. of New York reports that the prices for potassium cyanide is 20c. per pound; sodium cyanide, 22c.; mixtures (39.5% cyanogen), 18c.; and oxalic acid from 8 to 7.5c. per pound.

The Stock Markets

SAN FRANCISCO STOCKS AND BONDS

(San Francisco Stock and Bond Exchange.)

BONDS

October 29.

Listed.	Bid	Ask	Unlisted.	Bid	Ask
Associated Oil 5s	$ 97½	99½	General Petroleum 6s	$54½	55
E. I. du Pont 4½s	83½	85½	Natomas Dev. 6s	99	—
Natomas Con. 6s	—	70	Pac. Port. Cement 6s	99½	—
Unlisted.			Standard Cement 4s	90	—
Ass. Oil 5s	78½	—	Santa Cruz Cement 6s	82½	—

STOCKS

Listed.	Bid	Ask	Unlisted.	Bid	Ask
Amalgamated Oil	77	—	Mascot Copper	—	2½
Associated Oil	38½	38¾	Noble Electric Steel	2½	—
Giant	—	90	Natomas Consol	5	10
Pac. Cst Borax, com	—	100	Pacific Port. Cement	63	75
Pacific Crude Oil	—	35c	Riverside Cement	45	—
Sterling O. & D.	75c	—	Santa Cruz Cement	—	46
Union Oil	55	—			

NEVADA STOCKS

(By courtesy of San Francisco Stock Exchange.)

San Francisco, October 30.

Atlanta	$ .12	Mizpah Extension	$ .33
Belcher	.25	Montana-Tonopah	1.05
Belmont	7.65	Nevada Hills	.70
Big Four	.20	North Star	.40
Cash Boy	.07	Ophir	.22
Florence	.20	Pittsburg Silver Peak	.36
Goldfield Con.	1.40	Round Mountain	.38
Goldfield Oro	.08	Sierra Nevada	.10
Halifax	1.32	Tonopah Extension	1.75
Jim Butler	.64	Tonopah Merger	.58
Jumbo Extension	.09	Tonopah of Nevada	4.75
MacNamara	.10	Union	.14
Mexican	1.37	West End	1.20
Midway	.39	Yellow Jacket	.30

COPPER SHARES—BOSTON

(By courtesy of J. C. Wilson, Mills Building.)

October 30.

	Bid	Ask		Bid	Ask
Adventure	$ 1½	1¾	Mohawk	$ 41	42
Allouez	34½	35	North Butte	24	24½
Calumet & Arizona	64	64½	Old Dominion	50	51
Calumet & Hecla	410	420	Osceola	80	81
Centennial	13½	14	Quincy	58½	60
Copper Range	37	37½	Shannon	6¾	7
East Butte	11½	12	Superior & Boston	2¾	3
Franklin	3½	3¾	Tamarack	28½	29½
Granby	70½	71	U. S. Smelting	38½	38¾
Greene Cananea	—	32½	Utah Con.	9½	9¾
Hancock	16	—	Victoria	1⅛	1½
Isle-Royale	18	18½	Winona	1¾	2
Mass Copper	2	2½	Wolverine	42	43½

NEW YORK CURB QUOTATIONS

(By courtesy of E. F. Hutton & Co., Kohl Building.)

October 30.

	Bid	Ask		Bid	Ask
Braden Copper	7	7¼	McKinley-Dar.	1⅝	1½
B. C. Copper	2⅜	2½	Mines Co. Am.	2	2¼
Davis-Daly	1⅝	1⅞	Nipissing	8⅜	8½
Dolores	2	4	Ohio Copper	½	⅝
El Rayo	1	2	San Toy	18	22
Ely Con.	5	6	Sioux Con.	1	2
First Nat.	2⅞	3½	So. Utah	⅛	¼
Greene Can.	6	7	S. O. Calif.	191	193
Giroux	1⅛	1½	Tri Bullion	⅛	¼
Hollinger	16¾	17½	Tuolumne	¾	1
Iron Blossom	1.05	1.15	United Copper	¼	¾
Kerr Lake	4	4⅛	Wettlaufer	8	10
La Rose	1¾	1⅞	Yukon Gold	2	2¼
Mason Valley	3¼	3¾			

NEW YORK STOCK EXCHANGE

(By courtesy of J. C. Wilson, Mills Building.)

October 30.

	Bid	Ask		Bid	Ask
Alaska G. M.	$ 22½	22¾	Miami	22½	22¾
Amalgamated	73¾	73⅞	Nat. Lead	44½	44¾
Anaconda	35½	35¾	Quicksilver, com.	2	2¾
A. S. & R.	63	63½	Ray Con.	18¾	18¾
Calif. Pet.	17½	18	Tenn. Copper	28½	29
Chino	39½	39¾	U. S. Steel, pfd.	106½	107
Guggenheim Ex.	44¾	45⅛	U. S. Steel, com.	56¾	57
Mexican Pet	63½	64¼	Utah Copper	52⅜	52½

LONDON QUOTATIONS

(By cable, through the courtesy of Catlin & Powell Co., New York.)

October 30.

	£	s.	d.		£	s.	d.
Alaska Mexican	1	17	6	Kern River Oilfields	0	6	3
Alaska Treadwell	8	2	6	Mexico Mines	5	7	6
Alaska United	3	13	3	Messina	1	7	6
Arizona	1	18	9	Oroville	0	7	6
California Amalg.	0	1	3	Pacific Oilfields	0	2	6
California Oilfields	6	0	0	Rio Tinto	78	0	0
Camp Bird	0	15	0	Santa Gertrudis	0	17	6
El Oro	0	15	0	Stratton's	0	2	6
Esperanza	0	17	6	Tanganyika	2	9	9
Granville	0	11	8	Tomboy	1	6	3

AUSTRALASIAN

October 30.

	£	s.	d.		£	s.	d.
British Broken Hill	1	17	6	Mount Boppy	0	10	9
Broken Hill Prop.	1	15	0	Mount Elliott	4	11	3
Golden Horse-Shoe	2	18	9	Mount Lyell	1	5	0
Great Boulder Prop.	0	12	6	Mount Morgan	3	10	0
Ivanhoe	3	18	9	Waihi	1	17	6
Kalgurli	1	19	0	Waihi Grand Junc.	1	5	0

Company Reports

DE BEERS CONSOLIDATED MINES, LTD.

This Company operates the well known De Beers, Kimberley, Wesselton, Bultfontein and Dutoitspan diamond mines at Kimberley, South Africa, and the report covers the year ended June 30, 1913. The capital of the Company is £4,500,000, in 800,000 preference and 1,000,000 deferred shares of £2 10s. each. The year's results may be best shown as follows:

Yield per load (1600 lb.) was worth $4.68, $3.32, $4.76, and $4.96 from the respective mines.

Sales of diamonds	£6,297,782
Other income	143,068
Balance brought forward	807,388
Mining expenditure	2,080,622
Depreciation	706,035
African taxation	426,465
Debenture interest and sinking fund	235,932
Profit	3,799,183
Deferred dividends paid	1,500,000
Bonus	250,000
Preference dividends	800,000
Added to reserve	140,060
Balance brought forward	513,521
Diamonds unsold	595,601
Stocks of 'blue ground' on floors, loads	10,803,054
Value of this ore reserve	£1,540,419
Investments at June 30, 1913	1,932,184

The directors of the Company report that the year's results were most satisfactory, which may be judged from the large figures in pounds sterling.

AMALGAMATED ZINC (DE BAVAY'S), LTD.

This Company operates a large flotation plant at Broken Hill, New South Wales, and buys tailing from the mining companies there. Work during the year ended June 31 may be shown as follows:

Tailing treated, tons	523,698
Zinc concentrate, tons	142,668
Lead concentrate, tons	1,841
Dividends paid during first half of 1913	$480,000
Carried forward	321,000
Reserves	792,000

GIANT MINES OF RHODESIA, LTD.

This Company operates in the Gadzema district of Mashonaland, Rhodesia, and the report covers the year ended June 30, 1913. Results are as follows:

Ore treated, tons	131,887
Bullion recovered	$864,000
Net profit	360,000
Dividends paid (partly out of balance from previous year)	370,000
Ore reserves, averaging $8.20 per ton, tons	243,687

Current Prices for Ores and Minerals

(Corrected monthly by Atkins, Kroll & Co.)

The prices are approximate, subject to fluctuation, and to variation according to quantity, quality, and delivery required. They are quoted, except as noted, f.o.b. San Francisco. Buying prices marked *.

	Min.	Max.
Antimony ore, 50%, ₱ ton	*$22.00	$25.00
Arsenic, white, refined, ₱ lb	0.02½	0.03¼
Arsenic, red, refined, ₱ lb	0.08	0.08½
Asbestos, chrysotile	100.00	350.00
Asbestos, amphibole	5.00	25.00
Asphaltum, refined, ₱ ton	11.50	20.00
Barium carbonate, precipitated, ₱ ton	40.00	45.00
Barium chloride, commercial, ₱ ton	40.00	42.50
Barium sulphate (barytes), prepared, ₱ ton	20.00	30.00
Bismuth ore, 15% ₱ ton	*250.00	upward
Chrome ore, according to quality, ₱ ton	10.00	12.50
China clay, English, levigated, ₱ ton	15.00	20.00
Cobalt metal, refined, f. o. b. London, ₱ lb	2.50	
Coke, foundry, ₱ 2240 lb	15.00	20.00
Diamonds:		
Ballas according to size and quality, ₱ carat	70.00	
Borts, according to size and quality, ₱ carat	2.00	15.00
Carbons, according to size and quality, ₱ carat	55.00	90.00
Feldspar, ₱ ton	5.00	25.00
Firebrick:		
Bauxite, ₱ M	175.00	
Magnesite, ₱ M	190.00	275.00
Silica, ₱ M	50.00	55.00
Flint pebbles for tube-mills, ₱ 2240 lb	19.50	22.50
Fluorspar, ₱ ton	10.00	15.00
Fullers earth, according to quality, ₱ ton	20.00	30.00
Gilsonite, ₱ ton	35.00	40.00
Graphite:		
Amorphous, ₱ lb	0.01½	0.02½
Crystalline, ₱ lb	0.04	0.13
Gypsum, ₱ ton	7.50	10.00
Infusorial earth, ₱ ton	10.00	15.00
Magnesite, crude, ₱ ton	5.00	7.50
Magnesite, dead calcined, ₱ ton	20.00	25.00
Magnesite, brick (see firebrick).		
Manganese ore, oxide, crude, ₱ ton	10.00	25.00
Manganese, prepared, according to quality, ₱ ton	30.00	70.00
Mica, according to size and quality, ₱ lb	0.05	0.30
Molybdenite, 95% MoS_2, ₱ ton	400.00	450.00
Monazite sand (5% thoria), ₱ ton	150.00	200.00
Nickel metal, refined, ₱ lb	0.45	0.60
Ochre, extra strength, levigated, ₱ 100 lb	2.00	2.50
Osmiridium, ₱ oz	50.00	65.00
Platinum, native, crude, ₱ oz	30.00	45.00
Silex lining for tube-mills ₱ 2240 lb	35.50	37.50
Sulphur, crude, ₱ ton	20.00	25.00
Sulphur, powdered, ₱ ton	30.00	35.00
Sulphur, 80%, ₱ ton	16.50	18.50
Talc, prepared, according to quality, ₱ ton	20.00	50.00
Tin ore, 60%, ₱ ton	500.00	550.00
Tungsten ore, 65%	425.00	450.00
Uranium ore, 10% min.	25.00	per unit
Vanadium ore, 15% V_2O_5, ₱ ton	150.00	180.00
Wolframite (see tungsten ore).		
Zinc ore, 50% up, ₱ ton	*15.00	20.00

Current Prices for Chemicals

(Corrected monthly by Braun-Knecht-Heimann Co.)

Prices quoted are for ordinary quantities in packages as specified. For round lots lower prices may be expected, while in smaller quantities advanced prices are ordinarily charged. Prices named are subject to fluctuation. Other conditions govern Mexican and foreign business.

	Min.	Max.
Acid, sulphuric, com'l, 66°, drums, ₱ 100 lb	$0.75	$1.00
Acid, sulphuric, com'l, 66°, carboy, ₱ 100 lb	1.00	1.50
Acid, sulphuric, C. P., 9-lb. bottle, bbl., ₱ lb	0.13	0.18
Acid, sulphuric, C. P., bulk, carboy, ₱ lb	0.09½	0.12
Acid, muriatic, com'l, carboy, ₱ 100 lb	1.60	3.00
Acid, muriatic, C. P., 6-lb. bottle, bbl., ₱ lb	0.15	0.20
Acid, muriatic, C. P., bulk, carboy, ₱ lb	0.10½	0.15
Acid, nitric, com'l, carboy, ₱ 100 lb	6.00	6.50
Acid, nitric, C. P., 7-lb. bottle, bbl., ₱ lb	0.16	0.22
Acid, nitric, C. P., bulk, carboy, ₱ lb.*	0.12½	0.15
Argols, ground, bbl., ₱ lb	0.10	0.20
Borax, cryst. and conc., bags, ₱ 100 lb	3.00	4.35
Borax, powdered, bbl., ₱ 100 lb	3.38	4.50
Borax glass, gd. 30 mesh, cases, tin lined, ₱ 100 lb	10.50	13.50
Bone ash, 60 to 80 mesh, bbl., ₱ 100 lb	5.50	6.50
Bromine, 1-lb. bottle, ₱ lb	0.55	0.65
Candles, adamantine, 14 oz., 40 sets, ₱ case	4.60	4.80
Candles, adamantine, 14 oz., 60 sets, ₱ case	5.25	5.45
Candles, Stearic, 14 oz., 40 sets, ₱ case	5.00	5.20
Candles, Stearic, 14 oz., 60 sets, ₱ case	5.70	5.90
Clay, domestic fire, sack, ₱ 100 lb	1.50	2.00
Cyanide, 98 to 100%, 100-lb. case, ₱ lb	0.18	0.22
Cyanide, 98 to 100%, 200-lb. case, ₱ lb	0.17½	0.21
Cyanide, 128%, 100-lb. case, ₱ lb	0.21½	0.24½
Cyanide, 128%, 200-lb. case, ₱ lb	0.21	0.24
Lead acetate, brown, broken casks, ₱ 100 lb	9.00	10.50
Lead acetate, white, broken casks, ₱ 100 lb	10.50	10.75
Lead acetate, white, crystals, ₱ 100 lb	12.50	13.25
Lead, C. P., test., gran., ₱ 100 lb	13.00	15.00
Lead, C. P., sheet, ₱ 100 lb	15.00	18.00
Litharge, C. P., silver free, ₱ 100 lb	11.50	13.50
Litharge, com'l, ₱ 100 lb	8.00	9.50
Manganese ox., blk., dom. in bags, ₱ ton	20.00	25.00
Manganese ox., blk., Caucasian, in casks, ₱ ton (85% MnO_2—4% Fe)	36.00	47.00
Nitre, double ref'd, small cryst., bbl., ₱ 100 lb	7.00	8.00
Nitre, double ref'd, granular, bbl., ₱ 100 lb	6.50	7.50
Nitre, double ref'd, powdered, bbl., ₱ 100 lb	7.25	8.00
Potassium bicarbonate, cryst., ₱ 100 lb	12.00	15.00
Potassium carbonate, calcined, ₱ 100 lb	7.50	9.00
Potassium permanganate, drum, ₱ lb	0.10½	0.13
Silica, powdered, bags, ₱ lb	0.03	0.05
Soda, carbonate (ash), bbl., ₱ 100 lb	1.50	1.75
Soda, bicarbonate, bbl., ₱ 100 lb	2.25	2.75
Soda, caustic, ground, 98%, bbl., ₱ 100 lb	3.15	3.50
Soda, caustic, solid, 98%, drums, ₱ 100 lb	2.65	2.85
Zinc shavings, 850 fine, bbl., ₱ 100 lb	12.00	13.00
Zinc sheet, No. 9—18 by 84, drum, ₱ 100 lb	10.20	11.00

*Extra charge for packing nitric acid for shipment to conform to regulations.

Production Statistics

IRON AND STEEL

A report on the production of iron ore, pig iron, and steel, by Ernest F. Burchard, of the U. S. Geological Survey, includes statistics of production showing a highly prosperous condition in the iron and steel industries for the year, the total output of iron ore being valued at $107,050,153, an increase of $20,000,000 over 1911.

NATURAL GAS

The year was one of greatest prosperity to the natural-gas producer and a record breaker for output, according to B. Hill of the U. S. Geological Survey. The total estimated consumption of natural gas in the United States in 1912 was 562,203,452,000 cu. ft., valued at $84,563,957, an average price of 15.04c. per 1000 cu. ft., compared with 512,993,021,000 cu. ft., valued at $74,621,534, an average price of 14.55c., in 1911. The number of domestic consumers supplied with gas in the United States in 1912 was 1,621,557, and the value of gas consumed for domestic purposes amounted to $50,960,883, while the number of industrial consumers was 15,936 and the value of gas consumed for industrial purposes was $33,603,074. On the assumption that 28,000 cu. ft. of gas equals in heating power one ton of coal, the fuel displaced by gas consumed in 1912 was equivalent to approximately 20,000,000 tons of coal. West Virginia was the greatest producer of natural gas in 1912, the figures being 215,785,027,000 cu. ft., valued at $29,064,968.

COPPER ORES IN 1912

The following table, from a U. S. Geological Survey bulletin, shows how the ores in the various states were treated during the past year, in short tons:

State.	Ore concentrated.	Ore smelted.
Alaska	.....	93,452
Arizona	4,435,225	2,106,929
California	.....	408,622
Colorado	.....	13,718
Idaho	16,141	82,707
Michigan	11,411,941	.....
Montana	4,341,051	753,381
Nevada	2,986,087	290,082
New Mexico	1,121,575	74,108
North Carolina and Oregon	.....	5,069
Pennsylvania and Maryland	224,200	1,000
Tennessee and Texas	.....	603,251
Utah	6,098,491	572,354
Virginia and Wyoming	.....	1,315
Washington	7,685	8,030
Total	30,642,396	5,014,018

Concentrates

Most of these are in reply to questions received by mail. Our readers are invited to ask questions and give information dealing with the practice of mining, milling, and smelting.

COST of handling slag at the Grand Forks smelter, British Columbia, averaged 5½c. per ton of ore during the past fiscal year.

GLASS AND PORCELAIN NOZZLES for cone-classifier discharge have been introduced at various mills, and have been found to give a longer life than metal bushings.

THE Victoria Falls, on the Zambesi river, have a height of from 265 to 343 ft., and a width of over 1500 ft. So far no effort has been made to make use of any portion of the available power.

A CATERPILLAR TRACTOR of 25 to 65-ton capacity has been ordered to haul ore from the Tyler lease above Wardner, Idaho, to the Bunker Hill & Sullivan mills. The engine will be driven by gasoline and will haul four trailers. The round trip will take about 2½ hours.

THIRTY-TWO MINERS were killed out of 13,813 employed at 17 different copper mines in Michigan during the year ended September 30, according to the report of Thomas H. James, inspector of mines. About 32% of the casualties were among the Austrians employed.

DEVELOPMENT WORK at the Phoenix mines of the Granby Consolidated company covered 11,517 ft. and 14,996 ft. of diamond-drilling, the totals to date being 107,848 and 76,141 ft., respectively. The average cost per ton of ore, crushed, on cars, including development, was 75.4 cents.

WHERE WATER IS SCARCE the minimum of loss from a wet-crushing treatment plant is attained by the use of hand discharging frame filter presses, in which the moisture may be reduced as low as 15 per cent. The excessive use of compressed air for the purpose of reducing moisture in the residue is, however, a doubtful economy since the last few percentages of moisture expelled from the cake are not recoverable.

BAFFLES used in connection with the settlement of slime are mainly for the purpose of breaking up surface currents. There are two zones in any dewatering device not dependent on vacuum or pressure for their operation, which may be termed the settling zone and thickening zone respectively. Baffles should not be placed below the thickening zone; and, where maximum dewatering is being aimed at, it is preferable that no baffle should extend for more than a few inches below the surface of the pulp.

THE APPEARANCE OF HYDROGEN BUBBLES is often taken as an indication of good working in a zinc-box. The hydrogen is evolved as a result of the action of the free cyanide present on the zinc; and is necessary to complete the reaction involved in connection with the separation of the gold and silver from the solution. The appearance of the hydrogen is an indication that there is more than enough to complete the reaction. On the other hand, an extractor-box having a 'dead' appearance may not necessarily be working badly, since it is possible that the necessary amount of hydrogen is being absorbed as soon as formed.

QUICKSILVER is used for many well known purposes, but an interesting and increasing use in Scotland is the floating of the lights of lighthouses upon a body of quicksilver. The metal is not consumed, of course, and the loss in use is insignificant. The commissioners of northern lighthouses, Edinburgh, have in their charge 90 lighthouses on the coast of Scotland. Up to the year 1900 the revolving lights were borne on rollers. The 'float' system has been gradually introduced, however, and is now in operation at 30 coast stations and will be used at all others. The lighting machinery rests on a pontoon which runs on quicksilver in a groove. The quantity of mercury required for this purpose in a lighthouse is from 7 to 8 flasks of 75 lb. each. As the waste is trifling, the total present demand for this purpose is small.

AN ESTIMATION of the amount of gold in a specimen stone may be made with considerable accuracy when the actual specific gravity of both quartz and gold is known. If g_1 represents the specific gravity of the specimen, g_2 the specific gravity of the gold, and g_3 the specific gravity of the quartz, then:

$$\frac{100g_2(g_1 - g_3)}{g_1(g_2 - g_3)} = \% \text{ of gold in specimen.}$$

An approximation can be made by taking the specific gravity of the gold at 19, and that of the quartz at 2.6.

ANALYSES of the orebodies at the Granby Consolidated company's mines at Anyox, British Columbia, are as follows: The two orebodies differ in their analyses. The No. 1 orebody being higher in iron, sulphur, and lime content, while No. 2 is higher in silica, alumina, and magnesium. The table below gives the average analyses of the two orebodies:

	Orebody No. 1, %.	Orebody No. 2, %.	Orebody No. 1 and 2, %.
Silica	21.4	30.3	26.4
Iron	29.2	25.7	27.6
Lime	5.0	3.3	4.0
Sulphur	30.0	17.8	24.3
Alumina	5.6	10.6	8.3
Magnesium	1.3	4.1	2.4

THE LAST REPORT of the Central Mining & Investment Co. shows that the surface operating costs of the mines of the group have been reduced during the year, and the saving in this respect has been the most marked during the last few months of the year. The average operating costs for 1911 were 4.43s. per ton milled, and the gold recovered was 95% of the estimated content of the ore treated. The average operating costs for 1912 were 4.18s. per ton milled, and the gold recovered was 95.6% of the estimated content of the ore treated. The ratio of tube-mills to stamps has been the subject of further inquiry, and while it is not possible to establish a standard applicable to each individual mine, owing to the varying characteristics of the ore throughout the district, it is of interest to note that, as an average for the group, it is now estimated that the most economical crushing is obtained by employing a ratio of 30 to 40 of the present type of stamps per tube-mill, with mill screens of 10 to 14 I.M.M. Standard (100 to 200 holes per square inch).

ELECTROSTATIC SEPARATION of ores by the Huff method is increasing, and besides the treatment of zinc ores other fields are being entered, such as concentrating crude silver ores at Austin, Nevada; molydenite from its gangue in Australia; to reconcentrate concentrate at Cobalt, Ontario; removing mica from graphite flake. The Canadian Bureau of Mines has installed a complete plant in its testing laboratory at Ottawa. A typical mill flow-sheet for an electrostatic plant using the Huff process consists of a cylindrical dryer, about 4 feet by 20 feet, made of sheet iron; bucket elevator to the top of the mill, carrying the dried ore to the screens. In some cases only a scrap screen is needed if the sizing required is 20 to 50 and through 50 mesh. If the various minerals will break mechanically free above 20 mesh, one or two coarse screens are necessary as 6 to 12, 12 to 20 mesh. Then the ore is taken to the separators, through which it falls by gravity, the conductors and non-conductors as separated passing directly to storage bins. Returning a small amount of middlings from each separator back into the system is beneficial in increasing the tonnage and making cleaner products. These middlings finally pass out of the system in the finished products, according to Frank S. Macgregor. The power required is small, a 3-hp. generating outfit being sufficient to electrify a plant of from one to fifty separators. The machinery of one plant is operated on 12 actual hp., which includes power for the dryer, elevator, screens, and six separators. One attendant will care for a shift, exclusive of handling ore.

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EDITORIAL

STATISTICS of Canada's mineral production for 1912, recently announced, prove highly satisfactory. These figures have been collected since 1886 and since that time the per capita output has increased from $2.23 to $18.27.

ACCORDING to a recent press bulletin of the United States Geological Survey, the output of manganese alloys, ferromanganese, and spiegeleisen from American mines during the past year was 227,939 long tons. May we ask why the output of the brass mines has not been reported?

LOS ANGELES has been celebrating this week the completion of the great aqueduct which is to bring water from the mountains to the city. And well may the City of the Angels rejoice, for not only has a work been accomplished that will make greatly for the city's material welfare, but a great public work has been built with such honesty and efficiency as warrants renewed faith in democracy. To Mr. William Mulholland, Mr. J. B. Lippincott, and the other engineers of the staff, we offer our especial congratulations.

USE of copper to improve the quality of iron and steel is not the right line of progress, according to Mr. A. S. Cushman, who argues, in a recent bulletin of the Bureau of Industrial Research at Washington, that such procedure is simply an attempt to overcome the bad effects of the usual impurities in steel by adding an additional one. Mr. Cushman is convinced that improving the quality of iron and steel by improving its purity is the proper method of progress. Apparently the hopes of those who anticipated a new market for copper are doomed to disappointment.

OBSERVATIONS of a tourist are proverbially rated low, but, after all, their value depends upon who the tourist is and what mental attitude and how much experience he brings to his task. The informed sympathetic comment of an expert, be he ever so transient a visitor, is worth careful reading, and it is such comment that we present this week in the translation by Mr. Herbert Haas of the address delivered at Aachen last July by Mr. Ferdinan Heberlein, the accomplished Frankfort metallurgist. His comparisons of American and European practice, and his frank admission of the superiority of what he saw in the United States in certain industries, gives all the more point to his criticism in other matters where we do less well. Americans worship the big, but it is worth remembering that quality as well as quantity is important.

IMPORTANT amendments to the laws governing placer mining in the Yukon are proposed, and Mr. Alfred Thompson, member of parliament, and Mr. George P. Mackenzie, gold commissioner, have been holding conferences with miners to obtain their views.

CRITICISM is easy when directed only to finding fault, but to point a way to the correcting of evils is more difficult. In the article on resoiling after dredging, Mr. G. L. Hurst contributes a few concrete facts that warrant attention. He does not claim that the method described can be applied in every instance, but he does show that it is workable in some. If it were applied as far as possible, that would help mightily to still the criticism of the farmers and conservationists.

NOME is far from downcast at the destruction caused by the recent storm, if one may judge from the appearance of the *Nome Weekly Nugget*. Money rather than supplies is needed. Many men will be brought out on the *Bear* and other steamers, and the smaller number to feed will render the stocks sufficient, but with one-third to one-half the assessed valuation of the city gone, schools must be closed unless assistance be forthcoming, and many will have no money with which to buy unless work can be furnished.

IRIDOSMINE is one of the rare metals concerning which so little is known that every note of its occurrence becomes important. In Mr. C. B. Horwood's article of this week will be found some notes on its presence in the Rand bankets. Fuller details were given by Mr. Horwood in a paper read before the Geological Society of South Africa in May of last year and published in volume XV of the *Transactions* of that lively society. We printed a brief abstract of this, taken from *Chemical News*, in our issue of September 27 last.

STRAIGHT thinking on industrial and political topics is sufficiently rare to warrant notice, and we commend to our readers the address delivered before the American Mining Congress by Mr. C. R. Van Hise, the militant geologist who is president of the University of Wisconsin. He is right when he says that it is profoundly immoral when the law officers of the government must prosecute one set of offenders against anti-trust laws and shut their eyes to the offenses of others. Recognition of the facts of the situation is the first requisitum to the finding of a remedy.

AFTER successfully combating the yellow fever and malaria in Panama, Col. William C. Gorgas has been called to the Transvaal to conduct an investigation of the diseases peculiar to the mining industry of that region and to devise, if possible, some remedy for those conditions which have been responsible for the high death-rate among the miners on the Rand. While the mosquito has no part in pneumonia or phthisis, it is to be hoped that the cause of these dreaded diseases may be eradicated, and we know of no one more eminently fitted for this humanitarian undertaking than Colonel Gorgas.

Immigrants and Mines

In the first of what promises to be a most interesting series of articles on 'The Old World in the New', Mr. Edward Alsworth Ross writes in the November *Century* of the effect upon industrial and social conditions in the United States produced by the rapid influx of untrained laborers from eastern Europe and western Asia. He points out that this is a movement that is artificially stimulated; that the steamship companies, largely foreign owned, have been engaged in a great hunt for emigrants for the sake of the passage money; and he estimates that in 1908 and 1909 the money paid to these companies and to the railroads by incoming and outgoing emigrants amounted to $75,000,000. He believes that manufacturing in this country has been overstimulated at the expense of American laboring men. Without denying that there is much to be said from that point of view, and without attempting to settle off hand the problems of immigration in this country, we doubt the correctness of Mr. Ross' deductions, at least as regards mining.

The "hejira of the English-speaking soft-coal miners" is cited "as showing what must happen when low-standard men undercut high-standard men." According to Mr. Ross, the miners of Pennsylvania and West Virginia, "finding their unions wrecked and their lot growing worse under the floods of men from southern and eastern Europe, migrated in great numbers to the Middle West and the Southwest. But of late the coalfields of the Middle West have been invaded by multitudes of Italians, Croatians, Poles, and Lithuanians, so that even here American and Americanized miners have their backs to the wall." These "displaced trade-unionists" are said to have gone on "to make their last stand in the mines of New Mexico and Colorado." As a matter of fact, the coal miners never were organized in West Virginia until recently, and the United Mine Workers is dominant in Pennsylvania today, despite the influx of Slavs.

In another place he relates an instance of how American miners, earning $2.75 per day, in one of the copper mines of the Southwest, were abruptly displaced by a trainload of raw emigrants at $1.50 to $2 per day, while for the Americans there was nothing to do but to "go down the road." The "Iliad of the woes of these displaced workmen," he says, "has never been sung," and by implication the pioneer American miner has become a "hobo." We strongly dissent from this conclusion, and we believe that if Mr. Ross will follow some of those men "down the road," he will quickly learn that their fate has not been so hard as he evidently thinks.

It is entirely true, as implied, that twenty years ago the coal mines of the Middle West were manned almost exclusively by English-speaking miners. It is also true that the majority of the men now in these mines are recent emigrants of the type Mr. Ross describes. It is to be remembered, though, that the output and the total number of men employed has, roughly, been doubled. In 1900, to take the year Mr. Ross has used, Indiana produced 6,484,-

000 tons; Illinois, 25,767,981; Iowa, 5,202,939. In 1911 the corresponding outputs were 14,201,355 tons, 53,679,118, and 7,331,684. The output per man has not changed greatly, and nearly 40,000 new men have been needed in the Illinois mines alone. This is but illustrative of what has taken place in all branches of mining and metallurgy. Mr. Ross says that "if the supply of raw Slavs were cut off, the standard and status of the laborers would rise, and the Americans would come into the industry." From where would they come? And from where would the extra men needed in the last ten years have come if there had been no emigrants? Picture the result in almost any community of excluding the new workmen of the last ten years. It is true that in the coal-mining towns the visitor sees squalor and misery. Bituminous coal-mining in many states is necessarily a seasonal industry. The mines are idle 100 to 200 days in the year. This idle time comes in the summer when less coal is burned, for it must be remembered that much of our coal will not stand storage. The American and English-speaking miner of earlier times used these summer days for cultivating gardens or for farm work. Many a one graduated into a small landed proprietor. The Slav finds his income from a half year's work so much larger than that to which he has been accustomed, and the new freedom so alluring, that he idles away the summer days. Hence the misery and the low standard of living; but his children will not be content with that, for children are keenly sensitive to the comment of their school-fellows.

It is not true, so far as our experience goes, that the English-speaking, and presumably more competent, miner has been injured by the influx of the foreigners. The large number of men employed has made room for more bosses, especially since the untrained laborers require more supervision than did the old style workman. The introduction of machinery has made places for others. Still others have it is true "gone West," but we who live in the West do not look upon that as any terrible fate, and the old miners that we know in the West are doing fairly well. The men who have drifted out of mining are working at something at which they make more money—witness the Irish saloonkeepers at La Salle, Illinois—or are working under conditions of greater personal independence. Many an active lessee in Western gold mines is a former coal miner, and many a well-fixed Iowa farmer once dug coal. A large number of the displaced iron miners of Minnesota, of whom Mr. Ross speaks, will be found comfortable and happy in the copper mines of the Southwest to which they were attracted, not forced, by the good pay, better climate, and the lure of the unknown.

It will be remembered that twenty years ago western Missouri and eastern Kansas were dotted with small zinc smelters. These were largely manned with English-speaking workmen. When natural gas was found and larger plants were built, these men formed the nuclei of each force and additional workmen were found locally. A few years ago, as the gas pressure fell, these plants began to close and new coal-fired furnaces were built in Illinois. A man trained in zinc metallurgy is a valuable workman, a fact thoroughly appreciated by the managers of these enterprises, and large inducements were offered to the old men to go with the technical staffs to the new field. In a specific case that we have in mind comfortable houses were built within street-car distance of an excellent city, and practically the whole force was moved over from Kansas. In less than two years nearly all of the men had drifted back to their old home, where they had friends, connections, and other interests. There was no dispute as to wages, but the bulk of the men owned some little property in Kansas, and besides, as the Irish washer-lady said, "I'd ruther do as I'd ruther." The manager of the zinc plant could not get new men from the Illinois farms for the reason that land in central Illinois earns interest on $200 to $400 per acre. As a result, that plant is now run with Slav labor, and the manager had to give up use of the top row of retorts because the strong, heavy Slav cannot fire them properly, though the lighter American had done so for years. We believe this is a fairly typical case of "displacement" of American labor, and we see in it nothing to discourage the American. Just at present times are dull in mining, as occasionally happens. Men are out of work at many places, but if there is any great reserve into which a mine manager can "dip at will," we do not know of it. Under normal conditions the miners who are persistently out of work are those who have personal characteristics which militate against their holding jobs, or are reputed ore-thieves. In mining, low-priced men are not substituted for high-priced ones to any large extent, because the world-wide experience of American mining engineers has proved that, with rare exceptions, the substitution results in trouble rather than economy. The same engineer often has charge of mines in a half dozen countries or districts and under as many different wage scales, and it takes but the study of a few company reports to show that the cost per ton is not measured by day's wage. Any experienced mine manager would rather have a force of 8-hour, $3 men, than of 10-hour, $2 men, provided the men put their minds on their work as is the happy characteristic of the American working man. Immigration causes problems serious enough in all conscience, but the "displaced" American miner is not asking sympathy.

The Rand Banket

By T. A. Rickard

In presenting these articles the editor has found one technical difficulty: that of terminology. As is generally known, the pioneers of the Witwatersrand adopted several Australian terms and called their lodes 'reefs.' Finding a type of ore with which previously they were unfamiliar, they borrowed a Dutch word, and called it 'banket.' Further, being more eager to make money than to preserve the English language, they spoke of their workings as 'drives,' not drifts; they sought 'high values,' meaning ore having a high assay-value; they delved in search of 'good gold,' not doubting that all gold was good, but desiring gold in goodly proportion. Even educated engineers borrowed the language of

trammers and timber-men, so that ore was described as 'payable,' instead of profitable; waste became 'mullock;' shale was loosely labeled 'slate;' and the locality itself became "these fields."

'Banket' is a genuine addition to the English language. It is the word used by the Dutch for almond cake; it is significant and full of local color. A 'banket' stands for a conglomerate containing sufficient gold, or any other valuable metal, to be exploited as an ore deposit. 'Banket' in its etymology harks back to the Dutch domination of the Transvaal, and to the great series of gold-bearing conglomerates or almond-rocks associated with the modern mining development of South Africa. It is convenient to use 'conglomerate' in petrography, and 'banket' in economic geology. Every banket must be a conglomerate, but not many conglomerates are bankets. By giving precision of meaning to words, and by setting aside special words for special duties, we gain accuracy of expression.

Another useful South African addition to technical English is 'deep-level.' The first properties developed from the surface were known as 'outcrop' mines; these had no extralateral rights, and were estopped from trespassing beyond their side-lines projected vertically downward. The next mine on the dip of the lode became known as the 'deep-level' mine or 'deep' of the corresponding outcrop property; thus the Ferreira Deep exploits the ore beyond and below the limits of the Ferreira. In the same way the Tamarack, in the Lake Superior copper region, is the 'deep' or 'deep-level' of the Calumet & Hecla. On the other hand, the habit of writers on Rand geology to use such terms as 'reefs,' 'reef-matter,' 'values,' and the like, tends to obscure the basic economic feature, namely, that the conglomerate is 'ore.' We have read articles on the Witwatersrand in which the words 'ore' and 'lode' were absent to such a degree as to warrant the reader in forgetting, or failing to apprehend, that the deposits under discussion were the object of profitable industry. The word 'reef' was introduced into mining by the sailors and stewards who left their ships to participate in the rush to Ballarat and Bendigo in 1851. To them a rock projecting above the water was a reef, and when they saw outcrops of quartz they likened them to one of the perils of navigation. However descriptive the term may be when applied to an orebody emerging above the plain, it is wholly a misnomer for lodes that have no outcrop and for orebodies found far below the surface. Any significance that 'reef' may have in mining is entirely lost when applied to ore discovered or intersected far from sunlight, especially when, as in Rhodesia, it may be a mass either lenticular or without definable shape. Fortunately, it is a local term peculiar to Australia and South Africa. In other equally important mining regions it is not legal tender, but one of the many spurious verbal coinages of illiteracy. Nor is it required. We have 'lode' and 'vein.' Indeed, the use of 'reef' has tended to obscure the fact that the ore deposits of the Witwatersrand or 'white waters range' are not unique, except in their persistence. Beds of conglomerate containing gold have been found elsewhere in many regions. Gold is found enriching rocks of every kind, both crystalline and clastic. The deposits exploited in the environs of Johannesburg are lodes as much as, and no less than, those of other celebrated mining districts. A 'lode' is a deposit having such continuity of structure as will lead a miner to the discovery of ore. The word comes from the Anglo-Saxon word *lad*, from *lithan*, to go, and is related to *leadan*, to lead, another derivative from *lithan*. 'Vein' may not fitly describe the bed of conglomerate, because it is not typically a ramifying fracture or fissure filled or followed by ore, but a seam of banket is certainly more nearly a bedded vein than a 'reef,' in so far as these terms have any precise meaning. 'Drive' is an error when used as a synonym for 'drift.' The miner drives his working, which results in a 'drift.' 'Mullock' is a wretched Australian vulgarism that only obscures meaning. It stands for waste rock, the reject from ore. When the Australian sailors and shepherds introduced 'good gold,' 'poor gold,' 'rich gold,' and so forth, to express the relative richness of their ore, they garbled their speech. No need arises for educated men to adopt such illiteracies. Thus also 'values,' with 'high' and 'low values,' was originally an abbreviation for ore valuable by reason of its metallic contents. As now used it is only a misleading colloquialism. To seek values in a mine is comparable to the pursuit of a quadratic equation in an automobile. Whatever excuse there may be for carelessless in casual talk, there is none for the introduction and use of such phrases in scientific writing. Again we say that accuracy of thought is fostered by precision in the use of the vehicle of thought, namely, language, whereby we transfer ideas from one to the other.

'Shale' and 'slate' are different rocks. No educated engineer should use one term for the other. A 'shale' is fissile along its lamination, which is its line of original deposit. A 'slate' is fissile along lines independent of the stratification and usually at a high angle with it. 'Payable' is a mere vulgarism. Ore does not 'pay' nor is it able to pay; it yields a profit; it is profitable. Even if we overlook the use of an intransitive verb as if it were transitive, it remains a fact that ore that only 'pays,' that is, meets the expense of exploitation, has no economic worth. To have that it must yield a profit; it must be profitable. As for 'fields,' this also is scarcely worthy of castigation. It is bucolic. As an abbreviation from goldfields, it exemplifies the hankering for an inexpressive plural, the squandering of a useful inflection, and the popular fancy for the abstract as against the concrete. These matters of terminology seem petty, but they are not. Apart from the clarification of thought by the filtering of language, it is worthy of remembrance that the English language is the common heritage not of the Briton, the American, the Australian, or the Africander, each and severally, but of the 400 millions of English-speaking peoples on both sides of the equator and in both hemispheres. All of us share a priceless inheritance, our common literature, and it should be our aim not to curtail the usefulness of it, especially in technical science, by the employment of terms half understood locally and misunderstood everywhere else.

An Excursion to North American Smelting Works

By Ferdinand Heberlein

*In connection with my visit to the eighth International Congress of Applied Chemistry held in Washington and New York, I made a trip through the most important metallurgical districts of the United States of America and Mexico. I therefore shall gladly comply with your request to tell my German colleagues of my traveling impressions. With the limited time placed at my disposal today, a detailed description of operations of the processes and apparatus used will be precluded. You are very likely fully acquainted with these from the literature of the subject. I will therefore restrict my remarks, by calling attention to those particulars of practice in the works of the Western Hemisphere that most impress metallurgists familiar with European conditions. The general, as well as the mining and metallurgical conditions in particular, are so radically different in the two hemispheres, that the development of the smelting industry as well as the requirements demanded abroad in the solution of certain problems, show a decided departure from our practice. America's metallurgical industry is hardly fifty years old, and, compared with the centuries old European metallurgical and mining industries, is just at the beginning of its development.

Conditions in the Eastern States

In the Eastern states the general conditions resemble or rather remind us vividly of Europe. The density of population and wage conditions related therewith, and the existence of large chemical and mechanical industries are very much the same. These as producers and consumers in the metallurgical industries play an important part, but even in the East, wages as well as the cost of living are appreciably higher, and the price of coal lower, than with us. For instance, at Pittsburgh, iron works can buy excellent coal for 3 to 4 mk. (0.75 to $1) per ton, and can therefore easily make coke for about 8 mk. per ton. Workmen earn per shift 12 to 16 mk. ($3 to $4). Whereas here in Europe, feeding of our smelting works depends to a great extent on the working of relatively small ore deposits and on the receipt of smelting products from remote parts of the world, in America we have to deal primarily with immense ore deposits which have commensurably extensive mine surface plants and reduction works. The American mine and metallurgical industries are controlled by companies which command very large capital, have excellent organization, and show a commendable business aggressiveness. That smaller enterprises are taken advantage of and hurt in business by these giant concerns is natural and may now and then have been the case, but on the other hand it must be admitted that without the resources of these powerful companies many a mine and smelter could not be operated or worked with commercial success. I also gained the impression that even the most powerful companies, if for no other reason than not to violate the anti-trust laws, let the small ones live and recognize their right to existence. For the progress of the science of mining and metallurgy, healthy competition can only be welcome.

Smelter By-products

Excepting those in the Eastern states, the smelting works are remote from centres of chemical trade and consumption. It is thus naturally brought about that certain principal constituents of ore and by-products cannot be utilized now as in Europe. For instance, the utilization of enormous quantities of sulphur from the sulphides in the ore cannot be thought of in many cases, notwithstanding the fact that the quantities of sulphurous acid gases escaping into the air are in places enormous. On my trips I visited works in which so much sulphur in the form of sulphur dioxide went into the air that 1000 tons of sulphuric acid could have easily been produced per day. The escape of these large quantities of SO_2 gases can, however, not be avoided unless the mining and smelting operations are suspended. As in those districts the mining industry by far outweighs in importance all other industries, it has the first right to free development and operation. After the mines have once been exhausted the land will undoubtedly be made available again for agricultural purposes. Naturally, even in such works not only the operators but also the inhabitants have to be protected from damage of the sulphur dioxide gas. In smelting works which have been adapted to acid manufacture, as at Ducktown, Tennessee, the sulphur is retained and utilized. In these works 550 tons 60°B. sulphuric acid is made daily from the gases of the (copper) pyrite blast-furnaces which is used with such great commercial success in the preparation of superphosphate (acid phosphate) that the above named works are said to produce copper indirectly at the lowest cost. What I have said regarding the extensive non-use of the sulphur applies also to other material such as low-grade arsenious ore, and to zinc and other ores which cannot stand high freight charges. While therefore, we cannot criticize the prevalent but justified non-utilization of the sulphur and of other materials, there still exists in other operations, as for instance in the coking of coals, great wastes through non-recovery and non-utilization of the by-products. During the excursion of the members of the eighth International Congress on Monongahela river near Pittsburgh, the leader called our attention to the fact that the steamer had just passed 2500 beehive coke ovens and that not only the gases but even a portion of the carbon is lost in the coking process. Of late, however, modern coke oven installations are being rapidly adopted in the United States, principally the Otto, Koppers, and Solvay types. I was very much surprised to find that large copper and lead smelting works which treat daily several thousand tons of ore and therefore have a daily coke consumption of more than 200

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tons, have not yet started to erect their coking plants at the smelting works. Even if the benzol, ammonia, etc., were not recovered, the utilization of the gas and tar would at any rate permit of cheap production of steam power.

While many smelters are situated at the mines, those which entirely or at least partly depend on custom ore are built at the junction of a number of railroad systems. This is not only done to facilitate the shipment of ores but to secure better freight rates from competing railroad companies which here are not government owned. On long hauls these companies make lower rates than on short ones so that, for instance, a smelter in Missouri is able to compete with works in Colorado, in securing ore from Montana, as far as freight costs are concerned. Conspicuous to us Europeans is the extremely limited use of waterways for the transportation of ore in bulk and coal. This is particularly due to fluctuating water and bad shipping conditions on even the largest rivers, as the Mississippi, Ohio, and Missouri, and partly to the action of the powerful railroad companies. These are interested in preventing the development of the cheap water transportation. In the matter of water transportation, we Europeans are no doubt far ahead of Americans.

Tonnage of Ore Handled

The quantities of ore which are handled in American lead and copper smelting works are materially greater than those in European works. The smallest lead smelter which I inspected still puts through very much more ore than the largest European smelter of which I know. The treatment of such vast quantities of material has forced the American metallurgical engineers to give to the conveying and handling of materials as much consideration as to the metallurgical part of the work itself. For this reason there are generally built very complete installations for cheap conveying, loading, crushing, and transporting of the ore and fluxes. The railroad cars have the usual loading capacity of 50 tons. The upper part of these cars is made of sheet steel and nearly all have automatic unloading arrangements. For the transportation of materials in and around the works electric locomotives, large traveling cranes, and particularly belt conveyors and similar contrivances are extensively employed. In this respect we can learn a great deal from the Americans.

Methods of Handling Molten Material

Fluid materials such as slag, matte, molten lead, and copper are stored in various sizes of receptacles in the form of ladles or slag pots and are transported by rapidly moving locomotives or traveling cranes. The size of ladles for copper matte are of course, adapted to the capacity of the converters, but frequently they hold 30 tons, and slag pots 5 to 10 tons. In one of the works we even saw one of 30 tons capacity, but the gentlemen operating this plant themselves thought this was somewhat too large. The slag pots are usually emptied by piercing the slag hole, which is about 25 cm. (10 in.) above the bottom of the pot, from the inside through the slag and not from the outside. The slag shells, with that matte which has accumulated at the deepest point, are re-smelted, whereas the fluid slag flows over the slag dump. In places both the slag and matte are granulated by water and sluiced by it to their respective destinations. The molten lead of the blast-furnaces is tapped intermittently through the automatic (siphon) tap into a lead kettle running on wheels and this is run to and poured into large collecting kettles to remove the lead dross. To remove the molten lead from one kettle to another one, or to refining furnaces, centrifugal pumps made of iron are now being used. These are suspended in the lead kettles and driven by electric motors. Such a pump can lift five tons per minute to a height of three metres (about 10 feet).

In nearly all smelters there are air-compressor plants and compressed air pipe-lines are found in all the buildings and are thus handy for the great variety of uses. For instance, air hammers are used to break up materials and air lifts are connected with these air lines. The lifts serve to raise smaller loads such as lead and copper bars and blocks out of the mold, to cars or into the furnaces. Even the workmen are elevated in high buildings. In a Colorado ore-dressing and sampling plant which treats daily 1000 tons, a rapidly moving endless canvas elevator running through all four stories of the building is used for elevating men. On a strong vertical canvas belt are fastened handles and steps. In all other respects it is like the usual bucket elevator and in constant operation. The workman who, for instance, wants to get from the highest story to the lowest one, takes hold of the handles, steps upon one of the supports, and immediately disappears into an opening in the floor.

Prime Movers

Reciprocating steam engines are generally used as prime movers in the operation of smelting and ore-dressing plants, whereas we here in Germany and in other European countries have replaced the older types of machinery with more modern sets, especially with large units of steam turbines. I found that in America, especially in the more remote metallurgical plants, a large number of steam engines of older construction and in small units are still extensively used. For blowing engines Green blowers are generally used and the latter are usually direct connected to vertical steam engines. Special attention is given in many works to the air consumption of each furnace. In the works of the Cia. Minera de Peñoles at Mapimi (Durango), Mexico, logs of the air consumption per ton of charge smelted have been kept for years. With these uninterrupted reports, which make comparison possible, not only defects in the air mains, and the tuyere pipes were discovered and thus leaks stopped, but in time the record system made it possible to reduce materially the cost of the air used per ton of smelting. I am of the opinion that in this direction we should keep very careful and constant records in European works.

A peculiarity of the works situated at high altitudes in the Rocky Mountain mining districts is the so-called thawing house, its use being made necessary by the cold climate. These are long narrow houses in which 8 to 10 railroad cars can be

placed with frozen ore (during winter), these thawing houses have usually double walls and double roof and are either heated by steam coils or by a long centrally placed masonry or brick flue fired direct with coal. In other places small coke stoves are placed in the railroad cars to thaw the ore. The ores in stock houses naturally have to be heated also. Of great importance in American reduction works are the sampling mills on account of large quantities of ore that are daily received. The sampling is usually done by machinery where a large quantity of ore has to be sampled, or where a large number and a great variety of lots, especially small ones, have to be sampled, this work is usually done by hand. The mechanical sampling mill is connected directly with the unloading and coarse-crushing plant in which all large pieces of ore are first broken. The crushers are followed by Vezin or Snyder samplers and smaller crushers. Rolls and samplers gradually reduce the ore down to a definite size. A model plant is that of the Golden Cycle mill in the Cripple Creek district near Colorado Springs.

Concerning the modern metallurgical laboratories. I must say that these as a rule are very well equipped and that electricity is very extensively used for heating muffle and fusion furnaces for the preparation and heating of distilled water, for sand baths, dryers, and similar uses. It is the usual intention to keep the laboratories as free as possible from dust producing ovens and furnaces and to reduce as much as possible the manual labor. I wish to add that the lead in ores as well as in the slag is almost exclusively determined wet by titration. The silver, however, is determined dry by scorification; copper by titration or electrolytically.

Fluxing Materials

In working the different ores, the use of fluxing materials containing no valuable metal constituents is as much as possible avoided. The preparation of a uniform furnace mixtures is therefore for American smelters even of greater importance than for us. In many cases this is not difficult, as many works receive large quantities of ore of uniform composition. More difficult is the mixing of ores in works whose operations depend on fluctuating receipts of custom ore. To insure uniform operations, large stocks and ore beds containing the different classes of ore are prepared. In the very modern lead-copper smelting works at Tooele, Utah, the different ores are stored in a large number of separate steel bins built in a row. Beneath each bin gate a loose sheet-steel hopper is suspended which is connected with an automatic scale. The desired quantity of ore or flux is emptied into these hoppers. An electrically operated charge-car running beneath these hoppers receives the load, the car operator in emptying the hopper distributing the ore over the entire car bed, which is long but narrow. After all constituents have thus been well mixed and loaded into the car it is run to the roasting furnaces or the charge-floor of the blast-furnaces. The doors, which usually keep the furnace top closed, are opened by a system of levers by the car operator, the bottom-dropping charge-car empties its contents, the furnace doors are closed again, and the car run back. With this system, two men per shift can deliver the entire stock for one blast furnace of 250 tons daily capacity. The arrangement here discussed presupposes a terraced smelting plant. In works built on level ground the smelting stock is usually delivered by inclined railways. In different works they use the Messiter system for the preparation of uniform stock mixtures. Large level beds are so laid out that the conveyors fitted with automatic trippers distribute the material evenly over the bin. The large copper smelting works at Douglas, Arizona, has the ore and flux delivered into large and long pits which are about 20 ft. wide and 13 deep. The different materials are brought to one side of the pits in railroad cars and dumped in successive layers into the pit. A steam-shovel running on a track in the bottom of the pit lifts the ore into rather large charge-cars running on a track on the other side which take it to the charge-floor of the blast-furnace. The final charges are dumped direct into the blast-furnace, no shoveling being done.

Roasting Apparatus

Regarding the roasting apparatus used in the preliminary preparation of the lead, copper, and zinc, the following may be said. The historical Freiberger reverberatory roasting furnaces rabbled by hand have nearly everywhere become extinct. I found them in operation only in two smelters in Mexico and Colorado, and here they will hardly remain much longer in operation. The Bruckner cylinder of old, once generally used, has disappeared. In its place, especially in works that treat lead and mixed ores and matte, the Huntington-Heberlein (circular hearth) furnaces with the H. & H. converters are used. In a lead smelter in the Missouri district the pure lead ore in dolomitic gangue used to be worked by the Savelsberg process. The roasting plants using the H. & H. process are usually built along different lines in the United States from those adopted in Europe and Australia. While we generally support the roasting pots some distance above the ground and empty the contents by tilting them, the so-called 'H. & H. converters' are usually embedded in the roasting floor. The converter, which holds 10 to 12 tons of roasting material, is covered with a hood having a gas out-take connected with the main flue and stack. A traveling crane is used to empty these converters; first the hood is removed, then the pot is moved to another part of the building, lifted high, and tipped. The large lumps remaining are broken to head size in large breakers. The empty pot is placed by the crane in front of an H. & H. round hearth furnace and the grate is first covered with about 1 ft. of hot preroasted material. Then about 3 ft. of cold wet raw ore with about 20% S and 10 to 15% Pb is added, and the converter is taken back to the blowing stand. The roasting is started by turning on the blast, and more cold ore is added later according to requirements. The heat developed in the H. & H. converter is greater than that generated with Dwight-Lloyd apparatus. It is therefore possible to roast raw pyrite with a smaller sulphur content. Should the heat generated by too large a quantity of sulphur be too great, then the excess sulphur can be eliminated by a preliminary roast, or can be reduced by the

addition of ore free of sulphur, roasted ores, limestone, or other materials. Even refractory ores that do not smelt easily can be sintered in the H. & H. converter by this practice. When roasting the pure lead ore of the Missouri district, sand or fluxes rich in iron and lime would be added before smelting, as is customary in European and Australian practice, which would make necessary only one reduction of the lead by blast-furnace smelting. This would in a way be a re-smelting of the already slagged constituents. The Americans, however, do not care to subject the lead ores to the double treatment in the H. & H. round hearth furnace and converters, or the Dwight-Lloyd apparatus, but prefer to blow the raw ore without any fluxes or additions direct. Therefore iron and limestone fluxes have to be added to the blast-furnace charge. Roasting costs therefore less in American works, but the work is inferior to ours. In a number of works the continuously operating Dwight-Lloyd apparatus is being adopted.

Furnaces

For free burning ores, such as pyrites, Herreshoff, Wedge, and Klepetko furnaces are almost exclusively used. Hand operated kilns or furnaces for roasting blende I have found nowhere on my trip. For the latter work the well known Hegeler furnace is extensively used in the United States, even when the sulphur in the blende is not utilized, which is generally the case. In addition to the Hegeler furnaces, a number of Zellweger and Cappeau furnaces are still used. The latter is a sort of Ropp furnace, altered for the mechanical roasting of blende; these two types are not muffle furnaces, but are direct fired.

In copper reverberatory smelting practice it is desirable that the roasted ore or concentrate be delivered to the furnace as hot as possible. The calcine from Herreshoff and similar furnaces is therefore delivered in hopper bottom cars to the charge hoppers over the reverberatory furnace in a redhot condition. Ores which have to be treated in these furnaces are first thoroughly dried, which is done in mechanical dryers. In one works a Wedge dryer is installed which daily had to dry and heat to 350°C. some 160 tons of copper concentrate containing 7% moisture.

As has been previously explained, fuels are comparatively cheap in most of the American metallurgical works. The natural result is that, on the whole, less care is exercised in utilizing the fuels as efficiently as here. Even zinc furnaces are frequently operated without regenerators or recuperators. In many localities natural gas can still be obtained at relatively low prices, as for instance in Pennsylvania, Kansas, Oklahoma, etc. The gas contains about 94% hydrocarbons (almost entirely methane), about 1% CO, and 4% N, and costs about ½ pf. (⅛c.) per cubic metre. About 600 cubic metres of gas is equivalent in fuel value to about 1000 kg. of coal of good quality, which would correspond to a cost of 3 mk. (75c.) per ton of coal. A special advantage of the natural gas lies in the circumstance that the installation cost for furnaces is very low, another that of ashes and dust being entirely absent. With the daily increasingly large natural-gas consumption for the lighting of cities, for generating steam in power-plants, etc., the gas pressure, as well as the gas volume, is decreasing rapidly, so that metallurgical works depending on natural gas for fuel have to be amortized in a short time. In a few states, as California, Texas, and Utah, petroleum is used as fuel in metallurgical furnaces, and the experience that has so far been had with oil firing has been extraordinarily favorable, even in places where the oil is not merely chosen as a fuel by reason of its cheapness. Neglecting cleanness in operation, the ease of transportation to the works and around them, and the facile handling of the oil, the flame can be regulated very easily, both as regards degree of temperature as well as oxidizing and reducing action. When it is remembered that a large copper reverberatory furnace consumes daily 80 tons of coal, of which about 16 tons (20%) is rejected in the ashes, it is easily realized what may be saved in transportation costs alone by substituting oil for coal firing. One of the large reverberatory furnaces about 6 m. wide and 33 m. long (20 by 110 ft.) consumes, with a daily smelting capacity of 300 to 400 tons of ore, about 45 to 50 tons of oil. The waste gases escaping at the end of the furnace pass under a water-tube boiler and generate sufficient steam for 600 hp. Installations using pulverized coal for firing are comparatively rare, very likely due to their high first cost and the accumulation of the ashes on top of the metal and slag bath, which makes these not only viscous but dirty.

Metallurgy of Copper

Without a doubt, the metallurgy of copper is a field of which the American metallurgists have become the masters, and nowhere else can the most modernly equipped copper-smelting works be better studied than in North America. The wonderful development of this industry during the last ten years is based on the most varied ore deposits, and the great variety of working conditions has brought the metallurgy of copper to a great degree of development. Not only the recovery of the metal itself has steadily been increased, but the costs of production have been constantly decreased, so that today ores are beneficiated which 15 years ago nobody thought of working. The great perfection of the copper-smelting processes has to a great degree limited the use of the wet processes, so that today dry methods are preferred to wet processes wherever possible. From the literature of the last few years you will be familiar with the apparatus and furnaces used in copper smelting, so that I can restrict my remarks to the principles of present-day copper metallurgy.

As a general thing, the sulphide ores are treated separately according to their size. Coarse ores larger than ¾ in. are sent direct to the blast-furnaces and are smelted pyritically wherever this is permissible, to a 40 to 45% matte; about 75% sulphur is burned in this operation and passes off as SO_2 into the air or into the sulphuric acid chambers. The matte is collected in the forehearth, and the slag, containing about 0.4% Cu, flows into the slag pots, which are emptied on the slag dump. The fine sulphides below ¾ in. are roasted if high in

sulphur in the manner presently described, or if they contain but a small portion of sulphur, are charged direct with the hot calcine into the reverberatories. These modern large reverberatories are at present very much favored, especially in localities where cheap fuel oil is obtainable.

Copper Smelter Products

The products are here a slag with about 0.4% copper and a matte with about 40% copper. The latter, as well as the matte from the forehearths of the shaft-furnaces, is tapped into ladles and poured into the convertors with the addition of silicious copper ores as flux. By Bessemerizing, a blister copper with about 96% Cu and varying gold and silver content is obtained, which is cast by means of ladles and casting machines into bars. Of late years, basic converters have replaced the acid converters. On account of their greater durability they have been rapidly adopted. While with the acid-lined converter only three charges could be blown, and at best only 150 tons of copper produced, it is possible to produce as much as 6000 tons of blister copper in similar converters with basic lining. Of late, experiments have been made in different works in blowing leady copper matte with low copper content in basic-lined converters. Technically, these trials are said to have been entirely successful, but there is still much difference of opinion among metallurgists as to whether the process is also a commercial success.

The blister copper is further treated by electrolysis in refineries which are principally situated around New York. The usual process is the multiple system, the series system being rather the exception. There are works with a daily capacity of 500 tons electrolytic copper. A number of refineries have wire bar furnaces which handle 300 tons of copper in 24 hours, while the capacity of copper blast-furnaces and reverberatory furnaces for smelting ore are 800 tons and 500 tons per day, respectively. Neglecting the Mansfeld works, which handle by far the largest tonnage of copper ore in Europe, a single blast-furnace of that size would nearly suffice to put through all the copper ore that is smelted in one day in Europe.

The lead smelting works of North America can be classed into two groups, namely, those that treat rich lead ores with more than 65% lead, and those that smelt ores low in lead with silver-gold ores low in copper. The works treating high-grade lead ores are nearly all situated in the Missouri district and produce about 130,000 tons of merchant lead per year. From the second class are produced some 250,000 tons of lead which would correspond to about 1.80 to two million tons of furnace charge. The Missouri ores contain so little silver that the merchant lead contains only about 60 gr. (about 2 oz.) per ton. It is therefore not desilverized, but principally is refined by blowing dry steam and air through it. Small amounts of copper in addition to the silver remain, therefore, in this lead, which is, as a result, not available for the making of white lead, but is used for rolling. The rich lead ores are either pre-roasted in the Scotch hearth and 50% of the lead in this operation eliminated, and then smelted in the blast-furnace, or they are roasted partly in the H. & H. round-hearth furnace or in the H. & H. convertor, or direct with the addition of silica and a small amount of flue dust in the Dwight-Lloyd apparatus, after which follows reduction in the shaft furnace. The shaft furnaces are almost exclusively rectangular and measure at the tuyeres from 36 to 42 in. wide by 96 by 144 in. long. The number of tuyeres is 12 to 18, with a nozzle of about 4 in. The blast varies from 120 to 160 cm. water column. The coke consumption is usually low, about 12% of the charge, in which, however, is not included any slag returned. Notwithstanding the low copper content and the richness of the Missouri ore, the matte fall as well as the coke consumption are high according to our ideas. It is my opinion that this is largely due to the difference in the work of roasting compared with that in America. The low-grade lead ores up to about 4½% S are sent direct to the blast-furnace; with greater sulphur content they are roasted like the richer ore, either by the H & H process or with the Dwight-Lloyd apparatus, and are then sent to the blast-furnace. Blast-furnace smelting, as a general rule, is so conducted that the charge does not contain less than 10 or 12% lead, and that a good extraction of gold and silver is only likely when lead bullion and matte fall combined amount to 18% of the weight of the charge. The matte is collected in a forehearth and the slag flows over into slag pots to be desulphurized. As a rule, the matte does not contain more than 10 or 12% copper. With higher copper content, difficulties are sure to be experienced with the siphon taps. The first matte is crushed, roasted, and sintered in the above-named apparatus, and then treated in the blast-furnace to a 40 to 45% matte, which is then sent to the copper smelter.

The lead bullion of the many different lead smelters in the United States is desilverized in a few large lead-refining plants where the methods are very much the same as with us. Of late oil fuel has been largely adopted for smelting, refining, and zinc distillation. To remove the zinc crusts, Howard presses are used almost exclusively, and the Howard mixer is also used to stir the zinc into the lead bullion.

Zinc Smelters

Zinc smelters have been erected in the United States at points where either cheap coal or a natural gas can be had. As already noted, the sulphur from the blende is not utilized even where roasting is conducted in the Hegeler, a muffle furnace. The Zellweger furnaces are about 35 m. long and have a maximum height between roof and hearth of less than 7 ft. The capacity per 24 hr. is about 30 tons of raw blende, with a gas consumption of about 600,000 cu. ft., which is approximately equal in heating value to 30 tons of coal or 100% of the weight of the ore. The roasting is nevertheless cheap and good, and metal losses are small. Considerably less gas is used with the Cappeau furnace, of which the height of hearth in centre is 3 ft. 7 in. In this furnace 25 tons of blende requires about 300,000 cu. ft. of gas, equal to 15 tons of

coal; corresponding to about 60% of the weight of the ore.

Distilling Furnaces

The zinc distilling furnaces heated with natural gas, as well as the Hegeler furnaces heated with producer gas, are fired without regenerator or recuperative systems, but have large capacities, up to 18,000 kg. (19,836 short tons) of ore, with 860 retorts. A peculiarity of these furnaces is the scarcity of prolongs; the condensers, partly extending out of the furnace, being fairly cool. The production of zinc dust is practically nil. The cleaning of the retorts is generally done by spraying water or steam into them, followed by the scraping off of slag that may adhere to the walls. Usually each furnace is in its own building. The fuel consumption of a distilling furnace is, of course, considerable and may be placed at about 180% of the weight of the roasted blende.

Among wet processes, cyanidation of gold and silver ores is the most important. Frequently amalgamation is used even when crushing the ore in cyanide solution. The ores of the Cripple Creek district which were formerly treated by the Plattner chlorination process are now cyanided, of course after the sulphur and tellurium have been removed by roasting. Even from the rich arsenical silver ores at Cobalt, the silver is extracted by a combination of amalgamation and cyanidation.

The extraction of copper by chloridizing roasting from pyrite and low-grade ores, which plays such an important part in Europe, is practised at present only in Philadelphia. A great deal was heard about copper leaching processes at the International Congress, but the future must decide the value of the interesting processes proposed. On account of the large quantities of precious metals produced yearly in the United States the parting of gold and silver is of great importance. I was somewhat surprised to see the large gold-silver refineries return from the electrolytic to the old sulphuric acid parting process. I was told that the latter permitted more rapid working, therefore lower interest losses.

The problem of flue dust precipitation has been given a great deal of attention lately in the United States and large sums have been expended upon experiments in construction. Contrary to European practice of wet concentration to condense wet as much as possible, preference is given to bag filtration, in places with automatic shaking of the bags. This works well where the gas is not too acid; the space requirements and cost of installation are, however, considerable. The flue chambers, which must be cheap to build and effective in cooling the gases, are constructed according to the catenary system. The old-style chambers originated at the Fredericks works are much liked and are said to give good results. In a number of works the Cottrell electric process of precipitation was tried, operating with a high-tension direct current. It gave especially good results with wet gases; of course, the oxidation of SO_2 to SO_3 and condensation of the latter forms no part of this particular process. Many experiments have been directed to making the sulphurous acid anhydride harmless, as large works have been forced to suspend operations on account of fume damage. A commercial process yielding a gas low in SO_2 has not yet been perfected; the only help is to mix the SO_2 gas with air. Young wants to make concentrated SO_2 gas harmless by reducing the sulphur with hydrocarbons at high temperature in the presence of catalyzers. It seems to have been demonstrated that Young's process works well on an experimental scale with gas high in SO_2 and low in free oxygen, but it is too expensive with gases low in SO_2.

New processes for production of potash salts from phonolites and leucites were much discussed at the congress. Of the commercial phases of these processes, I was not able to learn anything, but it is true that great efforts are being made in the United States to become independent of the German potash market. Work is also being done on the production of high-grade fertilizers from phosphate rocks without sulphuric acid treatment. An excellent fertilizer with its phosphoric acid soluble in citrate solutions, but insoluble in water, is soon to be made by burning at high temperature a mixture of phosphate and lime rock.

In regard to the hygienic arrangements of American metal works, little is to be said. While industrial safety and health laws are not so rigidly conformed to as here, the correctness of the principle is being recognized that the maximum work and effort of the workmen can only be demanded when providing as essentials for good work, lots of light and fresh air, and it is to the employer's own self-interest to provide well lighted and ventilated works.

Accounting

I wish to add a few words regarding works bookkeeping and accounting. I had opportunity to look into this in a number of works and received the best of impressions. Not only labor, ore, and warehouse records are kept, but the daily reports enable the works manager to determine operating costs from day to day, which is of far-reaching value to him. In conclusion, I wish to emphasize the extent to which American metallurgy is connected with German names. Ahrend, Eiler, Fabre du Faur, Aug. Meyer, Stetefeld, Aug. Rath, Fohr, Liebenau, Albert Ahrents, O. H. Hahn, Emrich, and Huber should be particularly mentioned. These men, the majority of whom received their training at Freiberg or Clausthal, are recognized as pioneers in the American metallurgy. The conclusion of my discussion of impressions obtained in my travel can be compressed in the opinion that Americans, as far as the metallurgy of copper is concerned, are far ahead of us. Regarding the treatment of large tonnages of low-grade lead ore, a similar comparison cannot be made because we have no corresponding works in Europe, but this work also is excellently done. But in the treatment of rich lead ores, we European smelter men compare very well with our American colleagues. As far as the metallurgy of zinc is concerned, I believe that we, in the matter of quality of work, that is, in zinc recovery and coal economy, are ahead of the Americans; but thanks to the cheaper fuels many American zinc works enjoy, their costs are lower than ours.

BEAVER DREDGE, SHOWING SLUICES FOR RESOILING.

Resoiling After Dredging in California

By G. L. Hurst

Although few people are aware of the fact, the resoiling of dredging ground in California has been going on for the past three years, on a property owned by the Beaver Gold Dredging Co. near Loomis and managed by N. J. Martin. This dredge has 3½-cu. ft. close-connected buckets and was designed to dig 20 ft. below the water-level, and is provided with a stacker which was used at the commencement of dredging operations. The dredge is electrically driven and was originally one of the Risdon dredges owned by the Feather River Exploration Co., having 5-ft. open type buckets.

A new ladder and sluice-way of the open structural steel type was built in place of the old ladder. New upper and lower tumblers were used and a line of 3½-ft. close-connected buckets. The revolving screen was lengthened and raised about 6 ft. The extra length of revolving screen was necessary, owing to the fact that the ground contained over 75% of fine material. The extra height was used for the purpose of getting greater area for gold-saving purposes, and also to facilitate resoiling the ground. This extra height of screen necessitated the upper tumbler, gearing, etc., being raised an equal amount and slightly lengthening the ladder and increasing the number of buckets required. It was proposed to put on a secondary screening device, but after some experimental work this was abandoned and the product from the revolving screen was passed over the gold-saving tables in the usual manner and collected from the tables into three tail sluices, one on each side of the dredge and one in the centre under the stacker ladder and supported by it. The central tail sluice carries nearly twice as much water and fine material as the outside sluices. This central sluice extends about 20 ft. beyond the side sluices.

After operating for some time in this manner the belt was removed from the stacker and a long chute at an angle of about 30° with the horizontal discharged the material from end of the screen above the central sluice-way. All rocks, roots, balls of clay, etc., larger than 4 in. diameter are not allowed to enter the central sluice, and are prevented from doing so by means of a fixed grizzly consisting of bars attached to the lower side of the chute from the screen, and extending out about 3 ft., the outer end of the bars being perfectly free and slightly fan shaped, this prevents the grizzly from getting clogged.

The oversize from the grizzly falls on a V-shaped apron about 3 ft. long, placed on top of the central sluice; the smaller material which passes between the bars falls directly into the central sluice and is carried away by the water and the fine material from the gold saving tables proper. Of course under this

TWO VIEWS OF RESOILED GROUND.

arrangement the sand and small rocks fill the void spaces between the large rocks and thus the swelling of the ground amounts to little, not over 5 per cent in this instance.

As previously stated, there was a large quantity of fine material, but few large rocks and stones. The fine material from the side sluices is not discharged as far from the dredge as that from the central sluice and the coarser material falls on this. It is remarkable how well the ground packs, and the surface is more even after than before dredging was commenced. Of course it is necessary to keep the level of the water in the pond almost at the surface of the ground. There is no more water required for this work than any other dredge of the same capacity, and the cost of operating is considerably less as there is no belt stacker to purchase every ten or twelve months. While it is true that the digging buckets have to lift the material about 6 ft. higher than formerly, there is but a very small increase in power necessary. Not only is the small expense saved in dredging operations, but the principal saving, in my estimation, is in the ground itself. Instead of leaving a pile of unsightly tailing the ground is left as level as a table and in first-class condition for agricultural purposes, inasmuch as the ground has had a deep plowing. The ground in the present case averages from 12 to 15 ft. deep, and was an old orchard before dredging. Trees are now being planted on the new dredged ground. Of course, this method of dredging could not be applied to all dredges now in operation in California. However, there are a number upon which this simple apparatus could be applied, and I believe the results will more than justify the slight additional expense necessary to make the change.

One of the most important iron mines in the world is the Loussavaara-Kiirunavaara, situated at Kiruna, Lapland, in latitude 68½° north, which is about the same as the northernmost boundary of Alaska. The climate is somewhat milder than in Alaska, and these mines are worked the year around. About 1600 men are employed and the equipment is all of the most modern machinery obtainable. Machine tools for the repair shop, air-compressors, and rock-drills, and several of the largest steam and electric shovels are of American make. The plant is operated by steam power, the coal coming from England and Spitzbergen. Steam coal is delivered here for about $4.50 per ton. The electrification of the mines is in progress, and this power will be used exclusively as soon as the new power-plant of the state of Sweden, now under construction at Porjus falls, is completed. The transmission line is completed and it is expected that the power station will be ready to deliver current early in 1914. The capacity of this station will be 150,000 hp. to be transmitted at 78,000 volts over a distance of 150 miles. The state railway between Kiruna and Narvik is being electrified and will be operated from this station. The ore is shipped from Kiruna to Narvik on the Norwegian coast by rail, and from there by water to Germany, a small percentage finding its way to other countries. The equipment is being rapidly increased and will soon be sufficient to ship more than 10,000,000 tons per annum. Up to the present time about 25,000,000 tons of ore has been shipped. The ore is magnetite and contains from 53 to 68½% iron. Owing to the comparatively large content of phosphorus it was impossible to utilize it until the Thomas furnace was developed.—*Daily Consular Report.*

Annealing of Gold

In a recent paper read by T. K. Rose before the British Iron and Steel Institute, the annealing of gold was discussed as follows. Impurities in gold generally raise the temperature of annealing to a remarkably great extent, different impurities having different effects. The effect of copper is more marked than that of silver, but other elements have far more effect than either. Gold melted on carbon in an atmosphere of hydrogen, although its purity has been reduced only two parts in 100,000, had its temperature of annealing raised from 150 to over 300°. In other cases in which the nature of the impurity was not determined, effects were observed intermediate in magnitude between those due to silver or copper and those caused by hydrogen.

Experiments were made to determine how far annealing could be used as a test for the fineness of gold, supplementary to the ordinary test, by parting assay, and it was clear from the results that, given a particular method of preparation of pure gold, its purity can be easily and quickly tested by annealing it. By the parting assay the composition of fine gold can be determined correctly to 0.01 per 1000 by taking the mean of 20 assays of each sample, weighed to 0.01 per 1000, the amount of metal required for assay being about 10 gm. in each case.

A study of partly annealed specimens of gold shows that recrystallization and softening does not take place simultaneously throughout the mass, but occurs in particular laminae or flattened crystals, while others remain unchanged until more time elapses or the temperature is raised. The new crystals do not increase in size at first, or as a general rule pass the original boundaries of the old distorted crystals, but if heating is continued they soon begin to eat into the original boundaries, which are gradually obliterated. The crystals subsequently increase in size and diminish in number, as is well known. The new crystals appear to be quite soft, and the unaltered laminae as hard as before annealing. The surface indication of softening corresponds to a real comparative softening in depth, and that recrystallization spreads in depth from one lamina to another more readily than sidewise, so that superposed laminae are more likely to be similar in hardness than those placed side by side. It followed that partly annealed metal consists of alternate strips of hard and soft material, and consequently that such metal has weak places where its rigidity and resistance to rupture are little higher than those of fully annealed material.

Natural gas consumed in Pennsylvania in 1912 totaled 173,656,003,000 cu. ft., the average price for industrial purposes being 11.53c. per 1000 cubic feet.

The Rand Banket—Part IV

By C. B. Horwood

Shape of the 'Pebbles'

As regards the shape of the pyrite replacements, it is remarkable that they are mostly either spheroidal or ellipsoidal and have comparatively smooth rounded contours; except those pseudomorphs formed by the replacement of angular, indurated, slaty-quartzite pebbles, which retain the original outlines. Those that are pseudomorphs after quartz pebbles assume well rounded forms, as they naturally have retained the original shapes of the pebbles replaced. Those again that are pseudomorphs after the ordinary quartzite pebbles are, also, usually spheroidal, as distinguished from those mentioned that have replaced angular slaty-quartzite pebbles. The spheroidal and ellipsoidal shapes of the remainder, that is, of the metasomatic concretions, is undoubtedly due to their mode of origin.[136] Examination of thin sections under the microscope shows that in the formation of one of these 'pebbles' a minute amount of pyrite was first precipitated; this may have happened either directly from solution in one of the channels or pores through which solutions were passing, or by replacement of silica, or silicates, or by both of these means. Thus a centre of growth was created around which pyrite still continued to be precipitated; and fairly uniform growth at every point would account for the rounded shape. The microscope indicates that there were usually several centres of growth for the same 'pebble.''

Growth of Pebbles

In such cases growth would have ensued independently around each centre; the seperate growths having increased in size until they became contiguous, further growth would then have taken place around the now united portions as one mass. After a compact body of pyrite had been formed, its surface would have been exposed to modifying influences due to continually renewed portions of active solution coming in contact with it. Thus any rough outlines due to the consolidation of separate growths, or to the shape of the material last replaced, or to other causes, would gradually have disappeared. If any quartz embayed depressions along the surface it would have been replaced by pyrite, for as already mentioned, the whole process indicates that the already precipitated pyrite acted as a precipitating agent for that still in solution,[137] and the particular solutions to which we owe this secondary pyrite, had, under the conditions that then obtained, a greater chemical affinity for the silica than for the pyrite; consequently, the former went into solution while the latter was precipitated. Iddings[138] has pointed out that in the case of a crystal surrounded by a liquid that can dissolve it, its angles and edges will be dissolved more rapidly than the other portions, resulting in the rounding of its shape. This is owing to the fact that there will be more space around the solid angles and edges for the diffusion of the dissolved material and so the layers here will less readily become saturated, and consequently inactive as a dissolving agent, than the layers of liquid next to other portions of the crystal. Exactly the same reasoning applies in the case under consideration, and explains why any rough outlines would have been obliterated.[139] Also, according to Riecke,[140] solution is most active at points of greatest pressure. Any roughness of outline would naturally present greater frictional resistance to the flow of solutions and the pressure of the latter would therefore be greatest where this occurred; consequently any unevenness of surface would be toned down. Thus it can be understood why the surfaces of the pyrite 'pebbles' tend to assume that smoothness of outline which is so characteristic of them; and which doubtless caused the earlier observers to regard them as water-worn. Probably, the majority of these replacements are ellipsoidal rather than spheroidal. The writer has observed that those of the former shape have their longer axes parallel to the dip of the strata, demonstrating that in such cases there has been a greater amount of deposition along the directions of the dip and the bedding planes than at right angles to them, clearly indicating that the flow of solutions was along the bedding and parallel to the dip of the conglomerate beds.[141]

Association of the 'Pebbles' With Rich Ore

Attention has been drawn repeatedly to the asso-

[136]This remark not only applies to the metasomatic concretions which are usually termed pyrite 'pebbles', but also to the small rounded particles and granules of metasomatic origin which occur plentifully scattered through the matrix of the banket.

[137]See also the *Mining and Scientific Press., loc. cit.*

[138]'Rock Minerals,' by Joseph P. Iddings, 1st Ed. (1906), p. 74.

[139]It also explains the frequent rounding of the edges of the pyrite crystals in the banket.

[140]'The Nature of Replacement,' by W. Lindgren, *Econ. Geol.* (1912), Vol. VII, No. 6, p. 533.

[141]Accepting Riecke's theory that solution is most active at points of greatest pressure, then in a pyritic mass in process of formation the surfaces parallel to the bedding-planes would present great frictional resistance to the passage of solutions and would therefore be those where the greatest pressure would exist. Solution along these surfaces would consequently be more rapid than precipitation. On the other hand, the end surfaces at right angles to the bedding-planes and to the direction of the dip would act as barriers and tend to check the rate of flow and so cause precipitation, which would therefore be greater on such surfaces. Hence, the resulting 'pebble' would be ellipsoidal rather than spherical. James Geikie has already remarked that concretions in laminated clay are usually lenticular, and are often flattened spheroids, owing to the mineral solutions having made their way most readily along the planes of sedimentation. He also explained that continuous seams of limestone or ironstone sometimes occur as a result of the fusing together of continuous nodules of calcareous or ferruginous concretions owing to their tendency to develop in the direction of the bedding-planes of the rock in which they occur. (James Geikie, *loc. cit.*, pp. 121-122.)

ciation of the gold and pyrite in the Rand banket.[142] In the present discussion the invariable association of the pyrite replacements with rich ore has been emphasized; and it has been shown that these metasomatic bodies originated after the deposition of the conglomerate beds. The evidence points to the agency of chemically-active heated solutions (liquid or gaseous) under pressure, ascending from great depth. The lateness of the period in the history of the conglomerate when the pyrite was deposited is proved by films of it occurring along cracks and planes of shearing in both the longitudinal diabase dikes and also in the pebbles of the banket.

Shearing Planes

The planes of shearing go through the pebbles and matrix. Sometimes a pebble is traversed by five or six such cracks, and sometimes each of them has been accompanied by minute step-faulting. These cracks are parallel with the strike of the main structural fractures of the district and with the direction of the big longitudinal, or strike, dikes. Films of pyrite occur here and there both along planes of fracture in the dikes and also on their surfaces; and a thin film of gold can occasionally be found on the dikes, demonstrating that this pyrite and gold has been deposited after the intrusion of these dikes.[143] In other words, the mineralizers were still circulating after the dikes had been intruded and had developed those various planes of fracture,[144] which are probably mainly due to cooling. The conditions indicate that the solutions, liquid or gaseous, were under great pressure, at high temperatures, and of deep-seated origin; and must, therefore, have been forced, or found their way, along fractures penetrating to great depth. Fractures of such extent and persistence must have been the main structural ones of the district. Their places are now marked by decomposed diabase dikes (offshoots intruded into them from the underlying magma) which finally sealed them against the passage of further mineralizers and of the silicious solutions such as had already to a great extent, by the deposition of secondary silica, closed the pores of the now auriferous bankets and prevented their further permeation by the deep-seated agents to which they owe their pyrite and gold. Thus the mineralization and dike intrusions became possible by extensive fracturing of the strata by means of which communication was established with the underlying molten magma. After the dikes had cooled and contracted, solutions still for a time found their way along them and through their fractures, and continued to deposit their mineral contents until in most cases they eventually closed even these channels by the deposition of silica or other mineral matter. The close and intimate intergrowth of the gold and pyrite and the fact that the former is so frequently bound up mechanically in the latter,[145] and the further fact that the pyrite replacements are a sure indication of gold are sufficient evidence that they were deposited more or less simultaneously from the same solutions; and rather suggests that the two may have been present as a eutectic mixture. If so, the pyrite present in excess of the eutectic ratio would first have been precipitated until the eutectic point was reached, when the gold and pyrite would then have both come down together as a eutectic mixture. George Barrow,[146] of the Geological Survey of Great Britain, has suggested the possibility of a gaseous eutectic mixture. There are molten eutectic mixtures, therefore why not gaseous ones? If there be, there is no difficulty in imagining a sufficiently high temperature to render gaseous the minerals found in veins such as pyrite, or a metallic element such as gold.

Influence of Slates and Shales on the Mineral Deposition[147]

The descriptions of the occurrences of pyrite 'peb-

[142]L. De Launay, *loc. cit.*, p. 519.

F. H. Hatch and G. S. Corstorphine, 'The Petrology of the Witwatersrand Conglomerates, with Special Reference to the Origin of the Gold,' *Trans.* Geol. Soc. So. Af., Vol. VII, Part 3 (1904).

C. B. Horwood, 'The Occurrence of Pseudomorphous Pebbles of Pyrites at the Crown Reef Mine,' Abst. *Proc.* Geol. Soc. London, No. 841, March 5, 1907.

R. B. Young, 'Notes on the Auriferous Conglomerates of the Witwatersrand,' *Trans.* Geol. Soc. So. Af., Vol. X (1907), and 'Further Notes on the Auriferous Conglomerates of the Witwatersrand with a Discussion of the Origin of the Gold,' *Trans.* Geol. Soc. So. Af., Vol. XII (1909).

C. B. Horwood, 'The Mode of Occurrence and Genesis of the Carbon in the Rand Bankets,' *Trans.* Geol. Soc. So. Af., Vol. XIII (1910), and 'Iridosmine from the New Rietfontein Mines, Its Occurrence, Analysis and Genesis,' *Trans.* Geol. Soc. So. Af., Vol. XV (1912).

[143]Similar reasoning has been applied to show that the flints in the English chalk are not only later than the latter, but later even than the period during which it was elevated and became dry land, because flints are found occupying vertical joints and cracks in the chalk and these cracks are certainly of later origin than the deposition of the chalk, there is indeed little doubt that they were produced as a consequence of its gradual upheaval. (W. J. Sollas, *loc. cit.*, pp. 152-154.)

[144]The main fractures are usually roughly parallel to the walls of the dikes. The dikes here referred to are the longitudinal, or strike, dikes. They are all diabase dikes, highly decomposed and uralitized.

[145]L. De Launay pointed out that the gold in the Rand banket is constantly associated with pyrite, but does not seem to be combined with it, and that the gold can often be seen, under the microscope, in crystals enclosed within the pyrite. *Loc. cit.* (1903), p. 519.

T. A. Rickard has shown that, as regards the occurrence of gold in the pyritic quartz of lodes, the evidence indicates that the gold does not exist in chemical combination, but as minute filaments or crystal aggregates distributed through the substance, especially along the structural planes of the pyrite. Further, that when the gold-bearing pyrite is treated by cyaniding, the gold may be leached out without deformation of the pyrite or any other change in its appearance except the acquisition by its facets of a pitted surface suggesting cavities left by the removal of a soluble constituent. ('The Formation of Bonanzas in Gold-Veins,' in 'The Genesis of Ore Deposits,' 2nd Ed., pp. 738 and 739.)

That the gold which is present in the pyrite of the Rand banket is mainly, and probably entirely, bound up in it mechanically is demonstrated from it being easily detected and separated (or most of it) from the pyrite in panning; from microscopical studies; from its largely yielding to amalgamation; and from the battery pulp readily giving up its gold in the cyanide process.

[146]*Trans.* Inst. Min. and Met., Vol. XVIII (1909), pp. 231-234.

[147]The discussion under this heading is a good example

bles' at the Crown Reef, Rietfontein, and Randfontein mines clearly showed that they were closely related to dike intrusion and rich ore, and to the retaining influence, in the case of the first, of a thin underlying impervious band of shale; and, at Rietfontein, of a shaly talcose foot-wall. At Randfontein the foot-wall of the Leader is usually sericitic and shaly, and has doubtless exerted a similar influence. Van Hise[147] has strongly emphasized the profound influence of impervious strata upon the deposition of ore. The foregoing merely illustrate local examples of the effect of thin bands of shale; or, even of sericitization along a foot-wall. The retaining influence of shale[148] has, however, a wide and important bearing throughout the whole of the Rand goldfield, which extends for more than 60 miles along the strike of the conglomerate beds. As long ago as 1905, the writer pointed out that, if the theory that the gold originated from ascending mineralizing solutions be accepted,[150] it is easy to understand how solutions may have come up along lines of weakness such as the junction-planes between dikes and their walls, and that during their ascent a point would be reached where it would be easier for them to spread out laterally along the bedding than to ascend farther in a more vertical direction. Further, that as this position would be determined by the porosity of the beds, depending largely on the compression caused by the superincumbent weight of strata,[151] the solutions would naturally select a conglomerate bed. The first of these, with the exception of a few in the Lower Witwatersrand formation, including perhaps the Du Preez series, would be the Main Reef series; and, the impervious foot-wall slate, which lies at their base, would doubtless have exerted a favorable influence by helping to retain the mineralizing solutions above it. He also, at the same time, stated that the underlying conglomerates, which do not contain sufficient gold to be exploited, did not afford such easy channels, being composed of smaller pebbles, and being more compact owing to a greater weight of overlying strata; further, that traces of gold could be found in every series and in much of the intervening quartzites, showing that the whole of the Witwatersrand beds had been, to some extent, permeated by mineralizing solutions, but, that the main circulation was doubtless confined to certain channels such as those suggested.[152] George G. Holmes,[153] manager of the New Goch mine, speaking in a general way to the writer in the early part of 1912, also expressed the opinion that the good average grade of the Main and South Reef sub-series of conglomerates throughout the Rand was due to the retaining influence of the big mass of slates several hundred feet thick under the former, or lower, of these two sub-series. It has been seen that the writer entirely agrees with this opinion. The conglomerates below these broad belts of slate are at a much lower geological horizon and are, therefore, as just stated, more compact; they are also smaller and less defined; and, thus formed less suitable courses for the ascending solutions.

Mineral-Bearing Solutions

On the other hand, above the Main Reef foot-wall slates, the mineralizers were in a higher geological horizon, where the strata were less compact, and they encountered a series of coarse conglomerates along which they could easily flow. In addition to their lateral motion they would also have had a downward component due to gravity, which would be checked as the neighborhood of the foot-wall slates was reached; thus the greater proportion of their gold contents would have been precipitated in that series of conglomerates nearest the basal slates; in this latter series along the central portion of the Rand, the thin Main Reef Leader is immediately underlain by a thin impervious band of shale, only a few inches thick, by which it is separated from the poor underlying Main Reef.[154] The good average grade of the Main Reef Leader, especially along the Central Rand, compared to the much more erratic yield of the South Reef Leader, is doubtless due to the retaining influence of this thin shale band. Beyond this area, where the thin shale band underlying the Main Reef Leader is sometimes missing, and the Main Reef Leader also is sometimes either missing or poorly developed, the Main Reef itself[155] often rests immediately on a talcose foot-wall, or on the underlying foot-wall slate. This is so on the Far East Rand, where the Main Reef is locally known as the Van Ryn Reef, and in such cases it is the gold-carrier or 'pay-reef' of the district. The fact that the average grade of the Main Reef series is more uniform than that of the South Reef series is doubtless due to it being nearer than the latter to

of the important bearing that questions of economic geology often have on actual mining practice; and, incidentally, shows how knowledge obtained from scientific investigation of the origin and concentration of the gold in the banket can prevent money being squandered in useless prospecting work on conglomerates unlikely to contain enough gold to be exploited profitably.

[148]'Some Principles Controlling the Deposition of Ores,' in 'The Genesis of Ore Deposits,' 2nd Ed. (1902), pp. 396-416 and 780. See also, in the same volume, 'The Rôle of the Igneous Rocks in the Formation of Veins,' by J. F. Kemp, p. 699.

[149]The terms 'shales' and 'slates' have in the past been rather loosely used to describe various members of the Witwatersrand system. The beds, to which one or other of these terms is applied, are generally fine-grained argillaceous quartzites in which slaty cleavage is often, but not invariably, developed.

[150]The reader will find a bibliography of the literature on this subject in the *Proc.* Geol. Soc. So. Af. (to accompany Vol. VIII of the *Trans.*, 1905), p. 28. For later writings on the subject, see the various references in the present paper.

[151]Consisting of slates, quartzites, and conglomerates, each of which would, under similar conditions, be more porous than the one before named.

[152]'The Witwatersrand and Associated Beds,' by C. B. Horwood (June 1905), Esson and Perkins, Johannesburg, pp. 61-62.

[153]G. G. Holmes has enriched our geological knowledge of South Africa by much valuable field-work in various parts. He is not merely a deep thinker, but is also an accurate observer.

[154]The description already given of the section of the Main Reef sub-series at the Crown Reef mine may be taken as typical.

[155]Under these conditions the Main Reef series is sometimes represented by a single bed of conglomerate, or is accompanied merely by one or more insignificant, overlying, leaders.

the foot-wall slates below the Main Reef. It is certainly a remarkable fact, otherwise difficult to explain, that, speaking generally for the whole Rand, the yield of the South Reef Leader, which is not immediately underlain by shale, is far less reliable than that of the Main Reef Leader, which usually lies some 60 to 120 ft. or more below it. In the absence of modifying conditions such as the presence of a shaly, talcose, or sericitic foot-wall, the tendency can frequently be observed for the gold to be spread over several bands of conglomerate (which are often thin and separated by barren quartzite) in such a way that the total gold contents cannot be mined within a sufficiently narrow stope-width to extract it profitably. On the other hand, when one of the ancient channels of circulation has been outcrops,[157] probably nearly twice the amount of the yield to date,[158] would not in the future be available.

Iridosmine in the Banket

The writer has dealt elsewhere with this subject[159] and mentioned several mines where iridosmine has been noticed in minute quantities associated with the gold, for example, at the Modderfontein, East Rand Proprietary, Randfontein, and Rietfontein mines: also from the banket in the Black Reef formation at Klerksdorp and in the banket that immediately underlies the diabase at the Steyn's Es-

[157]This depth will certainly not mark the limit to which profitable mining will be extended.

F. H. Hatch has shown that figuring on the data obtained from H. F. Marriott's experiments, which demonstrate that on the Rand the rise of temperature with depth is only 1°F. for every 208 ft. of depth, the temperature at 7000 ft. would be about 97.5°F. He also pointed out that the electrical transmission of power as applied to stage-winding has so modified mining engineers' ideas of the depth at which mining is practicable, that it is now generally assumed that no mechanical difficulties exist which cannot be overcome, if it pays to do so. 'The Past, Present, and Future of the Gold-Mining Industry of the Witwatersand, Transvaal,' by F. H. Hatch. *Min. Proc.* Inst. C. E., Vol. 186 (1911).

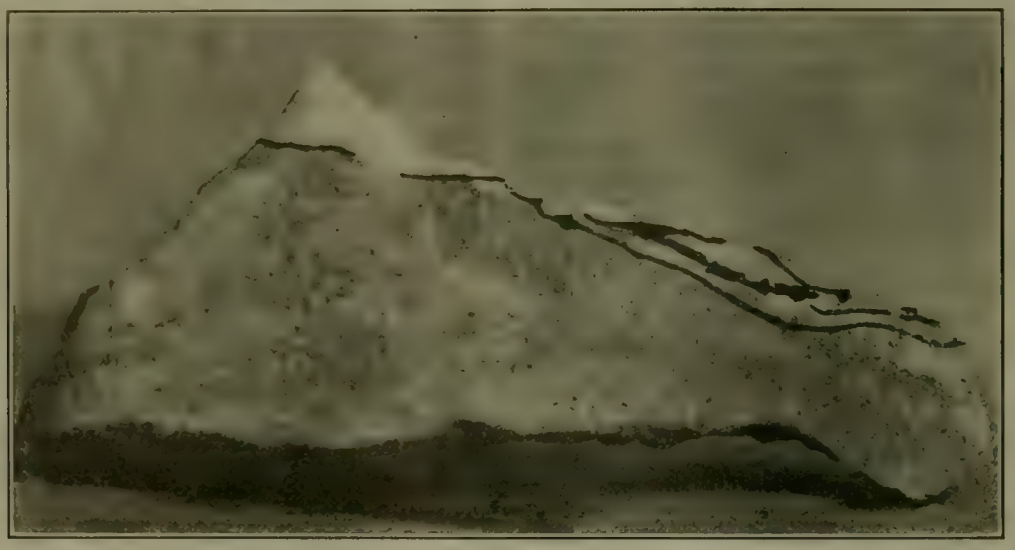

FIG. 21. LIGHT-GRAY QUARTZITE WITH LINES OF VISIBLE GOLD, INDICATED, AS TO POSITION AND THICKNESS, BY THE BLACK MARKINGS. SOUTH RANDFONTEIN. NATURAL SIZE.

restricted owing, say, to a reduction in the thickness of the banket, or, for a short distance, to entire absence of pebbles, the gold is frequently concentrated in this narrowed area; and, in the latter case often into a line of visible gold along the contact of both walls, as illustrated in Fig. 21.

Influence of Slate and Shale

The result of the retaining influence of slate and shale is thus of great economic importance. It is not merely that the more uniform yield of gold from the Main Reef sub-series, as compared with that from the South Reef sub-series, has affected actual mining operations, but that except for the retaining influence of slates and shales it might have been that the gold of the Rand was not sufficiently concentrated in any particular series of conglomerates to pay for extraction; in which case the £347,000,000 worth of gold already won,[156] would have remained in the ground; and the gold still obtainable down to a vertical depth of, say, 5500 ft. below the banket

[156]This is from and including the year 1887 up to the end of December 1912. The actual figures, as closely as they can be estimated, are: 81,703,602 oz. of fine gold, valued at £347,054,851. Out of this, £91,502,871 has been paid in dividends. (*So. Af. Min. Jour.*, Jan. 18, 1913.)

[158]This means a total, of, say, £1,000,000,000 down to a vertical depth of 5500 feet.

T. H. Leggett and F. H. Hatch, in 1902, estimated the total gold production from the Main Reef series down to a vertical depth of 6000 ft. at £1,310,300,000. The average figure used by them for gold recovery, was 38s. per ton milled. At the time the average recovery was 42s. 'An Estimate of the Gold Production and Life of the Main Reef Series, Witwatersrand, down to 6000 ft.,' by T. H. Leggett and F. H. Hatch. *Trans. Inst.* Min. and Met., Vol. XII (1902-3), p. 39. The recovery has since gradually decreased; and, for the year 1912 was only 29s.

It was hardly anticipated ten years ago that low-grade rock (of, say, an assay value of about 5 dwt.), from the deep-level ground of the Rand, would ever be of economic value. Now large tonnages of low-grade ore can be, and are, included in the ore reserves and can be profitably treated; thus greatly adding to the life of the Rand as a gold-producer.

[159]C. B. Horwood (1912), *op. cit.*

tate mine.[160] He pointed out that it occurs in such minute quantities that it is never visible in the ore, and is therefore only of scientific interest. The detection of it is a result of high specific gravity,[161] as it accumulates in the battery concentrate or black sand residue, and die sand. For example, at the Rietfontein mines the black sand that was separated from the plate-dressings was put into the ball-mill each day and once a month the accumulations from the latter were put into the Berdan pan, where they were treated for about 48 hours, and afterward the iridosmine was separated from this concentrate by panning; being the heaviest metal, it remained in the pan until the last. In this way several months passed before even 1000 grains of this mineral were collected.

Spectroscopic Analyses

Spectroscopic analyses which have been made of iridosmine concentrate from the Rietfontein mines were described in the paper mentioned; these, through the courtesy of Sir J. Norman Lockyer and W. J. S. Lockyer, having been carefully made for the writer at the Solar Physics Observatory, at South Kensington, by C. P. Butler. Two of them are illustrated in the accompanying plate (Fig. 22). It will be noticed that the strong osmium and ruthenium lines have been lettered, but not the iridium lines, as they are too weak to be readily recognizable in a photograph. Silver poles were employed and in each case the spectrum given by the silver poles alone is shown immediately below the spectrum of the concentrate. So the lines in the latter that are merely due to the poles can be seen at a glance. Spectroscopic analysis is useful in cases such as this, as the rare elements can be detected quickly and with certainty. The presence of traces far too small to be detected by the chemist are often quickly and easily revealed by the spectroscope. However, it is well to remember that such analysis is only qualitative; for example, some elements although present in minute quantity may give strong lines, while others, present in much larger amount may give quite weak lines. This depends on whether the element is easily vaporized by the heat of the electric arc, or, in other words, is better able to carry the current, in which case the lines will be relatively strong. It approaches a little to quantitative methods in the case of a differential analysis when a spectrum of a substance containing an unknown quantity of an element is compared with that of another containing a known quantity of the same element, when some idea of the relative quantity present in the former can sometimes be formed. Also it may be possible to get an idea of the relative quantities present when the spectra of two substances each containing an element in unknown but different amounts are compared. These

[160]Probably closer investigation would show that the metals of the platinum group occur as minute traces throughout the mines of the Rand, as traces of these metals are invariably found when the gold, as despatched to Europe from the Rand, is refined.

[161]The specific gravities, when pure, of gold, iridium, and osmium are 19.3, 22.7, and 22.5, respectively. The two latter generally contain impurities, and so the specific gravities are reduced and thus more nearly approach that of gold.

SPECTRA OF HEAVY CONCENTRATES. FROM THE RIETFONTEIN ESTATE GOLD MINES.

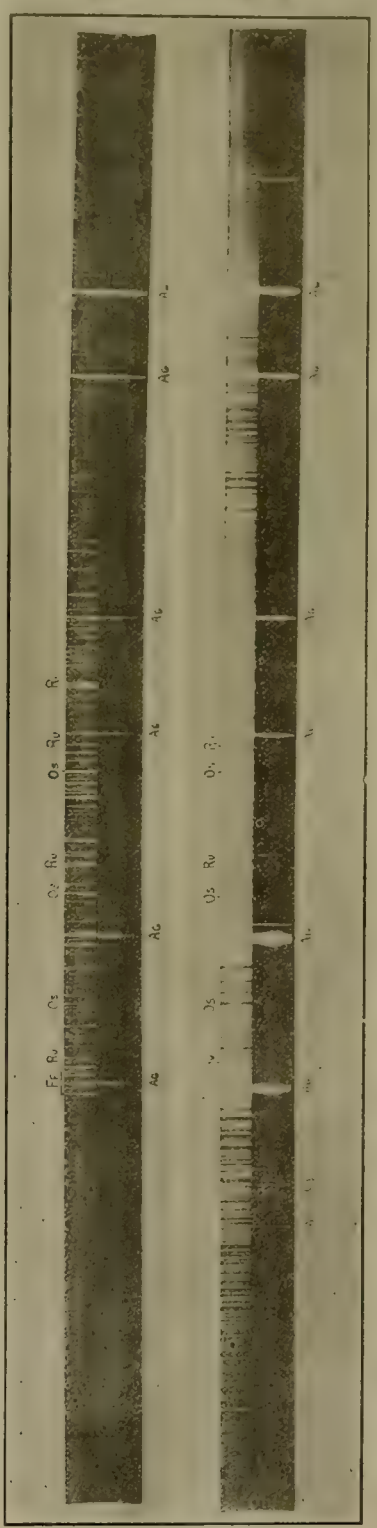

FIG. 22. THE OSMIUM AND RUTHENIUM LINES ARE INDICATED BY THE CHEMICAL SYMBOLS AGAINST THEM; BUT NOT THE IRIDIUM LINES, AS THEY ARE TOO WEAK TO BE READILY RECOGNIZED IN A PHOTOGRAPH.

particular analyses of the iridosmine concentrate disclosed the presence of osmium, ruthenium, and iridium, constituting apparently the bulk of the material. Iron, chromium, calcium, aluminum, titanium, magnesium, strontium, sodium, manganese, and silicon lines were also present.[162] A chemical analysis made by the Imperial Institute authorities[163] was also given at the same time. The concentrate had a specific gravity of about 19 and was found to have the following composition:

	Per cent.
Gold	1.24
Platinum	0.81
Iron (expressed as Fe_2O_3)	1.29
Nickel (expressed as NiO)	0.66
Osmiridium (Ir, Os, and allied metals)	95.52
	99.52

The osmiridium was found to contain about 45% of iridium; but Mr. Dunstan pointed out that the result of a single analysis may be misleading, as osmiridium varies greatly in composition even in the case of samples from the same locality.

Genesis of Osmiridium

In discussing the genesis of this substance, the present writer emphasized the fact that the atomic weights of gold, iridium, osmium, and ruthenium are 197, 193, 191, and 102, respectively, and that the elements of highest atomic weight are, on the whole, relatively the rarest in rocks; further, that if one could explain why elements of high atomic weights are rare, then, as R. K. Duncan has pointed out, the explanation of the genesis of matter would probably be revealed.[165] The forty years' labor of Sir Norman Lockyer[166] has accustomed the world to the conception of an inorganic evolution in the sun and stars according to their supposed differences of temperature; and he ranged certain elements in the order of their appearance in these stars. The radio-active elements, on the other hand, such as radium, thorium, uranium, etc., possess the heaviest atoms known, and their radio-activity seems to depend upon their devolution into simpler elements. It may thus be that the lighter elements are taking up as much energy when evolving into heavier elements as is given out by the latter in disintegrating into the former.[167] As regards the genesis of the iridosmine in the Rietfontein mines, he pointed out that it was associated with gold and pyrite and seemed mostly to occur in that seam known as the Carbon Leader:[168] some of it was distinctly crystalline; it was accompanied by a small proportion of nickel and a little chromium, both of which occur in basic rocks as a product of differentiation of an igneous magma; moreover, the original home of the platinum metals, often with some gold and chromite, is the basic and ultra-basic rocks, in which they exist as primary segregations formed by magmatic concentration; further, that the metallic elements of the auriferous bankets, gold, silver, iron, cobalt, copper,[169] and nickel, together with the metals of the platinum group, form three analogous series, all occurring in Group VIII of Mendeléeff's table,[170] and that this association, agreeing as it does in such a striking way with their chemical association and their grouping by Mendeléeff according to their atomic weights, valencies, and other chemical properties, is too remarkable to be purely accidental and must surely indicate a close genetic relationship; therefore, if a particular genesis be admitted for any one of them it must seemingly be admitted for them all. He laid stress also on the fact that the iridosmine was associated with gold, silver, pyrite, carbon, and traces of cobalt, all of which had already been shown to occur in neighboring basic dikes encountered in the mines of the Rand and, that in these Rietfontein mines basic rocks are abundantly represented by big persistent diabase dikes, 80 to 120 ft. thick, which are exposed underground for a distance of nearly two miles. He maintained that the auriferous Rand

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[162] There were traces of the strongest lines of vanadium; and indications that rhodium, platinum, and palladium were also present. Many other rare elements, including radium, were sought, but were not found.

[163] The sample used was a portion of one from the Rietfontein mines; the other portion had already been used for the second spectroscopic analysis (the upper one in Fig. 22).

[164] Through the courtesy of the Transvaal Mines Department and R. N. Kotzé, the Government Mining Engineer, who obliged the writer by making an official request for a quantitative analysis of the concentrate, and the director (Wyndham R. Dunstan, F.R.S.) kindly had this done.

[165] 'The Chemistry of Commerce,' by R. K. Duncan (Harper Bros.), chap. 'Rare Earths and their Application.'

[166] *Proc. Roy. Soc.*, 61, p. 204.

[167] See R. K. Duncan, *op. cit.* Also Crookes on the Genesis of the Elements,' Brit. Assoc. Report, 1886; Presidential Address of Sir William Crookes, *Trans.* Chem. Soc., 1888. 'The Evolution and Devolution of the Elements,' by A. C. and A. E. Jessup, *Phil. Mag.* (1908), Vol. VI, No. 15, p. 21; and 'The Elements,' by Sir William A. Tilden (1910), chapter 4 (Harper Bros.).

[168] Reference has previously been made to this 'reef' in this paper.

[169] It is interesting to note that traces of copper occur in the Klipriversberg diabase (Horwood (1910), *op. cit.*, p. 38), with which the longitudinal dikes, in the mines of the Rand, are doubtless genetically connected.

[170] The reader is referred to the table of the elements as revised by this famous Russian chemist as recently as 1904 to include all the known elements except the 'rare earths.' It is true that copper, silver, and gold are usually considered as occurring in series 5, 7, and 11, respectively, under group I. It will, however, be seen that Mendeléeff indicates their very close relationship to the three analogous series of group VIII by also including them, in brackets, under that group. In the first analogous series of this group are iron, cobalt, nickel, and copper. Iron is largely present in the Rand bankets, chiefly in the form of iron pyrite, which, as previously stated, occurs in quantities varying from about 2 to 3%. Cobalt, nickel, and copper occur in minute quantities throughout the mines of the Rand (they can be detected by analysis in the cyanide solutions: see Horwood (1910), *op. cit.*, p. 72). Ruthenium, rhodium, palladium, and silver form the second analogous series. Both spectroscopic analyses showed that ruthenium was largely present in the heavy concentrate from Rietfontein. The probable presence of rhodium and palladium was established by the first spectroscopic analysis. Silver occurs associated with the gold of the Rand to the extent of about 125 parts per thousand of bullion. The third analogous series of this group consists of osmium, iridium, platinum, and gold. The chemical analysis and both spectroscopic analyses showed that the Rietfontein concentrate was largely composed of these first two elements. The chemical analysis disclosed the presence of platinum; and the spectroscopic investigation of the first sample had also suggested its presence. In Rand bullion, gold accounts for about 875 parts per thousand: see Horwood (1910), *op cit.*, pp. 72, 77, and 82; also Horwood (1912), *op. cit.*

bankets differ in no important essentials from ordinary gold-bearing quartz-veins, and that dikes are sufficient evidence of former deep-seated communications; he remarked that Kemp[171] laid special stress on the almost constant association of eruptive rocks with veins and the usually very restricted occurrence of the latter and rightly argued that considered as to area there is adequate reason to attribute to these rocks a great importance in vein production. Therefore the writer concluded that these metals are of secondary origin, and had existed in minute proportion as primary segregations, formed by magmatic concentration, in the basic eruptives of these mines, from which they were extracted by active superheated gases; still later hydrothermal action probably playing an important part in concentrating them in the bankets.

Crystalline Structure

R. B. Young,[172] in combating these conclusions, says that the present writer stated that "the iridosmine shows no signs of being water-worn" and that "it consists of crystals with perfectly sharp edges and smooth faces." What the latter actually stated was that "the iridosmine, and the gold with which it is associated, is crystalline; and does not show evidence of being water-worn, as one would expect it to do, if it were an original constituent of the banket."[173] At the meeting of the Geological Society of South Africa, subsequent to the one when his paper on the iridosmine was read (in reply to a query from Professor Young), he said that the Rietfontein concentrate contained sharp angular particles of iridosmine: which it does. He did not say that the concentrate consisted entirely of angular grains and contained no rounded ones. In fact, when examined under the microscope, the roundness of grain as compared with iridosmine concentrates from other sources is seen to be one of the chief characteristics of the iridosmine from the Transvaal bankets. Young refrained from discussing the paper at that meeting while the writer, who was just leaving Johannesburg for England, was there to reply. Consequently, the writer did not disclose all his evidence, or the main features of his slides; but, at Young's request, he agreed on his return to England to find his slides[174] and send them for Young to see. Pressure of business in England and then a visit to Germany prevented him doing this immediately. In the meantime, without waiting for the slides, Young[175] attacked his conclusions in a brief paper, basing his opinion that the iridosmine is of detrital origin on the rounded form of the mineral grains and their association with what he considered detrital chromite; and on the fact that it occurs in conglomerates where a concentration of heavy minerals might have taken place during sedimentation. The last argument can equally well be used to argue that the gold is of placer origin, and Young admits it is not. As regards his other two arguments, the present writer had already pointed out that the concentrate was associated with nickel and chromium, but had referred their origin to the dikes. He had shown that traces of nickel occur associated with the gold of the Rand and can be detected in analyzing the cyanide solutions;[176] and later in the present paper he instances the occurrence of nickel in a basic dike at Pilgrim's Rest;[177] and also shows that chromium is one of the agents responsible for the pigment of the black-edged pebbles in the banket; and further that it was probably introduced into them under pneumatolytic conditions.[178] Young in calling the chromite detrital is merely expressing an opinion. Young states[179] that in the samples from Rietfontein and Klerksdorp that he has examined "distinct crystals are moderately common, but in every instance the edges are rounded off. Every gradation can be observed from crystals in which the faces are plainly discernible to rounded grains in which one can just trace the original hexagonal form. A large proportion of the iridosmine is in beautifully rounded grains, bearing no trace of crystalline form. Cleavage flakes and irregular fragments also occur." He then illustrates the general rounding of the grains by means of two photographs.

Rounded Forms of Iridosmine

As regards the rounded form of the iridosmine grains being proof of detrital origin, the early observers fell into similar error over the so-called 'rolled' pyrite 'pebbles.' The iridosmine of admitted detrital origin from the Urals, California, Brazil, New South Wales, and Tasmania has a flaky habit and the extent to which it has been abraded is slight. The iridosmine from the auriferous banket from the Rietfontein mines and from Klerksdorp differs from the former in two striking respects, namely, in the minuteness of the grains, and in their extremely rounded form. Prof. Young in his argument points to occasional crystals of other minerals, showing no trace of rounding, and says the hard iridosmine crystals without exception have rounded edges; and concludes that these features dispose of any contention that the rounding was produced during the various processes to which the ore was subjected before the iridosmine was finally extracted from the ore. In the iridosmine of known detrital origin and in that from the South African bankets sharp angular fragments occur; but since the grains are so much smaller and are mostly of such extremely rounded form in the latter as compared with the former, if the rounding was due to abrasion one would hardly expect that angularity of any of the particles could have survived in these South African concentrates. Owing to high surface-

[171] 'Igneous Rocks and Circulating Waters as Factors in Ore Deposition,' by J. F. Kemp, *Trans.* Amer. Inst. Min. Eng., Vol. XXXIII (1903), pp. 703-704.

[172] 'Note on the Origin of the Iridosmine in the Banket,' by R. B. Young, *Trans.* Geol. Soc. So. Af., Vol. XV (1912), p. 113.

[173] *Trans.* Geol. Soc. So. Af., Vol. XV (1912), p. 59.

[174] Which he had determined when in England some months previously.

[175] 'Note on the Origin of the Iridosmine in the Banket,' by R. B. Young, *Trans.* Geol. Soc. So. Af., Vol. XV (1912), pp. 112-113.

[176] 'The Mode of Occurrence, etc., of the Carbon in the Rand Bankets,' (1912) *loc. cit.*, p. 77.

[177] See part VII.

[178] See Part VI of the present paper.

[179] Young (1913), *op. cit.*, pp. 113-114.

tension, metallic particles when heated to temperatures above their melting points usually assume a more or less spherical form. Thus it is well known that when small irregular particles of copper are allowed to fall through a tube heated well above 2000°C. they become approximately spherical. In making lead shot, the molten metal when poured on a sieve and allowed to fall a considerable distance is disintegrated and the particles become spherical. If small irregular pieces of silver, gold, platinum, or other metals of the platinum group are heated to above their melting points on cupels they assume spherical shapes. When platinum wire is heated before a strong oxy-coal-gas blowpipe flame, the platinum melts and falls down in small rounded globules.

Extraction of Iridosmine from Dikes

The writer concluded that pneumatolysis had been responsible for the extraction of the iridosmine from the dikes; which would involve a higher temperature than that required for the molten metal; thus similar laws would apply, and the tendency on cooling would be to assume spherical forms,[180] and this explanation would account for the roundness of grain. In making room for itself, metasomatism may also have come into play; as in the case of the pyrite and of the carbon. The fact that rounded particles, sharp and irregular grains, and crystals occur together in the iridosmine concentrate strengthens the similarity of its ocurrence to that of the pyrite in the Rand banket; and it is now generally admitted, as in the previous pages it has been shown, that the latter is not of detrital origin. Apart from roundness of form due to influences operating at the time of the deposition, the writer has also accounted for possible subsequent rounding of angles and edges of crystals when discussing the shape of the pyrite 'pebbles.' Similar reasoning applies in this case; the prevailing roundness of the grains is therefore no evidence that the iridosmine is water-worn. On the other hand, its crystalline character is undisputed. On a previous occasion Young[181] had given a description of it, as obtained after the gold ore had been treated in the stamp-batteries, in the following words: "It is got in flattened and rounded grains, and in tubular six-sided and rhombohedral crystals, both averaging in diameter about 0.12 mm. In the crystals the basal and rhombohedral faces are distinct, the prism faces less so or absent. The basal cleavage is distinct, many of the grains being in the form of basal flakes, probably produced, in part at least, during the crushing of the rock." In basing his conclusion that the iridosmine is of detrital origin on the general roundness of its grains, he had apparently forgotten that in discussing the occurrence of pyrite 'nodules' or 'pebbles' in the banket he contended that the shape was the "direct result of the mode and conditions of their growth,"[182] and also that he had stated he was of opinion that "the rounded form of a pyrite grain affords no reliable evidence of its detrital origin."[183] The present writer contends that the same remarks apply equally well to the iridosmine of the bankets.

Deposition of Carbon

The carbon, which is certainly not of detrital origin, exists in warty, rounded, grains, and, as we have seen, investigations indicate that it was deposited at high temperature from a gaseous state, or from a very mobile liquid. The writer's researches on the origin of the iridosmine indicated the basic dikes as their source. Recently Alfred Fowler[184] has kindly undertaken a spectroscopic investigation of specimens of the big diabase dike in the Rietfontein mines to ascertain whether it would reveal traces of iridium and osmium. At first he thought some lines were faintly shown, but further work did not confirm this. As already stated, the amount of iridosmine present in the banket is so minute that it has never been discovered in place. At the Rietfontein mines it took about six months to collect some 910 grains of the concentrate, during which time 102,800 tons of ore was crushed, and over 52,500 ounces of fine gold was recovered.[185] Thus if its presence in the banket be due to the intrusion of these dikes it is only to be expected that any still remaining in them would exist in such minute proportion as not even to be capable of detection by so delicate a method as spectroscopic analysis. The final spectroscopic results were based upon photographs taken with a 10-ft. concave grating. The presence of iridium, osmium, ruthenium, platinum, or nickel was not detected, although long exposures were given in order to register the fainter lines of the spectrum. Among the elements present in the samples were aluminum, magnesium, chromium, titanium, scandium, and vanadium. The spectroscopic examinations of iridosmine concentrate from Rietfontein had revealed the presence of these first four elements; and the slightest trace of the strongest vanadium lines had also been obtained. Thus five out of six of these elements had been found in the concentrate. One of the characteristic minerals, associated with the Rietfontein

[180] As cosmic bodies do on gradual cooling from a gaseous state.

[181] Young (1907), *loc. cit.*, p. 18.

[182] Young (1909), *op. cit.*, p. 88.

[183] Young (1907), *loc. cit.*, p. 20. In describing the occurrence of pyrite in the banket, he says it is of especial interest as it is generally the gold-bearer of the rocks; that in a number of the microscopic sections which he has examined almost every pyrite grain is beautifully crystallized and shows no trace of rounding; but that it is a fact that a large proportion of the pyrite in the banket occurs in the form of rounded grains, and he mentions that Becker gave their average diameter as 0.1 mm. and that the latter stated that they constitute most of the pyrite in the banket. Young then states that as a result of his own investigations he is "of opinion that the rounded form of a pyrite grain affords no reliable evidence of its detrital origin."

[184] Mr. Fowler, who is a Fellow of the Royal Society and one of the greatest living authorities on spectroscopic work, was for many years closely associated with Sir J. Norman Lockyer in his world-famed work.

[185] These figures indicate that the Rietfontein lodes contain about 27,500 times as much gold as metals of the platinum group. However, it must be remembered that the gold recovered was obtained both from the mill and the cyanide plant; but the iridosmine concentrate was obtained only from the battery, and it is just possible that a little may have passed to the cyanide works and been lost.

iridosmine, and the one on which Young lays so much stress, is chromite. The spectroscope examination of samples[166] of the neighboring basic dike has thus revealed a definite source of chromium. Young argued that the source of the iridosmine must be the same as that of the chromium; he assumed that the latter was of detrital origin and suggested the ultra-basic rocks of the Swaziland system as its source; whereas Mr. Fowler's research work has demonstrated that there is no occasion for such assumptions as a source exists in the basic rocks occurring in the mines, in the immediate proximity of the bankets containing the chromium and iridosmine. The foregoing facts and arguments and the association of the iridosmine with gold, silver, pyrite, carbon, traces of cobalt, and also with chromium, all of which have been shown to occur in the neighboring dikes, indicate the latter as the responsible agents for the minute quantities of these rare metals in the auriferous banket.[167]

[166]The samples consisted of portions of bore-hole cores from the central portion of the main dike.

[167]It is quite possible that there may be a small proportion of pyrite and gold of detrital origin in the banket; but, if so, it is admittedly unimportant in discussing the genesis of the pyrite and gold; and the same remarks apply with regard to these rare metals.

(To Be Continued.)

Valdez Creek Placer Mines

By George W. Sias

During the season of 1913 the Valdez Creek Placer Mines completed a large ditch 1¼ miles in length having a capacity of 2500 miner's inches with a grade of ½ in. to the rod, laid 2800 ft. of pipe, built a penstock, a by-wash ditch with a length of nearly one mile, put in a flume, and started hydraulicking operations on August 1 on the famous claim known as the 'Tammany' on Valdez creek. On this claim in the year 1907 an adit was started on bedrock, and from 1907 to 1911 this work had been extended by lateral drifts and stopes to an average of 25 ft. wide, 7 ft. high, and 1200 ft. long. On the bedrock of this old channel some of these drifts had been run out on each side at least 100 ft., showing that the bedrock was in places 200 ft. wide between the rims.

Grade of Gravel Being Handled

In doing this work and proving up the value of the gravel on the bedrock, more than $160,000 was taken out. In the report made on this property by Forbes Rickard in 1911, he estimated the entire bank would run 94c. per cubic yard. This year hydraulic operations on the face of this bank, cutting the bank back 125 ft., proved in the clean-up that the gravels averaged $1.50 per cubic yard in that part of the bank above the old workings. Every hour of piping into the flume averaged about $100, and the values found more than confirm the estimate of Mr. Rickard and prove beyond question the old channel. Furthermore, the work done on this bank of gravel shows the face 110 ft. high and 200 ft. wide. These are the claims that Mr. Rickard had estimated could be worked for twenty years. It is easy to estimate from the results of this season's work the wealth of gold that will be taken out when this channel has been hydraulicked back for one mile, and all the geologists who have visited the creek believe that it extends many miles.

The trustees of the Company are contemplating sending in 6000 ft. of pipe of 36-in. intake, with necessary equipment, and having it ready for work, under a head of 300 ft., not later than July 1, 1914. This would give an additional capacity of not less than 5000 yd. per 24 hours for 150 working days. The trustees are more than satisfied with results for the year 1913, as there had been some speculation as to what this large bank of gravel would run.

In doing assessment work on other claims, gravel of value was found, especially on Lucky Gulch, a property seven miles above, which the geologists, including those representing the U. S. Geological Survey, considered to be the source of the gold in the old Tammany channel mentioned above. Here the men have recovered by hand work in a short time this season about $3000 in dust, including nuggets ranging from $5 to $60. Indeed, many nuggets of from $5 to over $900 are often found in the sluice-boxes on these claims.

There is a large acreage on this property, and with a proper equipment installed, the management believes that the amount of gold recovered from this property will be surprisingly large. On Discovery, about one mile below the Monahan adit, in doing the assessment work, coarse gold was shoveled into the boxes, which proves that there is a large amount of gold to be recovered from the benches below, as the engineers have asserted would be the case. The trustees have underwritten the bonds and it is their intention to send in a No. 4 Keystone drill and an Empire drill with pipe and other supplies for the year 1914 at an early date.

Australian Copper Production

September returns from some of the principal mines were as follows:

Mine.	Ore treated, tons.	Copper, tons.	Gold, oz.	Silver, oz.
Great Cobar	.....	532	2411	10,819
Great Fitzroy	9,121	184	961	2,371
Hampden Cloncurry ...	5,160	509	141	4,336
Mt. Elliott	4,212	500	820	1,160
Mt. Lyell	28,721	589	742	41,343
Mt. Morgan	22,667	694	8827	.....

Dredges operating in the South Island of New Zealand during 1912 numbered 87, and produced gold worth $1,230,000, of which $187,000 was paid in dividends by registered companies.

Big Business and Industrial Prosperity

By C. R. Van Hise

*There can be no question that the competitive system, when unrestrained, is positively opposed to the policy of conservation. This is true alike for minerals and timber. The minerals of the earth require the building of the earth for their making. Mineral deposits are doubtless in the process of manufacture at the present time; but even if so, this is at so low a rate as to be negligible. From the point of view of mankind, the stores of minerals in the earth are deposits of definite magnitude upon which we may draw but once and which by no possibility can be increased. In this connection it should be recognized that modern civilization would not be possible without the mineral resources of the earth—no iron ships, no tools except those of stone, no fuel but wood. Without the sub-surface products of the earth we would at once return to the material conditions of the stone age. It is therefore incontrovertible that from the point of view of the human race, economic systems or laws which result in unnecessarily rapid use of the mineral stores of the earth are indefensible; but such are the economic theories and laws now dominant in the United States.

Wastefulness of the Competitive System

The wastefulness of the competitive system may be proved with regard to every product which is taken from the earth. Lead and zinc in Wisconsin and Missouri are mined on a small scale under an extreme competitive system. The losses of these metals in their mining and metallurgy are nothing short of appalling. In Missouri, according to the late E. R. Buckley, not less than 15% of the metal is left underground; the losses in concentration approach 15%; the loss in smelting and concentration frequently amount to 15 or 20%; thus making a total loss of from 45 to 50%. These great losses are due to the system of numerous small holdings combined with the competitive system. High royalties on the part of the small feeholder are demanded of the operator. The operators desire to get large returns at the earliest practical moment upon this small investment. In consequence, ore is left in the ground that should be mined; unnecessary losses take place in concentration; also unnecessary losses occur in smelting.

But the most disastrous losses in mining as far as the future of the human race is concerned are in connection with coal. J. A. Holmes, of the United States Bureau of Mines, in a paper upon mineral wastes, presents the facts in regard to the ruinous wastes of the unrestrained competitive system in connection with coal. He says that in the early days of mining when there was much subdivision of ownership, not more than 30 to 40% of the anthracite coal in the veins mined was brought to the surface, leaving 60 to 70% in the ground. He states that even at the present time not more than 50% of the anthracite reaches the surface. The situation is similar for bituminous coal, but until recently the losses for such coal was substantially half. This loss has been somewhat reduced, but it continues to be appalling. Holmes estimates that since the beginning of mining in the United States, two billion tons of anthracite and three billion tons of bituminous coal have been left underground in such condition as to make their future recovery doubtful or impossible. The principles which from the point of view of conservation should apply to the mining of coal are well known. So far as practicable the mines should be so worked as to make one superimposed vein after the other available. Coal slack should be reduced in amount and utilized. No considerable percentage of coal should be left in the ground as pillars. If these reforms were introduced, the losses could be reduced to half the present amounts and possibly to one-fourth.

But to ask that any such proposals should be put into operation is purely chimerical. Under the Sherman law there is no opportunity to limit output, divide territory, or regulate prices. Five thousand bituminous operators could produce two hundred millions of tons of coal per annum beyond present demands. If the operators could agree upon limitation of output, and division of market so as to reduce freights, and could arrange for reasonable prices, which would give them no more than their present profits, they would then be able to follow these principles in mining their coal; for they themselves would be gainers in prolonging the life of their mines, and far more important many future generations would be the immeasurable gainers in that they would have an adequate coal supply. Under the competitive system, we are recklessly skimming the cream of the natural resources of a virgin continent with no regard for the rights of our children or our children's children. They will have a heavy score against us if we continue to ignore the future and to apply the unrestrained competitive system in total disregard of their rights.

Remedy for Existing Conditions

My proposal to remedy these conditions is neither regulated competition, nor regulated monopoly, but retention of competition, prohibition of monopoly, permission for coöperation, and regulation of the latter. At the present time there are state and national movements to still further extend the advantages of coöperation to the farmers. Since it is unquestionable that the sense of justice of the citizens of the United States will support the courts in prohibiting class legislation, we shall, therefore, I believe, ultimately permit coöperation in all lines of business alike. If we, however, retain freedom of competition, permit concentration sufficient to give efficiency, allow reasonable coöperation, and prevent monopoly, this will require regulation just as it has been necessary to regulate the railroads. This done, the Sherman law will be forgotten. Has there been

*Part of an address delivered before the American Mining Congress.

any prosecution of the railroads for violations of the Sherman law because of collusion of fixing rates? And yet, everyone knows that they are just as flagrant violators of the Sherman act as any other class of corporations in the United States. Are the freight rates the same for different roads between any two points? Are the passenger rates between Philadelphia and Chicago identical on all roads? Can you do better in price by traveling over the Pennsylvania than over any other road? The rate is the same providing the speed is the same. How does it happen that the roads all got together? Just by Providence I suppose. It was doubtless by a providential act that these rates were fixed identically upon all the roads, under the same conditions, all over the country.

Why is it that nobody proposes to indite the railroads for collusion? Simply for the reason that the rates which they can charge are controlled by commissions, national and state. Nobody any longer wishes to make them further trouble, because the public is protected by its commissions. The railroads are just as amenable to attack under the Sherman act as any other combination in the United States, but when the railroads are giving reasonable rates, and are competing in giving reasonable service, even if the law is on the statute book and is the hallowed thing that has been described—the sense of official justice is such that they are not attacked in the courts. Will the Attorney General of the United States or the Attorney General of this or any other state bring suit against the railroads for conspiracy in fixing rates when the public is properly protected? I have not heard of such a proposal.

However, it is a wrong condition when we have on the statute books a law of a kind which requires the officials of justice to close one eye whenever they pass by the men in control of one group of industries and at the same moment see other men not one whit more guilty. We ought to remedy this condition so that honorable business men shall not be in the unfortunate position of being technically violators of statutes which it is not advantageous from the public point of view to enforce.

The Sherman Act

In regard to the Sherman act, it has been assumed that its only violators are the great combinations. This assumption is made in practically all discussions of the question. The 'Steel Trust,' the 'Tobacco Trust,' and a few other large combinations are mentioned; and it is supposed that the small business men and the small producers are not acting in violation of the law. But the principle of coöperation which the Sherman act tries to suppress extends from the great industrial centres like Philadelphia to the country cross-roads. Does it make any difference here in Philadelphia, the home of anthracite, whether one buys anthracite of one retail dealer or another? It doesn't make any difference in the country cross-roads either. The price is just the same from all the dealers in the same locality. The same is true of ice, the antithesis of anthracite, and is also true of all standard articles. The principle of coöperation has extended from the great manufacturers and the great dealers of the large cities to the small manufacturers and small dealers of the small cities and even villages. All are coöperating in the same way; the principle is the same for the large and small man; one is violating the law just as certainly as is the other. I am willing to stand for enforcement of law when the law is enforced alike for all; but when somebody is picked out because he is in the front seat, or because it is good politics to attack him, and ninety-nine or nine hundred and ninety-nine are allowed to escape, I say that it is a profoundly immoral situation.

Farming Trusts

The cranberry growers of Cape Cod, New Jersey, and Wisconsin, sell about 90% of their products through an agency down in Hudson street, New York. Similarly, many products of the farmers, illustrated by cotton, citrus fruits, and others, are marketed through coöperative selling agencies. Have we heard of the Attorney General prosecuting these farmers? Congressmen understand the situation, and at their two recent sessions they attached to the Sundry Civil bill a clause containing an appropriation of $300,000 for the enforcement of the anti-trust laws, which included the provision that none of this money should be spent in prosecuting combinations or agreements of labor, nor spent for the prosecution of producers of farm products and associations of farmers who coöperate and organize in an effort to and for the purpose of obtaining and maintaining a fair and reasonable price for their products. The purpose of this provision is clearly to make the Sherman law class legislation by indirection and in effect to prevent equality before the law of the manufacturer as compared with the farmer. And some of the smarter state legislatures have seen the situation and in order to prevent the farmers from being hit by their anti-trust bills exempted the products of the lands so long as in the hands of the producers. The state legislatures, like Congress, saw that the farmers have so many votes that they have to be dealt with gently when they form a trust. But some of the state laws got into the United States courts, and these courts promptly declared these exemptions unconstitutional as being special legislation. I venture to predict that it will not be so popular a political game to shout, 'Bust the trusts,' when the farmers understand that their trusts are also to be 'busted.' No more pernicious or immoral legislation was ever passed by Congress or by the states. The principles of justice in regard to trusts and combinations are alike for the manufacturers, the farmers, and the laborers. In this country we have not a special situation which concerns a few men, but a general, irresistible impulse. There is just as close-riveted an arrangement between the three icemen in the country town as there is in steel; and any solution of the problem of combination, if it be a just solution, must be applied not only to steel and tobacco, but to the small tradesman, the farmer. Just as certainly as the great combinations are violating the Sherman act, as I have no doubt many of them are, so are the small aggregations of wealth violating state anti-trust statutes. This general violation of the trust laws national and state is the problem that we have before us.

Holdings of the Hollinger Reserve Mining Co., Ltd.

By An Occasional Contributor

The Hollinger Reserve Mining Co., Ltd., is incorporated under the laws of the Province of Ontario and capitalized at $2,000,000, divided into 400,000 shares at a par value of $5 each. The Company owns claims H.R. 9, 25 and M.E. 44, 45, and 46 in the township of Ogden, Porcupine mining division, Ontario.

The country is slightly rolling and heavily wooded in this vicinity, mostly sandy plains with one rocky knoll near the Mountjoy or Foolham river. The country rock is Keewatin greenstone, intruded to the south by a quartz diorite. A belt of schist, 120 ft. wide at the surface, resulting from the metamorphism attendant on the diorite intrusion, lies at the contact of the diorite and greenstone. This belt of schist has been found to be 134 ft. wide at the 100-ft. level and 240 ft. wide at the 200-ft. level. In this belt of dark gray, fine grained, and compact schist, a series of five parallel veins have been formed, ranging from two to six feet wide on the surface and striking 15°N. of E., and with a dip of 5° from the vertical to the north. These veins, in many places, have no regularly defined walls and the gold content diminishes as the distance from the pay streak increases. The veins consist of quartz in distinct stringers as well as in bunches, irregularly distributed throughout the schist, the whole being impregnated with iron pyrite, some copper pyrite and a little mispickel, in spots. Free gold has been found in a great many places along a definite rich pay-streak on the surface of No. 1 vein. On the 100-ft. level free gold can be traced almost continuously along the entire 70 ft. which has been driven on the pay-streak of this vein, and can be seen in numerous places along the pay-streak on the 200-ft. level.

On the 100-ft. level, the vein assays average $51 for the 70 ft. driven, with an average width of 4 ft., while on the 200-ft. level the average assay for the 168 ft. driven was $27, with an average width of 5 ft. The vein at this level has a total width of over 12 ft. The eastern face of the drift at the 200-ft. level showed assays of $47, for the entire face, which is over 5 ft. wide, and the western face showed assays of $34 per ton. The five parallel veins are all being developed at the 200-ft. level, where the principal development work is now being done, after cross-cutting the entire vein system at the 100-ft. level. No. 2 vein averages 4 ft. wide on the 100-ft. level and can be seen in the shaft for the entire distance between the 100 and 200-ft. levels. It has been driven for a distance of 140 ft. on the 200-ft. level and shows assays averaging $6. The drift is 6 ft. wide.

No. 3 vein merges with veins 4 and 5 on the 200-ft. level, all of which show assays ranging from $5 to $10 over widths averaging 5 ft.; on the 200-ft. level. The united veins are 5 ft. wide and average $8 per ton. From a depth of 65 to 87 ft. in the shaft, a series of quartz stringers showing considerable free gold traversed the shaft dipping toward the No. 1 vein. These stringers gave assays averaging $57 per ton across the width of the shaft.

A fault was encountered at the 200-ft. level which will cut veins No. 1 and 2 at a depth of between 200 and 300 ft. and which let in a lot of water. The shaft is making 14 ft. of water per day, and to pump this, two sets of Cameron duplex pumps have been installed. In case one set stops, the other set is ready for immediate operation, thus obviating any vexatious delays.

Practically all the development has been done on the rocky knoll, where during the winter of 1911-1912 a series of diamond-drill holes were drilled to a depth of 350 ft., and the results were so satisfactory that a shaft was commenced on June 15, 1912. A Rand compressor of 585 cu. ft. capacity has been installed with two boilers of 60 hp. each. The equipment has been increased until now the Company has a complete set of buildings, comfortable offices, manager's house, cooking and sleeping quarters, shaft house, well equipped blacksmith shop and power house, and a comfortable dry house for the men, with hot and cold water in the baths. The 215-ft. shaft is equipped with bell, and air signals, and the cage with an automatic safety device. On the 100-ft. level, 290 ft. of driving and cross-cutting has been done, and on the 200-ft. level, 650 ft., where development is being rushed preparatory to the erection of a mill. The property has just passed into the hands of the Lewisohns, who are to finance further development and receive in return an interest in the Company.

Costs at the Great Fingall Mine

During 1912, there was treated 71,603 tons of ore at this company's mill in Western Australia, at the following cost:

	Cost per ton.
Ordinary development	$0.76
Ore extraction:	
Breaking ore	1.14
Filling stopes	0.09
Tramming and raising	1.32
Total mining	$3.31
Ore treatment:	
Rock breaking	$0.14
Ore transport	0.05
Milling	0.56
Concentrating	0.04
Filtering and fine grinding concentrate	0.08
Fine-grinding sand	0.30
Cyaniding by percolation	0.21
Slime (vacuum filtration)	0.22
Precipitation and smelting	0.06
Disposal of residue	0.15
Sampling custom ore	0.07
Treating custom concentrate	0.04
Total treatment	$1.92
Less receipts from custom ore	0.21
Net treatment	$1.71
General expenses	0.60
Bullion expenses	0.07
Total expenditure	$5.69

During September the Elmore vacuum plant at the mines of the Sulitjelma company, Norway, produced 1163 tons of copper concentrate.

Ore Formation and Country Rock

In a recent report to the Kalgurli Gold Mines, Ltd., Malcolm Maclaren cites an especially clear and interesting instance of the effect of country rock on the value of ore in veins.

"The productive lodes and orebodies of Kalgoorlie," he says, "lie almost entirely in a broad dike of quartz-dolerite that, when uninfluenced by faulting, dips westward at 65°. The general effect of the faulting (all of which has taken place prior to ore deposition) has, however, been to give the dike a somewhat flatter dip. The dike strikes north and south, and is intruded through older greenstones that are everywhere barren except at and near their contact with the quartz-dolerite. Since the dike dips west, the underlying older greenstone (in this case calc-schist) lies beneath all the mines on the eastern side of the Kalgoorlie field at depths varying with their respective distances from the eastern margin of the quartz-dolerite. Naturally, also, since the lode channels of the eastern side of Kalgoorlie are approximately vertical, they pass ultimately in depth into the underlying calc-schist.

"The experience of five important mines is identical and to the effect that beyond a certain short distance (generally less than 100 ft.) beneath the quartz-dolerite, lode channels fail to carry ore. In gaining this experience, a sum certainly not less than £345,000, and probably not more than £400,000, has been expended in actual driving, sinking, and cross-cutting in the calc-schist. One mine, vainly hoping against hope, has during the past three years spent £48,000 in this pursuit, reaching a depth of 500 ft. beneath the contact, but recovered practically no profitable ore. In this instance the lode was far stronger and better defined than the ore channel of the Kalgurli mine, rich though the latter has been. Nothing better than a few tons of low-grade ore has ever been obtained from the calc-schist once the favorable quartz-dolerite has been left behind.

"On the other hand, a favorable locus for ore is in the calc-schist immediately beneath the quartz-dolerite. It was here that the famous Oroya 'shoot' occurred. The depth of this zone of possible ore in the calc-schist may be placed about 100 ft. below the quartz-dolerite, though no large body of ore has ever been found more than 60 ft. beneath, and, as already indicated, some of the lodes that have gone down into the calc-schist have been far stronger and better defined than any ever shown in the Kalgurli mine. Experience has further shown that as orebodies and lodes approach the lower margin of the quartz-dolerite, there is generally a marked diminution in the strength of the orebody and in its value. The height of this zone of impoverishment above the plane of contact may vary from a few feet to 200 feet."

The total quantity of gas produced in New York in 1912 is estimated by E. W. Parker, of the U. S. Geological Survey, at 8,625,979,000 cu. ft., valued at $2,343,379. On the other hand, the consumption of gas in New York during the year was 16,927,598,000 cu. ft., valued at $4,886,821, an average price of 28.7c. per 1000 cu. ft. The larger proportion of the gas used in New York is consumed for domestic purposes, the estimated amount so used being 15,329,811,000 cu. ft., valued at $4,583,414, an average price of 29.90c. per 1000 cu. ft. Only 1,597,787,000 cu. ft., valued at $283,407, was consumed in the industries.

Smelting Works at Grand Forks, British Columbia

The following notes are from the report of the superintendent of smelters, W. A. Williams, to the Granby Consolidated Mining, Smelting & Power Company.

The blast-furnace department ran steadily for the full year, and averaged 7.94 furnaces in continuous operation for 365 days. The furnace department smelted:

	Tons.
Granby ore	1,264,690
Foreign ore	15,179
Converter slag and matte	48,078
Flue dust	4,422

Average per cent of coke used per ton of ore, 13.36.

From the tonnage standpoint operations were good, and the tonnage for the year was 1,279,869 tons of ore, against 739,519 tons for 1912 and 984,346 tons in 1911. The average smelting cost for the year was $1.214, as against $1.256 in 1912. All the machinery in this department is in good repair and being operated to full capacity at the present time.

GRANBY SMELTER, GRAND FORKS, B. C.

In the converting department costs are lower this year per ton of ore, and the machinery is all in good repair. This department produced 22,683,181 lb. of copper in 1913, as against 13,226,360 lb. in 1912 and 17,858,860 lb. in 1911. There was 34,500 tons of 32.9% matte handled.

Taking the year as a whole from the operating end it shows very well. A larger tonnage was handled than in previous years, and higher silica slags have been produced with less copper loss. Costs are less than any previous year since operations began. The railroads handled all material satisfactorily, and there was no difficulty with labor.

The total value of the mineral production of Illinois in 1912 was $123,068,867, of which coal represented $70,294,338.

Depth of Shafts at Cripple Creek

The following list has been compiled by the *Cripple Creek Times-Record*, and will serve as an index of the present scope of operations at Cripple Creek.

Battle Mountain: Ajax Gold Mining Co.'s main shaft, 1228 ft. deep. Granite Gold Mining Co.'s Gold Coin shaft, 1225 ft.; two levels are now submerged by seepage water. Portland Gold Mining Co.'s No. 1 shaft, 1250 ft., in course of sinking to depth of 1600 ft.; No. 2 shaft, 1600 ft.; and No. 3 shaft, 1200 ft., has been abandoned. Stratton's Independence, Ltd., main shaft, 1430 ft. Strong Gold Mining Co., 1200 feet.

Bull Hill: Bull Hill not only has the deepest shaft in the district, but also the greatest number of shafts sunk below the 1200-ft. point. Acacia G. M. Co., South Burns shaft, 1200 ft. Blue Bird G. M. & M. Co., main Johnson shaft, 1750 ft., and now sinking to water-level, probably 100 ft. deeper. Findley Con. G. M. Co., main shaft, 1387 ft. Golden Cycle M. Co., main shaft, 1700 ft.; Theresa mine shaft, 1200 ft. Gold Sovereign M. & T. Co., main shaft, 1100 ft. Isabella Mines Co., Lee shaft, 1275 ft.; Empire State shaft, 1220 ft. Last Dollar G. M. Co., main shaft, 1200 ft. Stratton's Independence M. & D. Co., American Eagles shaft, 1500 ft.; John A. Logan shaft, 1500 ft.; and Orpha May shaft, 1500 ft. Trilby Mines Co., main shaft, 1120 ft. United Gold Mines Co., Wild Horse shaft, 1225 ft. Vindicator Con. G. M. Co., main or No. 1 shaft, 1630 ft.; Hull City shaft, 1265 ft.; Lillie shaft, 1526 ft., has been abandoned.

Beacon Hill: El Paso Con. G. M. Co., No. 1 shaft connected with the Roosevelt deep-drainage tunnel at 1332 ft. from surface. Henry Adney G. M. Co., Maid of Orleans shaft, 900 ft. Gold Dollar Con. Mines Co. has the deepest shaft on the opposite or eastern slope of Beacon hill in the Mable M. shaft, 994 ft. deep.

Carbonate Hill: Elkhorn shaft, 450 feet.

Globe Hill: No shaft in this district has attained a depth of 1000 ft. The two deepest shafts are on properties of the Stratton estate. The Plymouth Rock, between 800 and 900 ft., is inactive and is reported in bad working condition. The Deerhorn shaft, active and producing, is 650 feet.

Gold Hill: The shafts to attain a depth below 1000 ft. on this hill are the Anchoria-Leland, 1200 ft.; the Moon Anchor, 1100; and the Half Moon and Conundrum are below 1000 ft. The Mary McKinney drifts will cut under the summit at a depth of 1700 feet.

Galena Hill: The deepest shaft on this hill is that on the Sunshine mine. The property is now active. A depth of 450 ft. was attained in the incline sunk on this property.

Guyot Hill: The Katinka G. M. Co.'s shaft on the Chicken Hawk mine, now 1020 ft. deep, is being sunk by the Progressive Mining & Development Co. to a depth of 1250 feet.

Ironclad Hill: Jerry Johnson M. Co., main shaft, 975 feet.

Mineral Hill: Addie C. shaft, 485 ft. The property is inactive.

Poverty Gulch: Gold King M. Co., main shaft, 1007 ft. Abe Lincoln mine, of the Stratton estate, 925 ft., with drifts into Womack hill in excess of 1200 ft. from surface.

Raven Hill: Cresson Con. G. M. & M. Co.'s main shaft is 1350 ft. Elkton Con. M. & M. Co.'s main shaft, on the Walter claim, 1200 feet.

Squaw Mountain: The two deepest shafts are the Climax, 400 ft., and Nellie V., 325 feet.

Tenderfoot Hill: Grafton G. M. Co., Hoosier shaft, 650 ft.; Mollie Kathleen shaft, 1000 feet.

Outside districts: No shafts have been sunk to a depth of 500 ft. on Copper or Rhyolite mountains, Signal hill, or in any of the outlying districts.

The Deep Drainage Tunnel, with its portal at an altitude of 8033 ft., attained its greatest depth under the summit of Beacon hill at an approximate depth of 1500 feet.

Electric Blasting

By Charles S. Hurter

It is not at all improbable that electric blasting in the stopes after the men have left the mine, followed by proper ventilation, will in part solve the dust problem in South African mines. A good air current should remove the dust that is fine enough to pass through the respirators worn by the men, but it is very doubtful whether it will be possible for the men to work with safety at any time without the use of respirators.

Electric blasting from outside the mine is a comparatively easy matter. This problem was worked out originally at Castlegate, Utah, at a mine of the Utah Fuel Co. and the method has since been adopted with great success at a large number of the Western coal mines. The advantages of electric firing are the entire absence of smoke from burning fuse, the greater safety due to the absence of premature and hang-fires, the reduction of the number of misfires, particularly in wet places, the absence of burnt charges, and the fact that everybody is in a safe place when the shots are fired.

At the present time I doubt if electric blasting will be introduced for blasting drifts owing to the delay due to the fact that only one set of holes can be fired at a time. In the stopes there will probably be a large number of instances where more ground will be broken by a line of holes blasted together by electricity than would have been accomplished by shooting singly by means of blasting caps and fuse. However, there will be a number of instances where, while more ground is broken by electric firing, it will be in larger pieces and require a greater expenditure of explosives for block-holing and mud capping.

In order to get rid of as much dust as possible, the ventilating current should be established at its maximum speed through the working places before and during blasting, so that the maximum amount of dust will be carried out of the mine. In short, it appears that the use of electric blasting after the men have left the mine would reduce the amount of bad dust in the working places provided these working places have the proper ventilation.

Discussion

Readers of the MINING AND SCIENTIFIC PRESS are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment. Insertion of any contribution is determined by its probable interest to the readers of this journal.

An English View of Mexican Conditions

The Editor:

Sir—I believe that the people of the United States are badly served with news as to real conditions in Mexico. That is to say, there is a tendency on the part of the border newspapers to paint matters in a very unfavorable light for the present Mexican government, and I do not think that the situation is quite so bad as these papers would have one believe. However, there is no doubt that things are bad in the north of Mexico, and in some parts of the south they are not too good. I am exceedingly dubious as to whether any government made up of Mexicans can ever be equal to handling a country of such undeniable wealth and resources. The chief difficulty is that the country is ahead of the people, and foreign capital is almost wholly responsible for its development, having taken all of the important enterprises out of the hands of the Mexicans. In consequence, their cupidity is aroused and they want to have the profits that reward the zeal and enterprise of the foreigner. They do not realize that their only hope of salvation is to become patriotic and industrious. On the contrary, they have sunk more and more into a state of degeneracy and uselessness, and unless something unforeseen happens, in my opinion, the United States sooner or later will be compelled to take a hand in the matter. A recent trip to Mexico convinced me more than ever that Mexico is the greatest mineral country in the world, and nothing—not even the Mexican people and the poor government—can stem the developments that are bound to take place there.

It seems possible that Huerta has the ability to handle the rebel trouble and there is no doubt but what he has sent many an aspiring bandit to an early and hurried grave. Should it be quite clear that Huerta has the ability to handle the country single-handed, it will be difficult for the jingo element in the states to show any good reason for intervention. That is to say, that they will not be hurried into an intervention whose sole object will be to further the financial schemes of certain unscrupulous interests who only represent a very small percentage of the people of the United States. It may be, of course, that intervention will become necessary for reasons other than those at present put forward, and it may be that those reasons will be strong enough to carry the support of all of the other nations in such a step, but if America is rushed into hasty action without reasonable grounds, it will do her incalculable harm.

I have always had the fear that the Mexican people are too far behind the development of their country to govern it satisfactorily, because those developments have been brought about by foreign people with foreign capital. The people of Mexico have stood aside and watched the progress made, but they have neither done any work nor learned how to do it. For these reasons it may be that in view of the astonishing resources of the country, its further development may become too great a thing for any Mexican government to handle unassisted. For the protection of these great interests America may have to take some active step for her own protection and that of her European friends. This kind of intervention, however, is not yet called for, and I am one of those who hopes that America will pursue a policy of the greatest forbearance and that she will only take the decisive step suggested, when there is absolutely no other alternative.

H. S. DENNY.

London, September 2.

A Geological Survey of China

The Editor:

Sir—Your editorial in the issue of June 28, 1913, regarding the proposed Geological Survey for China is deserving of serious consideration from anyone interested in that great country and its wonderful people. I say wonderful, because the Chinese are probably the most interesting, if not in some respects the greatest nation in the world. They have always been an essentially agricultural race, possessing the virtues and strength of character peculiar to a nation 90 per cent of whom are tillers of the soil. The two fundamental resources of the earth are the products of its soil and mineral deposits. Although it has been known for many years that China possessed great stores of mineral wealth, up to the present time they are practically untouched and undeveloped. The Chinese have lived for many centuries chiefly from agricultural products. Hence the beginning of her mineral development marks an epoch of the utmost importance to this nation and probably in time to the world at large.

The creation of an efficient, well equipped, and generously financed geological survey is, beyond doubt, a proper and wise step, but its efficiency and success will be very seriously menaced if it be placed in the inexperienced native hands. Not that there are not plenty of intelligent and well educated Chinese to call upon, but that these men, be they ever so brilliant in mind and administrative ability, are liable to be devoid of the requisite technical training and experience. The Chinese who have received technical educations in our Western schools are, most of them, too young to have had much practical experience. It will, of course, be pointed out that the Japanese have developed their mineral resources by first employing Western engineers and geologists, then as their own people became educated replacing them by natives. But it must be remembered that Japan is a small country as compared with China, and that her mineral resources are immeasurably inferior; moreover, those who are familiar with this development in Japan know that it has not always been well done and that needless waste resulted.

In a general way, the geologic conditions of China are fairly well known through the researches of

Pumpelly, von Richthofen, Bailey Willis, and many European geologists, especially Le Clère and Du Clos. The economic character of these researches was necessarily limited, for investigations of this kind demand close and painstaking study that will require many years of continuous and skilled effort. To delegate such work to the teaching staff of an institution of learning or a commission composed of academicians, be they native or foreign, would be folly. Mining is a commercial business; it must profit its backers or else it ceases to be mining. It is to be feared that men who are simply technologists may prove unsafe advisers because, as a rule, they lack the business experience necessary to properly organize successful mining operations. The Chinese in some respects are unrivaled merchants and traders. In other ways they are children when it comes to coördinated combinations such as joint-stock companies, which are absolutely necessary to carry out engineering undertakings. This, at least to some degree, explains the slowness with which mining development has progressed in China. It has frequently been ascribed to the lack of railroads, political disturbances, and the ignorant superstition sometimes exhibited by the natives of all classes. No doubt such influences have had some effect, but they are slight as compared with the lack of coöperation among the natives, for they naturally distrust themselves in matters not fully understood.

The geologic conditions of the Yangtse basin and river valleys tributary to it, resemble in a general way those of Pennsylvania, Ohio, and western Virginia, in that they contain great stores of coal and iron. Today the great steel industries of Pennsylvania could not exist without the rich Lake Superior or foreign iron ores. Pennsylvania, as in fact did England, commenced her iron industry with the comparatively lean and inferior local ore, but it grew and thrived because of the vast supplies close at hand of cheap and excellent coking coal and anthracite coal. Being once established, it was cheaper to bring the ore to the fuel than the fuel to the ore, hence our present conditions wherein comparatively little local ore is used when the freight rates are sufficiently low to make possible the purchase of richer ores from greater distances.

Turning now to China, it may be noted that her one large and prosperous steel industry is at Hankow, a city at the junction of the River Han and the great Yangtse, both rivers draining large areas of coal territory. Eighty miles below Hankow and 18 miles back from the left bank of the river at Tayeh there are some excellent hematite deposits which are now extensively worked. With this exception, as far as I know, no high-grade iron ore deposits have yet been developed in China. The fact that China has vast stores of coal and will doubtless eventually develop an abundance of iron ores, is one of tremendous importance to the whole world; for, as we know, a coal and iron supply is the backbone of all modern industry, everything else being subservient to it, and by comparison all other forms of metallurgical and mining industry paling into significance. Without fuel, steel is impossible, and, lacking that, no railroads, battleships, or other essentials to modern civilization—or savagery if viewed from the battleship standpoint.

In dealing with oriental mining affairs, it is important always to bear in mind the great difference in labor conditions between those in America and those existing in China. Properties which would not pay in the United States may be made to yield a large profit with the cheap Chinese labor: but even so, there can conceivably be circumstances under which this cheap labor may be a delusion and a snare. Where skill and high efficiency count, as in most of our Nevada and Arizona mines, cheap labor would in the end be expensive; but when it is a matter of simple brute force, skill is ever at a disadvantage. Foreign investments in Japanese mining have been almost without exception disastrous.

If the Chinese are well advised, their National Geological Survey or Bureau of Mines, whichever it may be termed, will be organized by experienced American or British mining engineers, and at first will be largely composed of well trained men, having directly under them picked natives who have had some technical training. In the course of time, the Chinese would naturally replace the foreigner, just as in the Chinese custom service so efficiently organized many years ago by Sir Robert Hart, and which has proved an invaluable mainstay through the stormy and trying days which have overtaken China during the last twenty years.

Japan for some time past has been drawing a large part of her iron ore supply from China and is now beginning to import Chinese coal. This is certain to continue in a steadily increasing volume, for Japan is too poor in resources to meet the demands of her artificially stimulated industrial propaganda. The great steel works at Wakamatsu was for years conducted by the Japanese government at a loss, but now is said to yield some direct profit. I believe much the same may be said of the Han-Yang steel works at Hankow, which was scandalously mismanaged when left wholly in untrained and inexperienced Chinese hands.

China has many other mineral resources besides coal and iron. Practically all the metals are found in her vast territory, but as a rule it would seem that her metal deposits are lean as compared with other countries; this disadvantage, however, is more than offset by an unlimited supply of cheap labor and fuel. Deposits which would be unprofitable where labor is dear could be made to pay in China under such extraordinarily favorable conditions.

As time goes on, rich deposits all over the world are being rapidly exhausted: a difficulty often, at least temporarily, overcome by the use of clever labor-saving devices. It seems likely, however, that there must be a limit or point where mechanical efficiency cannot be made to equal cheap Oriental labor, and competition with the Chinese will eventually become hopeless unless we lower our standards of living or they raise theirs. This theme is a fascinating one, grave and serious menace though it be. Americans cannot expect, even if they desired, to lower their ways of living; but if they are to be the teachers of the Chinese in their com-

ing industrial development, they may hope to lift their standards of existence to a plane somewhat nearer the American.

F. Lynwood Garrison.

Andover, Massachusetts, August 26.

[Our correspondent overlooks the most important factor which now restricts mining development in China, namely, lack of capital. The public temper will not permit the granting of more concessions to foreign companies, foreign investors will not risk their money in mines under Chinese control, and the demands for capital within China are so great that the native investor can readily place all the funds at his command. Naturally, he prefers trade, at which he is an adept, rather than mining, with which he is rather unfamiliar, beyond knowing that several companies financed by Chinese and managed by foreigners have been lamentable failures. Doubtless the proposed geological survey will also be greatly hampered in its work by lack of funds, if it is finally launched. While agreeing in general with our correspondent's view, it is only fair to point that the Chinese administration doubtless feels that a single experienced foreigner would cost, in salary and expenses, as much as a half dozen Chinese, only to go home at the expiration of a contract, taking most of his knowledge with him, and that, having waited 'ten thousand years' to develop her mineral resources, China can afford to wait until a native staff has been trained for the purpose. Whether they will ever receive that training without foreign supervision is 'another story.'—Editor.]

Grinding-Pan Practice

The Editor:

Sir—I am glad to be put right by Mr. von Bernewitz as to my misinterpretation of the capacity column of his figures on grinding-pan practice at Kalgoorlie. His explanation, however, calls attention to the vague and indefinite meaning of the words 'slime' and 'sliming' as used in mill practice in different parts of the world. Here is a case in which a distinction is made at the 150-mesh screen in the case of the pan feed, but at the discharge the whole product is regarded as being 'slimed' although in two mills but 52% will pass the same screen.

The average daily tonnage, then, of 5-ft. pans in the district, grinding to 150 mesh, is:

	Tons.
Roasted ore	7.18
Roasted concentrate	16.20
Following stamps	7.97

This seems to be good work considering the fact that the pans do not have the advantage that a tube-mill usually has, a classified feed, and also that the particles not ground to 150 mesh are greatly reduced in size.

As a practical matter, this question is new to me, but interesting, as a pan that has some faults in its construction is now working under my observation. As far as I have studied the problem, it seems that the capacity of a pan depends principally upon getting the greatest possible number of grains of sand under the shoes, and this is best accomplished by crowding the grains as closely together as possible in a pulp as thick as consistent with circulation, and containing the least possible amount of material already ground. The pan of which I speak has been lately fed with pulp containing 29 to 31% moisture. This has resulted in a large increase in capacity.

R. H. Richards, in discussing amalgamating pans, refers to this circulation outward through the spaces between the shoes, up the sides, and returning inwardly. It consists of a vortex movement precisely like a 'smoke ring,' but is compounded with the whirling motion of the pulp, the latter movement being of no particular advantage as far as grinding is concerned. The shoes, acting like the vanes of a centrifugal pump, are sure to set up and maintain this movement, and that renders the usual plowshare-shaped wings or deflectors entirely unnecessary. Also, as Mr. von Bernewitz points out, there is no advantage in a device for centre feeding. The feed will go to the centre and down to the shoes in any event. It thus seems that pans can be somewhat simplified.

In view of this vortex movement of the pulp in a grinding-pan running at any ordinary speed, I cannot conceive of a fair degree of classification occurring at the overflow lip, and this condition would seem to make outside classification of the pan discharge quite necessary. Classification would undoubtedly occur at the lip to some extent if the pulp were thin enough and the lip arranged for the return of the sand to the pan, but the disadvantage of thinning the pulp would seem to more than offset the advantage of this method of classification. I look for improvements in practice that will make the grinding-pan a very efficient machine.

John Randall.

Atlantic City, Wyoming, August 27.

The Editor:

Sir—In reply to John Randall's further contribution to this subject, I would say shortly that the terms 'slime' and 'sliming' are used in a vague way in the many mining districts of the world, but simply indicate the point at which further grinding is unnecessary to obtain the best recovery of gold and silver in the ores; the duty of pans at Kalgoorlie is good; the use of wings or deflectors in a pan used for complete sliming is an advantage; a properly constructed overflow lip does classify the pulp to a large extent, but with a classifier in closed-circuit with a pan, the pulp can be kept thick and the capacity increased, although there is a point which would need close observation, namely, is it better to dispense with the overflow lip and give the classifier all of this work, or let the pan classify in the lip and produce a final slime also? Mr. Randall could no doubt give us some interesting figures on screen analyses of the feed, pulp in the pan and overflow lip, and final slime.

M. W. von Bernewitz.

San Francisco, September 10.

[Mr. von Bernewitz's article is bringing out some useful discussion and it occurs to us that the experience of those who have used pans in clay-working industries would be of interest. Can any reader supply data?—Editor.]

Special Correspondence

MELBOURNE, AUSTRALIA

MINERAL PRODUCTION OF AUSTRALIA IN 1912

Statistics of Australian mineral production recently published call attention to the fact that there are two sets of reliable mineral statistics compiled annually for Australia. One is the work of the Commonwealth statistician, G. H. Knibbs, the other is the work of the editor of the *Australian Mining Standard*, E. H. C. Oliphant. The latter makes a strong feature of securing uniformity for the returns from the various states of the Commonwealth, and for purposes of comparison his work is therefore the more valuable. Although in a series of articles published during the last year or two, he agreed in favor of the inclusion of figures relating to any and every branch of the mineral industry, admitting the returns for building stone, brick clays, sand, cements, slates, and lime, he found that to effect any fair comparison between the states he would have to omit all these, because some states failed to give any returns regarding them. He has been obliged to omit salt for a similar reason. His figures, therefore, vary from those of the Commonwealth statist, who includes, for example, salt, in the South Australian data and does not include it in the Victorian returns, because it is unobtainable. There is another great difference between them, and in regard to this there can be little question that the journalist is right; whereas Mr. Knibbs, following the lead of the New South Wales Mines Department, gives the net value of the product of the silver-lead mines of the state, Mr. Oliphant gives the gross value. His argument is that it does not matter where the separation of the metals is conducted, and that the product is entirely from New South Wales, even if much of the profit accrues to Germany. The Commonwealth statist's returns, except in this one particular, approximates fairly close to those of the *Australian Mining Standard*, since he also omits returns relating to building stone, brick clays, gravels, cement, and slates; but he is much less consistent, in that, while he includes the limestone used for fluxing, he does not include the limestone used for other purposes. Mr. Oliphant agrees that this is as unreasonable as it would be to restrict the ironstone figures to so much of the mineral as is used for fluxing purposes.

Mr. Oliphant's figures for the year 1912 have now been made available. They show the following totals for the various states of the Commonwealth:

State.	Value.	Compared with 1911, %.
New South Wales	$ 57,577,328	+12.7
Victoria	11,306,776	— 5.4
Queensland	20,120,923	+14.3
Western Australia	27,937,004	— 5.7
Tasmania	7,243,485	+10.7
South Australia	2,548,956	+37.0
Northern Territory	280,427	— 2.6
Total	$127,049,979	+ 6.3

To this may be added the figures for Papua or New Guinea, $340,979, a 5.6% decrease.

The chief items are set out as follows:

Metal.	Value.	Compared with 1911, %.
Gold	$48,211,696	— 7.3
Silver and lead	23,652,330	+17.2
Zinc	8,567,326	+24.8
Copper	15,783,020	+26.3
Tin	6,542,611	+11.6
Coal	22,215,323	+11.3

New South Wales produces 100% of the zinc output, 93.3 of the silver-lead, 25 of the tin, 17.8 of the copper, 83.4 of the coal, and 79.4% of the iron; Victoria 20.5% of the gold; Queensland, 14.9% of the gold, 52.2 of the copper and 27 of the tin; Western Australia, 54.9% of the gold; Tasmania 40.3% of the tin and 13.5% of the copper, and South Australia 14.2% of the copper and 15.4% of the tin.

In yet another table the *Australian Mining Standard* shows how each state's output is made up. From this it is seen that 32.2% of the total value of New South Wales' mineral production comes from coal, 23% from lead, 14.9% from zinc, and 14% from silver; 87.5% of Victoria's from gold and 11.1% from coal; 40.9% of Queensland's from copper and 35.6% from gold; 94.6 of Western Australia's from gold; 36.2 of Tasmania's from tin, 29.4 from copper, 20.6 from silver and lead, and 10.8% from gold; 86.6% of South Australia's from copper; 46.7% of Northern Territory's from tin and 39.2% from gold; 86.2% of Papua's from gold, and the remaining 13.8 from copper. Of the Commonwealth totals, gold provides 37.9%, silver and lead 18.6%, zinc 6.7%, copper 12.4%, tin 5.1% and coal 17.4; iron being the only other constituent of any consequence.

JOPLIN, MISSOURI

PROSPECTING TODAY IS AT MUCH DEEPER LEVELS THAN FORMERLY.—NEW MILLS OF THE THOMS STATION DISTRICT.

On one 20-acre lease in the Spring City camp, four miles south of Joplin, seven churn-drills are at work. This is no doubt the greatest number of drills ever operated simultaneously on such a small tract of land. Lee and Bridgeford, of Kansas City, Missouri, are doing the work, they holding a lease from J. W. Allen. They recently purchased this lease from the Frank A. Malang Mining Co. and will prospect the property in a thorough manner, as the ore deposits of this particular part of the district are very irregular. Rich mineral may be found at one point, while a hole sunk five feet away in either direction might penetrate barren rock. The prospecting also will be carried to a depth of 250 to 300 ft., former work on the land having been confined to the shallow ground, no work having been carried below 100 ft. Seven shafts are into ore on the tract at a depth of 90 to 100 ft., and a dump of 200 tons is on the surface. Some of the ore from these shafts was hand jigged by former operators, but the bulk of the mineral produced was from comparatively hard ground, and milling will be necessary. Not only at the property referred to, but on numerous other tracts, prospecting operations are being carried to deeper ground than ever before. J. M. Short has four churn-drills at work on an 80-acre lease of the Ragland land, northeast of Joplin. Work on this property was conducted down to 150 ft. Mr. Short has four good holes into disseminated ore at a depth of 240 ft. He will start a new shaft soon and plans the construction of a mill.

At Thoms Station, three miles north of Joplin, mining activities are in evidence on every hand. The ore occurs in soft ground, requiring timbering to support the roofs of drifts. The ore carries both sphalerite and galena, although the two are rarely found associated, as is so commonly the case in other portions of the district. The Thoms Station mine, as a general rule, is either a producer of galena or a producer of zinc sulphide, while the Napoleon, a heavy producer of both minerals, is one of the exceptions of importance.

A number of new mills are being constructed at Thoms Station. One, the Pocatella, operated by Danglade and Robertson, is nearing completion. It will have a capacity of 150 tons per 8-hour shift. This mine is on a 10-acre portion of the Snapp land, and one shaft has been sunk into ore, two drifts being operated, one of which goes east, the other west, and a dump of several thousand tons is on the surface. The ore will probably yield 15% of zinc-sulphide concentrate containing 60 to 63% metallic zinc. The drifts are at a depth of 180 ft., are 15 ft. wide and 20 ft. high, with about 5 ft. of ore in the roof. No deep drilling has been done on this lease. The Ortt & Coats mill, also on the Snapp land, has just been completed. The ore is yielding 10% blende and is of lower grade than that of the Pocatella and contains some iron. The Vinegar Hill, another mill on the Snapp land, is operating on high-grade zinc sulphide. This property has 200 tons of concentrate in the bin which is being held for higher prices. The Home Development Co. is operating

the Betsy Jane mill and making a fair recovery. The Texas Mining Co. has started operation at a new mill west of the Home Development Co. The Kansas City Mining Co. has just completed a new mill in the east part of the Thoms Station district and has begun production. Many prospecting drills are at work.

North of Miami, Oklahoma, a large new concentrating plant has been completed by the Barnes & McConnell Mining Co. The property is on Tar creek, two miles northeast of the present Miami field. This is the first mill in the new field, but others are contemplated. The Commerce Mining & Royalty Co. recently organized with $5,000,000 capital, has acquired leases on several thousand acres of land in the new field, and many churn-drills are at work. The ore deposits are found down to a depth of 300 ft. and are especially rich in galena. The Commerce company, formerly operated under the name of the Miami Royalty Co. Several other new mills are being constructed in the immediate Miami camp. One, the Lost Trails Mining Co.'s plant, will soon be ready for steady operation. Southwest of the main Miami field, Barnes and McConnell also have a new mill, which will be ready for operation in about a month.

TORONTO, CANADA

DECREASE IN ORE SHIPMENTS FROM COBALT.—QUARTERLY REPORT OF THE LA ROSA COMPANY.—DEVELOPMENT WORK AT THE PORCUPINE CROWN.

Ore shipments from the Cobalt camp have lately been greatly curtailed owing to the difficulty of marketing ore. Only three cars were shipped last week, which is the lowest record since 1905. The bullion shipments, however, amounted in value to $97,689, which is somewhat above the general average. Nearly all of the bullion was from the Nipissing. The quarterly report of La Rose indicates a decline in the ore reserves. Production for the first nine months of the year was valued at $905,039 from high-grade ore, and $80,546 from mill ore. R. B. Watson, general manager, reports that no accurate estimate as to ore reserves can be made at present, and no prediction as to the results of development work can be made with any degree of precision. The financial statement shows a surplus of $1,882,833, including the value of ore in transit, at smelters, and ready for shipment. The directors are working on a comprehensive plan for the investment of the surplus. The North vein of the Seneca Superior has been cut on the Gould Consolidated at the 200-ft. level, where it averages 2 inches in width and is stated to assay 4965 oz. per ton. Three of the veins found on the bottom of Kerr lake when partly drained have been cut on the 140-ft. level, and prove on development underground to be mere seams which had been overlooked in cross-cutting. They are being followed up with the view of opening up an ore-shoot which shows on the surface. The Beaver has decided on sinking to at least 1500 ft., and has ordered a large hoist, of the Corliss type, capable of handling ore at a depth of between 1500 and 2000 ft. At 700 ft. the main orebody is well defined and productive, and similar results are looked for at the present low level of 800 ft. The 900-ft. level will be opened during the winter. The Penn Canadian has cut a new vein carrying 3 in. of 2000-oz. ore on the fifth level. The wall rock for two or three feet on each side of the vein carries leaf silver and will make good milling ore. Owing to the unfavorable condition of the mine, the Timiskaming will pass its usual dividend. The lower levels of the mine yield small patches of high-grade ore, but the returns in silver are small. Work on the North Dome of Porcupine, operated by the Timiskaming, will be discontinued owing to lack of funds. At the Foster a vein 2 to 3 in. of smaltite has been found in an old stope, and some ore is being mined. The Casey-Cobalt has now 30 stamps in operation, with a daily capacity of 90 tons of ore. The battery is operated by electric power supplied from the Montreal river. The annual report of the Timiskaming & Hudson Bay shows a slight falling off in production. The output was 659,972 oz., and the cost of production 18c. per ounce. Dividends of $186,264 were paid. The mill treated 22,437 tons of ore during the year. The Conlagas declared an additional dividend bonus of 3%, making 14% in all, bringing the total dividend payments up to $5,920,000 or nearly $2,000,000 more than the capital. The Keeley mine of South Lorrain, which has made some good discoveries in the Keewatin of the upper levels, and has decided on deep-level explorations in the diabase, has been compelled to suspend operations until spring owing to inability to obtain electric power. It will be supplied next year from a new plant to be erected by the Northern Ontario Power Company.

The Porcupine Crown, formerly the McEnaney, is showing up well. Development work has proved the ore-shoot on the 300-ft. level to be larger than on the upper levels. The vein is proved up in quartz to a depth of 70 ft., where it assays $60 per ton. In sinking a winze below the 400-ft. level the vein has been found to average $80 per ton for 60 ft. down. The mill is crushing 80 tons per day. The Rea, operated by the Mines Leasing & Developing Co., has since June 20 produced $4500 with a 5-stamp mill running on low-grade ore. The September statement of the McIntyre shows that during the month the mill treated 2786 tons of ore, producing $28,015. Operating expenses, which included the cost of an aerial tramway, were $28,127. Alex. H. Smith has been put in charge of the Teck-Hughes at Kirkland lake, the position having been resigned by John Reddington owing to other engagements. At the Hollinger Reserve a winze is being sunk on the main vein below the 200-ft. level. The mine is being worked on option by the Kerr Lake of Cobalt. The Lucky Cross, in the Swastika district, has been reopened by a new force in charge of C. F. S. Anderson, late of the Buffalo. A month's test will be made to determine the best method of cyaniding.

KALGOORLIE, WESTERN AUSTRALIA

SONS OF GWALIA.—NEW CONSTRUCTION.

The Sons of Gwalia plant is being overhauled and brought up to date at a cost of $150,000 by A. Wauchope, who succeeded John McDermott in December last. The framework, guides, and all woodwork of the mill are being renewed, and new mortar-boxes installed where necessary. The Wilfley tables have been scrapped, and three new 18 by 4½-ft. tube-mills, together with additional vacuum-filters, with all accessories, are being erected. A new Kynoch 660-hp. gas-engine is being added to supplement the two Crossley 400-hp. and 167-hp. engines, and all will be driven by Commonwealth generators consuming firewood of 3-ft. lengths and effect a saving over charcoal generators of $1200 per month. Cement floors and drains are being laid down to prevent any losses of gold solution. The whole of the product will be slimed in future, and the old residue dump will be reground and treated. Changes are also to be made underground, as the ore-shoot has pitched so far south that tramming of 2000 to 2500 ft. has to be done at the lower levels. Larger passes and bins are to be made and horses used underground at intermediate levels, and so do away with hand haulage. Up to date the mine has produced 1,952,424 tons, yielding $19,151,200 and paid $4,771,800 in dividends. The ore in sight is estimated at 560,000 tons worth $7.50 per ton, or 3½ years' supply for the mill. The main shaft is down 2800 ft. on the incline, and is still being sunk. There are 19 levels, the deepest being at an incline depth of 2700 ft. The ore-shoot appears to be coming back north toward the shaft, as at No. 19 level, the lode, at 300 ft. south, is worth $10 over a width of 97 in., while at higher levels it was much farther south. In fact, at No. 14 level, the shoot has pitched so far south that shaft-sinking was suspended for three years, from April 1905 to February 1908. Shortly after taking charge in August 1906, Mr. McDermott, finding that the ore-shoot below No. 8 level was entirely south of the shaft, staked eight claims, comprising 192 acres, south of the shaft, and abandoned a similar area to the north. Since then practically the whole of the ore from the mine has come from this new ground, and this amounts to 1,286,560 tons, producing $10,173,900, from which $2,335,900 has been paid in dividends. This

is nearly twice the tonnage, and considerably more gold, and practically the same dividends that came out of the Company's holdings before Mr. McDermott's advent. Yet the ground lay open for years for anyone to take up. None of Mr. McDermott's predecessors made a move in this direction.

DENVER, COLORADO

STRIKE IN COAL MINES UNSETTLED.—STAG CAÑON DISASTER.—THE MOFFAT TUNNEL.—GOLD-DREDGING NEAR TIN CUP.

The strike in the coalfields of southern Colorado has rapidly grown into a state of civil warfare, which the local authorities appear to be utterly unable to suppress. In spite of the assertions of Frank J. Hayes, of the United Mine Workers, that the strike would be conducted along orderly and peaceful lines, there has been a steadily increasing amount of disorder and violence on the part of the striking miners. Serious conflicts between strikers and mine guards have been occurring daily, and several pitched battles have recently taken place. The lawless intent of the strike agitators has been apparent from the fact that nearly all of the strikers have been armed with high-power rifles, and it was recently reported that a machine-gun was shipped to the strike colony at Walsenburg. Ludlow has been the scene of constant rioting and violence ever since the strike began. Within the past two weeks armed bands of miners have made concerted attacks upon the camps of Primero, Sopris, Hastings, Aguilar, and Walsenburg. The Governor has concluded his trip of personal investigation through the strike districts, but he seemed at first in a state of indecision regarding the advisability of calling out the militia, although it has been apparent for some weeks that the sheriff was absolutely unable to preserve order or to prevent rioting and bloodshed. A number of strikers have been arrested, but there have been no convictions, and no serious attempts have been made to disarm the rioters who are terrorizing the coal camps. The Governor still seems to think that it may be possible to effect an agreement between the strikers and operators, but the latter maintain that their employees have no grievances and that they will not treat with those who have intimidated and driven out hundreds of perfectly contented miners who desired to continue at work in the mines. He has had several long conferences with the operators and the officers of the United Mine Workers in Denver in an attempt to adjust their differences, but the officers of the coal companies refuse to treat with the union, so there seems to be no hope for a settlement of the strike along those lines. The most recent press despatches state that the Governor has ordered two companies of the state militia to be sent to the strike districts for the purpose of disarming both the strikers and the mine guards and to preserve order throughout the coal camps, and that the importation of strikebreakers will be stopped. It is quite evident to all the people of the state that martial law should be declared and that the disarmament should proceed at once in order to put a stop to the continued state of armed lawlessness and violence.

The most appalling mine disaster in recent years occurred on October 22 at Dawson, New Mexico, in Mine No. 2 of the Stag Cañon Coal Co. A terrific explosion, supposed to be from some accumulation of gas, completely wrecked the mine, caused the blocking of every entrance, and entombed nearly 300 miners. In spite of the heroic work of the mine employees and officers, assisted by the crews of two mine-rescue cars, the death list will number 263 men, including the superintendent of Mine No. 2 and two helmet-men. Only 23 men are reported to have been saved. The exact cause of the disaster is unknown. The mine was considered to be one of the model coal mines of the United States, and was thought to be absolutely safe. The property is owned by the Phelps-Dodge interests, and is one of the largest coal mines in the country.

The contract between the Denver & Salt Lake Railroad Co. and the city of Denver, regarding the construction of the Moffat tunnel, has been signed by Newman Erb, president of the railroad company. A special city election will probably be called about January 15 to vote upon the question of issuing bonds for the building of the tunnel by the city. Since the citizens of Denver have previously expressed their approval of this measure, there is little doubt but that the bond issue will be authorized. The tunnel commission has had examinations made of the proposed tunnel sites, and the board of engineers has made careful surveys and estimates, supplemented by a geological report by R. D. George, state geologist. The board of engineers is composed of D. W. Brunton, John W. Finch, and J. V. Davies. Mr. Davies is a member of the firm of Jacobson & Davies, of New York, which built the Hudson River tunnel of the Pennsylvania railroad. The members of the board will proceed immediately to make a thorough investigation of the proposed tunnel site on James peak, and will submit detailed estimates of the cost of the construction of the tunnel about November 15.

It is reported that dredging operations are to be begun upon the gold gravel deposits near Tin Cup in Chaffee county. These old placers were among the first gold producers in Colorado, and were profitably operated by hydraulicking for many years in the early days, but were finally abandoned on account of the lack of fall and dump room necessary for their operation by means of giants and sluices. The Tin Cup Gold Dredging Co. has recently secured several hundred acres of gold-bearing gravel, comprising a large number of the old placer claims. The ground has been thoroughly tested, with satisfactory results. The Company has completed an electric power-plant at St. Elmo, and has recently launched a modern gold-dredge.

BOSTON

YUBA CONSOLIDATED GOLD FIELDS.—THE STEPHEN R. DOW CASE.—ADVANCE IN BUTTE-BALLAKLAVA SHARES.—NEW ALASKA PROPERTY OF THE UNITED STATES SMELTING, REFINING & MINING COMPANY.

One of the most successful mining enterprises with headquarters in Boston is one about which the public is almost entirely ignorant. This is the Yuba Consolidated Gold Fields, operating in California. About 65% of the stock is or was held by the Robert D. Evans estate, of Beverly, Massachusetts, and other large stockholders,

ONE OF THE YUBA DREDGES.

including John Hays Hammond, A. Chester Beatty, W. P. Hammon, and the Albert F. Holden estate. There are probably not over a dozen stockholders in all, and reports are made to them in the most secretive manner. For the year ended February 28, 1913, the Company handled over 14,000,000 yd. of gold-dredging ground at a cost of $760,365, making a net profit of $1,640,000, or over 200%. Some of the dredges of this Company are said to hold records for low costs. Last year the average was 5.34c. per yard. This is regarded as one of the most successful enterprises with which Boston capital has ever been identified. The Company's gold-bearing ground is, of course, limited, but it still has a large liquidating value.

The argument on appeal of the case of Stephen R. Dow, who last February was convicted and sentenced to a prison term of not less than eight or not more than 12 years, will not be heard at the current session of the Massachusetts Supreme Court, but will probably come up

in January. Dow is at liberty on $25,000 bail. He was convicted on 24 counts based upon the fraudulent appropriation and conversion to his own use of $251,764 belonging to the Algomah, Franklin, North Lake, and Indiana companies of the Lake district. It was claimed that Dow had borrowed $1,000,000 from these companies and had paid back $800,000. He started business with a seat on the Boston Stock Exchange in 1905.

The market action of Butte-Ballaklava, which in a recent movement has advanced from under $2 to nearly $6 per share, has been due to the belief that the Company's litigation with Anaconda will be settled out of court. Mr. Ryan, president of Amalgamated, denies this report, but the Butte-Ballaklava interests have sanctioned it. It was stated that a compromise would be effected and the suit withdrawn through Anaconda taking over Butte-Ballaklava on a one-to-five share basis, involving the issue of 50,000 Anaconda shares for the 250,000 Butte-Ballaklava shares now outstanding.

The most important announcement recently in a market way from Boston has been that of the acquisition by the United States Smelting, Refining & Mining Co. of several low-grade gold properties in the Juneau, Alaska, district, where the Company will carry on another mammoth mining enterprise similar to that of the Alaska Gold Mines Co. The smelting company has acquired ample water rights on Lemon creek at Juneau and has taken an option on the Ebner mine which runs until March 1915. The United States Smelting interests are perhaps the most active of all the large corporations with exploration departments in their search for new mining properties, but they have not succeeded in getting more than one or two a year on an average, although they take up each year from 700 to 900 properties for consideration. The United States Smelting, and Hayden, Stone & Co. interests are very close together in many ways, the late Albert F. Holden having been prominently identified with both groups. Both interests believe the Juneau district will become the greatest gold-producing territory in the United States.

Stock market interests here believe the days of the Lake Superior copper strike are numbered. The Western Federation of Miners has been defeated again, it appears, in its effort to get a new footing in this mining district. The Calumet & Hecla and other companies are willing to make concessions, but will not recognize the union.

NEW YORK

U. S. S. R. & M. Takes Hold of the Ebners.—Ely Central Joins Coppermines.—Tularosa.—Tennessee Copper.—Mexican Companies Suspend Dividends.

Much interest has been evoked by the possible advent of the United States Smelting, Refining & Mining Co. into the Juneau district, which has been the scene of such profitable activity by the Bradley interests for many years, and where the Jackling, Aldrich, McNeill, and Hayden-Stone interests are now directing attention through their rapid development of a large low-grade producer in the Alaska Gold Mines, which has taken over the old Alaska Perseverance or the Alaska Gastineau. Adjoining this is the Alaska Juneau, of which F. W. Bradley and associates have secured the control and which they are developing into a large low-grade mine, as announced in earlier issues. Just beyond this is the Alaska Ebner, which has been marking time, like the others, its development being especially hampered by the internal dissensions in the owning company. So little development work had been done that the value of the property was problematical. The United States company has taken an option, extending till March 1915, and will drive a long cross-cut to develop ore in depth, as has been done at the other two properties. The necessary water-power has been secured through additional options on water rights on Lemon creek and elsewhere. The cross-cut should reach the vein early next year, leaving ample time within the life of the option for the necessary development work to prove tonnage. With three such strong groups at work, the mainland opposite Douglas island has blossomed rapidly into importance as a gold-mining district of great promise.

Absorption of the Ely Central Copper Co. by the Consolidated Coppermines puts the latter into an even stronger position, and if any more big orebodies are developed in the Ely district they can scarcely escape being in the Consolidated Coppermines ground. It is to be hoped the Ely Central will not prove a 'hoodoo,' for its unhappy memory of the time when it served merely as an appanage of the bucket-shop run by 'Geo. Graham Rice' and B. H. Scheftel & Co. is scarcely likely to endear it to anyone. The property consists of about 480 acres adjoining the Copper Flat pit of the Nevada Consolidated. Three shafts have been sunk without developing any large orebodies, but the ground has not been thoroughly drilled. The stock is to be exchanged on the basis of 20 shares of Ely Central for 1 share of Consolidated Coppermines. Doubtless the shareholders will consider themselves fortunate to get out of a swindle and into a good company on any terms whatever.

Speaking of copper companies, some of the interests on the New York curb market are vigorously boosting the Tularosa Copper Co., which owns a property of a good deal of promise in Otero county, New Mexico. The ore deposits of this property were described by S. H. Ball in the *Mining and Scientific Press* of July 26, last. They consist of a stockwork of lenses in diorite, stringers of ore extending into the sandstone from the diorite, bedded ores in sandstone, and detrital deposits. The statement is made in brokers' circulars that 800,000 tons of 2½% copper ore has been developed. There is a 150-ton mill on the property, and the venture seems to be of much promise, though it is perhaps a question whether F. P. Kern, the president, and his associates will be able to make it blossom out very rapidly, as they are reported not to have the almost unlimited financial resources which have contributed to the development of some of the large new properties.

The Homestake Mines Finance Co., which has chosen a good name in the hope of developing a good mine, is at work proving the ground of the Commonwealth Gold Mines, Ltd., and the Sherill Porcupine Gold Mines, Ltd., which it controls. Each of these companies owns 200 acres of land in Tisdale township, Ontario, and is hoping to develop valuable deposits. The Homestake also owns 255,000 shares of the Foley-O'Brien. The Company is capitalized at $1,000,000, and is controlled by Buffalo people, W. H. Finch being president, Frank L. Bapst vice-president, S. J. Dark treasurer, and as directors F. V. E. Bardol, C. W. Williams, F. Irwin, and C. L. Sherrill, all of Buffalo, New York, and Alexander Fasken. E. V. R. MacMillan of Toronto is secretary.

The Tennessee Copper Co. is said to be making excellent profits from the sales of acid, which continue to increase, and is turning out copper at the rate of 1,500,000 lb. per month. Nevertheless, its shares display a good deal of weakness, and it has been suggested that the activity of its president in Gold Hill, with which Walter George Newman is associated, is scarcely to the advantage of Tennessee Copper. The Greene-Cananea has resumed dividend payments with the declaration 1%, payable December 1, after a period of interruption due to the disturbed condition of affairs at its mine and smelter throughout the spring and summer. Even yet the properties in Mexico are operating at little more than two-thirds capacity, but the prospect of better conditions soon is judged to justify resumption of dividends. The Mexican Lead Co. and the Montezuma Lead Co., controlled by the Compania Metalurgica Mexicana, owned by the Towne & Peabody interests, will pass their November dividends, having paid none for over a year, the disturbed conditions at Monterey and at Chihuahua having prevented work. All the properties of the Mines Company of America are now shut down except the La Dura, which still continues. This Company has done remarkably well, having made a net profit of $360,000 during the first half of this year, and not until recently has work been seriously interfered with. If conditions in Mexico get much worse, something must happen, and whatever it is, it is likely to be for the better.

General Mining News

ALASKA

Alaskan coalfields continue to be undeveloped, according to the U. S. Geological Survey. The only coal being mined is some lignite for local use at Cook inlet, on Seward peninsula, and at several other localities. The total production in 1912 did not exceed 100 or 200 tons. One oil company continued operations in the Katalla petroleum field in 1912, as in 1911. One of the two producing wells is said to have been sunk to a depth of about 800 ft. The oil is procured by pumping and is refined in a small plant near Katalla, and the gasoline finds a ready sale in the coastal settlements of this part of Alaska. There are several other oil companies which control property in this field, but these seem to have done little in the way of development during 1912.

CYANIDE MILL AT TREADWELL, ALASKA.

JUNEAU

September returns from the Alaska Treadwell stamp-mills are as follows:

Ore crushed, tons	78,113
Gold by amalgamation	$112,955
Gold by cyaniding 1509 tons of concentrate	115,235
Total realizable value	225,908
Net profit	123,310
Development, feet	218
Stock of broken ore, decrease, tons	8,821

The Alaska Mexican company reports that 17,364 tons was crushed, yielding a total of $35,709 by amalgamation and the treatment of 394 tons of concentrate. The net profit was $7625. Development covered 189 ft., and the stock of broken ore decreased 6630 tons.

ARIZONA

GILA COUNTY

All steel is now in place for the Inspiration concentrator warehouse and machine-shop, and riveting has been started. Work will shortly be commenced on the steel trestle reaching over the concentrator ore-bins. Within a few days steel will arrive for the main east and west shaft headframes. This will be a twin frame fastened together for the two shafts, the main west frame being 165 ft. high, while the main east will be 185 ft. high.

CALIFORNIA

NEVADA COUNTY

A 10-stamp mill is being erected for the Golden Center of Grass Valley Mining Co., and the superintendent, Charles Brockington, hopes to have it working in December.

SHASTA COUNTY

It is reported that the Bully Hill Smelting & Mining Co. will resume work at its property at Delamar, shortly. A new hoist has been installed at the Donkey zinc mine at Ingot. A large tonnage of ore has been opened and shipments have been made to Utah smelters. The Balaklala Copper Co. is employing 41 men at the mine and smelter. The gas receiver for the Hall process is expected in a few days. It is to be 22 by 45 ft., of steel. The Company has been shipping 55 tons of 3.25% copper and $2.50 in silver ore daily to the Mammoth smelter at Kennett. Precipitating vats are being built at the Balaklala mine to save the copper in the water.

TUOLUMNE COUNTY

(Special Correspondence.)—The mines depending alone on water for power will be forced to suspend operations on October 31 until rains replenish the supply, which is almost exhausted. Work in the shaft at the Wheal Rough mine, near Soulsbyville, was discontinued this week after sinking 200 ft., and cross-cutting to the vein, a distance estimated at about 15 ft., was begun. A shipment of rich ore from the Sonnet mine, near Columbia, to the Selby smelter was made this week. The parties to the suit involving the O'Donnell mine, near Jamestown, have agreed upon a settlement of the controversy. The action was begun about five years ago. The Pot Luck mine, near Phoenix Lake, is to be equipped with a 5-stamp mill. Other buildings besides the one for the mill will also be erected. D. T. and E. W. Morris, who are driving an adit to cut the ancient river channel in Table mountain, expect to reach the objective point within a few weeks. The adit is in 125 ft. The Gold Ship mine, near Groveland, at which development work has been carried on for a number of years, has begun yielding gold, the roller-mill, recently installed, being in operation since October 20. A gravel deposit 80 ft. wide and several feet thick was recently opened, and the gravel being extracted, it is understood, is giving profitable and satisfactory returns. William J. Graham has been manager of the property since the beginning of development work.

Sonora, October 25.

COLORADO

CLEAR CREEK COUNTY

(Special Correspondence.)—Shipments will be started next week from the French Flag mine in Gilson gulch to the Combination mill. It is estimated that there is 11,000 tons of material available, worth $7 per ton in gold and silver. C. S. Ripley is manager. A shoot of galena, 4 ft. wide, has been cut in the White vein, 2700 ft. from the portal of the Commodore adit. Shipments assay $25 per ton in silver and lead. F. Koontz is manager. The Newhouse mill has been closed for repairs, and it is understood that with the resumption of ore treatment a new manager will be in charge. The Little Mattie is shipping on an average of four carloads of smelting ore each week that is worth $2400 per car. The 100-ton con-

centrating plant is running on three 8-hour shifts and is making heavy shipments. W. S. Leebrick is manager. Work will be started in a few days in the advance of the east Bellman drift that is intended to connect with the lateral drift west from the Newhouse adit. D. A. Barry is in charge. The Idaho-Bride M. & M. Co. is producing from 1000 to 1100 tons of mill ore each month, valued at $4 per ton. The product is consigned to the Newton and Jackson mills for treatment. E. D. Payne is manager. The Captain Jack mine, on Columbia mountain, has entered the list of shippers. John R. Richards is manager.

Idaho Springs, October 30.

EAGLE COUNTY

The Brush Creek district is said to be active, yet little ore is being shipped, 13 tons of 52-oz. silver ore daily going from the Lady Belle. The hanging wall of this vein is sandstone and the foot-wall is schist. The main adit is in 240 ft., and an incline is being sunk northwest at 150 ft. from the mouth. Twenty-eight men and four teams are employed. Above this property is the Dakotas, where ore is being mined from a 'sheet' of porphyry in the sandstone. S. A. Nicholson and other Leadville people are prospecting a claim east of the Lady Belle, but water is hindering work. W. E. Brown and associates have not opened any ore to date.

GUNNISON COUNTY

The Tin Cup Gold Mining & Dredging Co., capitalized at $300,000, has begun work in the Bertha gulch near Tin Cup. The cost of getting the machinery to the site, together with the cost of installing it and bringing electric power from St. Elmo has been close to $200,000, but the Company fully expects to make that amount in two months. There have been between fifty and sixty men employed here since early in June.

LAKE COUNTY (LEADVILLE)

On account of recent snowfalls, prospecting in this district is at an end for the season. The *Carbonate Chronicle* considers that the work of the summer has been of great promise, especially in Big Evans, Iowa, California, Half Moon and Lackawanna gulches, where are the makings of producing mines. The Silver Bow Mining Co., operating the Big Four on Breece hill, is shipping gold-silver-lead ore to the Arkansas Valley plant. Lessees at the Lida shaft, Laplander, Little Giant, Baby shaft, Jolly, Chippewa, Bobbie Burns, and Iron Hat are doing the usual development and mining of ore.

TELLER COUNTY (CRIPPLE CREEK)

The following dividends have been paid by five important companies operating at Cripple Creek during the 10 months of the current year: El Paso, $61,250; Elkton, $150,000; Golden Cycle, $315,000; Portland, $240,000; and Vindicator, $104,740. From January 1 to September 30 the Mary McKinney Mining Co. had a revenue of $276,922, and a net profit of $95,722. Four dividends, totaling $104,740 were paid, and the cash balance was $105,671 at the end of September. The main shaft is being sunk from 900 to 1000 ft. depth.

The station pump which was installed at the property of the El Oro Mining & Milling Co. is making good headway toward dewatering the shaft, which work will continue until the 500-ft. level has been recovered. A crosscut will be started from the 500-ft. level toward the Carbonate Queen claim.

A good grade of milling ore is being mined by the lessees of the Vindicator Gold Mining Co. from a shoot which has been opened on the Vindicator vein, north of the main shaft at a depth of about 1000 ft. The ore is being hoisted through the Hull City shaft. The Vindicator company, which is operating the main shaft, is making a normal production and plans are under way for deepening the main shaft to 1600 ft. The Home Run mine, on the southern slope of Squaw mountain, is being worked under lease by Victor interests. This property adjoins the Santa Rita, which is also reported as about to resume operations.

THE SAN JUAN

Results from the Tomboy Gold Mines, Ltd., at Telluride, during the year ended June 30, 1913, are as follows

Ore reserves	
Argentine claims, tons	264,000
Montana claims, tons	162,000
Ore treated, tons	129,618
Bullion receipts	$1,040,357
Profit	471,345
Carried forward to current year	193,000

Work was to have been resumed in the Argentine group below the 2100-ft. level, but has been postponed and concentrated on the Montana group. Improvements in the mill have resulted satisfactorily, and the aerial tramway is saving from $4000 to $4500 per month. This is owned by an American company, the Tomboy Tramway & Tunnel Co., owned by the parent company.

IDAHO

SHOSHONE COUNTY

About 1500 tons of silver-lead ore monthly is being shipped from the Tamarack & Custer mine on Nine-Mile creek, to the Rex mill. Stoping is under way at the 500 and 750-ft. levels, where the ore is from 3 to 30 ft. wide. Extensive development is to be done at the Monitor mine, in the east Coeur d'Alene district, near the Montana boundary line. The properties recently merged include the Monitor, Richmond, St. Lawrence, Copper Age, Edison, and Waumpum claims. The first named is opened to 700 ft. depth, and has produced copper ore worth $150,000. High-grade ore has been shipped from the Richmond and St. Lawrence. It is proposed to drive an adit 8000 ft. in length and 3000 ft. of cross-cuts, giving a vertical depth of 1500 to 2000 ft. in the various claims. A hydro-electric power-plant of 200 hp. is to be constructed at Adair on the Chicago, Milwaukee & St. Paul railroad. The mines are at an altitude of 6000 ft. above sea-level. On November 4 the Bunker Hill & Sullivan Mining & Concentrating Co. paid dividend No. 194 of $81,750. This makes the total amount of dividends paid $14,647,500.

MICHIGAN

HOUGHTON COUNTY

There has been a steady increase in 'rock' shipments during the past week, and large numbers of men are being engaged at the copper mines. Calumet & Hecla has shipped 5640 tons per day; Copper Range, 1200 tons; Quincy, 1500 tons; Isle Royale, 300 tons; Osceola, 1600 tons; Centennial, 220 tons; Allouez, 160 tons; and Superior, 320 tons. The Ahmeek, Wolverine, Mohawk, and Tamarack have not sent out any rock yet, but hope to during the present week. At La Salle a new pump has been installed underground, while at the Lake, Indiana, South Lake, and Franklin there is little being done.

The Franklin Mining Co. has recently issued its annual report. This Company was organized in 1857 and was reincorporated in 1887; its capitalization is now $2,500,000 in shares of $25 each. The Company owns about 1700 acres, its mineral rights covering 320 acres. Half of this is the old Franklin mine, which is surrounded on three sides by the Quincy, and which is nearly worked out. In the Franklin Jr., mining is in progress on the Pewabic amygdaloid and also in the Allouez conglomerate. The report for the year ended Dec. 31, 1912, only covers 10 months' work, as the mine was idle during January and nearly all of July. The output for the year was 184,057 tons of ore hoisted. Of this 4.1%, or 7,585 tons, was sorted out and the remainder milled, yielding 1,710,651 lb. refined copper, or 9.8 lb. per ton. The mill has a capacity of 1200 tons per day, but due to the shortage of labor the best average attained during the year was 800 tons per day. During the year 5134 ft. of development work was done, with most encouraging results, as an area of better grade ore was developed north of the shaft in the upper levels and on both sides of the shaft in the two bottom depths. The 1200 ft. of driving on the 32nd and 33rd levels has developed ore of better grade, showing not only an increase of copper content, but also more uniform distribution of the copper. The cost of driving was $5.79 per foot, and cross-cutting 5.57. Raising cost $9.30 per foot and sinking $11.58 per foot. The stoping cost is

given as $6.62 per fathom. The treasurer's statement shows that $1,710,650 lb. of copper realized $287,286, and the surplus at December 31, 1912, was $41,839.

MISSOURI

Jasper County

Work has been started on the Martin claim of the General Lead & Zinc Co., near Thomas station. The shaft has been cleaned and continued to a depth of 80 ft., where a good grade of ore is reported to be found.

The Lee Hall mine has temporarily ceased producing, and development work is being actively conducted. The property is equipped with a concentrating plant and has been a good producer during the past seven years.

Severe weather has been the cause of curtailing the prospecting work in different parts of the Joplin district, it being almost impossible to operate a churn-drill in stormy weather. A number of the small hand-jig plants have also been forced to suspend operations, as is the case every winter.

MONTANA

Silverbow County

The report of John D. Pope, general manager for the North Butte Mining Co., covers the quarter ended September 30, 1913. Development totaled 4306 ft., and the ore reserves have been maintained. The Granite Mountain shaft is now 20 ft. below the 2600-ft. level. A raise between the 2000 and 1800-ft. levels has proved the Adirondack vein to be continuous, and on the former level the shoot is 300 ft. long, 30 in. wide, assaying 8.5% copper, and 9 oz. silver per ton. Driving east and west on the 2400-ft. level has opened 90 ft. of ore 3.5 ft. wide, worth 3.5% copper and 2.5 oz. silver, and 185 ft., 13 ft. wide containing 4.5% copper and 3 oz. silver, respectively. Work between the 2000 and 1800-ft. levels on the Edith May vein has developed an additional total of 15,000 tons of 6.5% copper ore. A small shoot of 9% ore was opened on the 1600-ft. level on the Jessie vein, also on the South Croesus vein a cross-cut passed through ore. Work on the Snowball vein on the 1600 and 1800-ft. levels indicates that the ore does not rise above the latter point. Results at 2200 and 2400 ft. on this vein were good, although in the east drift the vein was badly faulted for a time, but is now 9 ft. wide of 4.5% copper ore.

The Butte & Superior mill treated an average of 1149 tons of ore daily during the first 10 days of October, with 90.28% recovery, yielding 3,993,000 lb. of zinc. Stripping operations at the Bullwhacker mine have uncovered a shoot of sulphide 12 by 30 ft., with ore still exposed at each end and averaging 12% copper. The body of ore is in a formation of copper-bearing rock that assays 4% over 200 ft. At the mill, a decantation process is being tried in place of filtration, and results so far are satisfactory. It is intended increasing the capacity of the plant to 500 tons per day.

NEVADA

The state inspector of mines, Edward Ryan, after a tour of the state's mining districts, reports that he is highly optimistic regarding the future of the industry in Nevada, there being almost a total absence of 'wild-cat' business, and considerable genuine prospecting and development.

Churchill County

Eastern capitalists have acquired 24 claims in the Dixie district, between Marvel and Boyers, from John O'Connell for $125,000. The property contains wide veins averaging 2% copper, with some gold and silver.

The Nevada Hills Mining Co. reports as follows for September:

	Value.	Per ton.
Ore milled (4307 tons)	$50,392	$11.70
Metals withdrawn from absorption	3,010	0.70
Total	$53,402	$12.40
Loss in tailing	5,463	1.27
Recovery	$47,939	$11.13
Expenses	30,376	7.05
Net returns	$17,563	$4.08

Cash on hand and in banks	$92,911
Supplies on hand	42,830
Concentrate in transit	7,880
Metals in solution, etc.	20,244
Total resources	$163,865

There are no liabilities.

Elko County

Work is reported to be satisfactorily progressing in the vicinity of Bullion. A traction engine is to be put into service for the transport of ore from Bullion to a shipping point a few miles south of Elko on the Western Pacific railway. Ore is at present being shipped out by way of Eureka and the Palisade road.

Esmeralda County

With the checks for dividend No. 19, at the rate of 40c. per share, the Goldfield Consolidated Mines Co. reports as follows for the third quarter of the current year:

Ore treated, tons	89,611
Gold recovered	$1,085,189
Costs	565,650
Net realization	519,539

The output of the Goldfield Consolidated Mining Co. for the month of September was $21,000 less than that of the preceding month. This property, which was one of the largest gold-producing properties, has distributed dividends to the total of $25,000,000 during the past few years. The Company is now producing ore from the 1400-ft. level of the Grizzly claim. There still remains a large area of ground to be exploited.

Humboldt County

At National, the Buckskin National mine is southeast of the National and in the 160-ft. incline shaft a narrow vein has been opened assaying thousands of dollars per ton in gold. At 600 ft. in the National, good ore is being opened over 3½ ft. width. The mill is treating about 30 tons per day. A bond has been secured on the old Montezuma mine, near the middle of the county by Mr. Campbell. This mine has yielded rich silver-lead ore. For the transport of ore from Rochester and supplies to that place, a 4.5 mile narrow-gage railway is now in successful operation, having been constructed for A. A. Codd, of the Rochester Hills Mining Co. It extends from Nenzel, formerly known as Oreana, on the Southern Pacific line, to the mouth of Limerick cañon, one of the outlets of the Rochester district. The equipment consists of an oil-burning locomotive and one gasoline locomotive, two flat cars and 10 steel side-dumping ore cars. The Company's main shaft is down 250-ft., and 50 tons of $25 ore is being shipped per day. The total to date is approximately 6000 tons, worth $150,000. It is probable that a 10c. per share dividend will be paid at the end of the year. The line is proving a boon to mining in the Rochester district. Although originally planned solely for the transport of ore, the line is now being used as a common carrier, and besides moving the ore from Packard and Rochester, it is also carrying in supplies to these towns and to those which lie on the east slope of the Humboldt range.

Exploration and development work is being done on the claims of the Excelsior Copper Mountain Co. The ore is reported as highly desirable, as it carries a good per cent of magnetite and has valuable fluxing qualities. The principal work is being done through a shaft which has reached a depth of 700 ft., and it is expected that by the first of next April the Company will have sufficient ore blocked out to determine the future policy of the Company.

Lander County

A report has been published by Paul Valtinke, of Salt Lake City, on the Highland National Mining Co.'s property in the Mt. Tobin district, 40 miles southeast of Battle Mountain. He states that the vein has been traced for 4000 ft., and has a great width, and the ores are silver bearing. It is probable that the sulphide zone will be reached at a depth of 200 ft., judging from neighboring properties. The Cholona Copper Co., consisting of Utah and Idaho people, is sinking a shaft to 300 ft., and rich

ore is being obtained from a winze. The Nevada Packard Mines Co. has shipped 16 cars of ore averaging $55 per ton since May.

Lyon County

Results at the Nevada-Douglas mines are very satisfactory, especially the Casting Copper section, where 5 to 20% copper ore is being opened. Plans for the leaching plant have been submitted by W. E. Greenawalt, the Company's metallurgist, and the engineering department is in the field working on the details for the site. The site selected is at the mine, and about 1200-ft. from the Ludwig shaft, and about the same distance from the lower terminal of the Douglas Hill tramway. This location will do away with, or greatly reduce, the freight charges on the crude ore, and will eliminate the building of a power-line. It will also eliminate the installation of a pumping system, as the water from the Ludwig will be more than ample to supply the mill. As at present planned, the storage bins are so situated that they may be reached by simply extending for 800-ft. the N. C. B. siding at the Ludwig. The following has been extracted from a report recently made by the general superintendent of the Nevada-Douglas company: "While I have always been firmly of the opinion that the ore continued down, it is very gratifying to encounter and to prove it at depth and with so little development as has been required. It is now an assured fact that the ore found in the Ogden cross-cut in the No. 2 tunnel, at a depth of 150 ft. vertically below the main Douglas Hill level, is a continuation of this body, and a raise on the ore will be started from the No. 2 tunnel to connect the two. Cross-cuts will be run to ascertain the width of this body, which has been developed for 85 ft., and which has a vertical depth of at least 150 ft. As no development work has been done below the No. 2 level, I cannot at present state how much deeper this ore will go, but every indication points to permanency. This development work will increase the ore reserves very materially, as I am at the present time shipping only the ore extracted in the progress of development. From all of the samples taken, which have been running from 4 to 22% copper, I think it can be stated to have an average value for the entire body of from 6 to 8% copper."

Nye County

Development work on the 600-ft. level of the West End property has opened 9 ft. of a good grade of mill ore on the hanging wall side of the vein. The winze is 100 ft. below the 600-ft. level and has proved the extension of ore in depth for this distance. The ore is of a poor grade on the foot-wall side, but on the hanging-wall side some exceedingly rich ore has been found. The extreme west drift on the 600-ft. level shows a full face of a good grade of mill ore, in which are found streaks of ruby silver. This is believed to be an extension of the rich ore-shoot opened some time ago in stope 501-C above the 500-ft. level. In the eastern workings two raises are now in ore from the east foot-wall drift under the vein on the 600-ft. level. A third raise has been commenced, which is expected to be in ore in a few days. The stope from the winze between the 500 and 600-ft. levels is opening up a good grade of ore. The vein at this point is heavily oxidized and shows native silver.

The Belmont vein has been opened to a depth of 1528 ft., where it is from 25 to 30 ft. wide and has been driven on in an easterly direction for a distance of about 300 ft. The vein here is heavily oxidized and shows evidence of leaching, indicating that a good percentage of the metal content has been carried to greater depth. On one of the upper levels this vein has been driven on for a length of 1000 ft. and has been found to be from 25 to 40 ft. wide. Shoots of exceedingly rich ore occur at intervals through the vein and continue to the lowest level, where a body of high-grade ore was followed in a winze from the 13th to the 14th level. The Shaft vein has now been proved from above the 1000-ft. level, where it unites with the Belmont vein, down to the 12th level.

Storey County

The annual meeting of the Sierra Nevada Mining Co. was held in San Francisco on October 26. The superintendent, C. E. Julihn, reported that all work had been concentrated toward the development of the east vein on the 2000, 2400, and 2500-ft. levels, where a total of 1874 ft. was covered. The vein on the first level was 4 to 7 ft. wide, of masses of talc and bunches of quartz of low value, and was opened 133 ft. On the 2500-ft. level the northeast drift followed the vein through several faults to a distance of 965 ft. from the southern boundary. At 320-ft. there was 4 ft. of $6.50 quartz. From this point on, the vein has been from 2 to 9 ft. wide, $13 being the highest assay. At present there is 6 ft. of ore with 2 ft. of $2 quartz. In raising from 2500 to 2400 ft., silver content of the ore was contained in small stringers, this continuing for 62 ft., where two faults cut out the vein. About $9000 was recovered from this work. Great hope is felt for the future development of the property.

Washoe County

There is said to be considerable activity in the districts adjacent to Reno. At the Reno Peavine property a new hoist is being installed at the shaft, which is 247 ft. deep. A road is being constructed by the Copper Queen owners for hauling ore now on the dump. The Stoke-Pogis people are also preparing a road for hauling supplies. Prospecting and development is being done by Lynch, Zimmer, and Hagar at their respective claims in Horse gulch; by Rice and others near the Copper Queen; Gaston and Montrose are opening ore near the Nevada Central; also Pritchett and Smith are sinking on $5 to $16 gold ore nearby; the Williams and Godfrey shaft is being sunk to 200 ft., and two cars of ore recently netted $50 per ton; while a 5-ft. vein is being opened in the Twin Metals claims.

White Pine County

The new stack of the Steptoe smelter was being lined with an acid-resisting compound on October 20, when a gasoline torch caused an explosion, resulting in the death of two and injuries to four men. Quarterly statements have been received in the county assessor's office from the Vulcan Mining, Smelting & Refining Co., and the Hamilton Power & Mining Co. for the period ended September 30. The Vulcan company, whose property is situated in the Hunter district, shipped 223 tons yielding $6591, with a net yield of $387. The Hamilton company, at Hamilton, shipped 94 tons yielding $8590, with a net yield of $24.

At the rate of $2.16 per $100, the Nevada Consolidated Copper Co. will pay $6125 in taxes on its operations during the third quarter of the year. These were as follows:

Ore milled, dry tons	813,511
Gross value of ore	$2,477,305
Cost of mining	570,188
Transportation charges	215,072
Reduction and smelting costs	1,408,468
Net yield on which bullion tax is due	283,576

The output of ore from the Veteran mine has been materially decreased during the past few months, and unless new orebodies are found it is believed that this property will soon be forced to suspend operations, and the operating force transferred to the Ruth property. It was estimated some time ago that there was developed on the Ruth property over 13,000,000 tons of ore. This property is equipped with electric haulage to the Star Pointer shaft, which is in good condition and ready for use.

Two veins are being opened in the Shepherd claim in Heath cañon by Guy L. Gallagher, who has shipped 22 sacks of ore to Salt Lake City for testing purposes. The average value is estimated at $60 per ton in gold.

The Consolidated Coppermines Co. will probably commence the actual work of construction of the new concentration plant and smelter next spring. It is estimated that 2,000,000 tons of commercial ore has been added to the reserves of the Company since last July. A good part of this new ore has been developed by means of churn-drills. The depth of the ore in the new open-pit on the Ora claim has not as yet been determined. It has been shown, however, to be 900 ft. long and 300 ft. wide, and is believed to contain several million tons of ore. The work of grading for the opening of a new pit to the east

of the Morris shaft continues. This ground when ready for mining will be worked by steam-shovels. The new pit will lead directly to the Morris workings, which will eventually necessitate the removal of the equipment at the Morris and Bunker Hill shafts. A part of the grading for the railroad to be used for stripping operations has been completed. A report has been circulated to the effect that the Coppermines company is contemplating the purchase of the Ely Central Co., in the Ely district.

UTAH

Juab County

On October 25, the Iron Blossom company paid its fourth dividend this year, amounting to $100,000. The surplus is now $250,000. On the Salt Lake City Stock Exchange the shares were sold at $1.12.

Summit County

The deal between the Daly Mining Co. and the West Ontario Consolidated Mining Co. for the purchase of the latter's property, has fallen through for the time being. Since cutting ore at the end of last May in the American Flag, ore worth about $24,000 has been shipped. Preliminary work for the electrification of the Snake Creek tunnel is nearly completed, and the necessary machinery will soon be ready for installation. Fred T. Williams is contractor for driving the tunnel, and expects to continue work during the winter. Ore shipments from five mines during the past week totaled 1023 tons.

Tooele County

Work is to be started at the Dugway Silver Bell Co's property in the Dugway district on November 3. Eighteen inches of silver ore had already been opened, and trials between a leaching and a concentrating process seem to favor the latter. Rich concentrate would then be shipped to the smelters.

Washington County

According to J. B. Jenson, the Bull Valley district, 30 miles north of St. George, promises to develop into a large gold producer. The country contains a series of east and west mineralized dikes. Samples from the Bull Valley Gold Mining Co.'s property assay $10 per ton.

WASHINGTON

Ferry County

(Special Correspondence.)—A meeting of the users of power in the Republic 'camp' was held recently, at which a resolution was adopted favoring the use of Diesel engines at a central power-plant, for the distribution of cheap power. A committee was appointed to inquire into the cost of such engines, and their installation.

Republic, October 24.

Stevens County

(Special Correspondence.)—High-grade ore has been opened in the International mine in the Orient district. Two cars of ore from the Copper King, at Chewelah, returned $12 per ton over freight and treatment at the Grand Forks smelter. No. 3 vein is 23 ft. wide. Eighty men are employed at the United Copper mine.

Chewelah, October 24.

CANADA

Ontario

During the third quarter of 1913 there were 10 fatal accidents at mines in the province, making a total of 26 for the year to date. About half of the last quarter's fatalities were caused by premature explosions. The Drummond fraction, purchased from the Drummond Mining Co. jointly by the Kerr Lake and Crown Reserve mining companies, is to be worked as a separate unit. Nearly eight acres is under Kerr Lake, which is now being drained, and work is to be started at the fraction at once. On No. 5 level of the Penn Canadian, about 3 in. of 2000-oz. ore has been opened in a new part of the mine. Owing to shortage of power, the Keeley mine, in South Lorrain, is to be shut down for the winter. Prospecting during the summer has been quite satisfactory.

The production of the Hudson Bay mines for the month of September was slightly below normal, the production figures being as follows:

Tons crushed	1,776
Average assay head, ounces	23.9
Average assay tailing, ounces	3.1
Extraction, per cent	87.4
Month's production, ounces	42,643

The production for the month of August was over 70,000 oz., which is above what has been the average. The whole of the production is not obtained from the mill, a good part of it being obtained from high-grade and hand-picked ore.

The work of draining Kerr lake is making good progress. At the present time 3000 gal. of mud is being pumped per minute. This muddy sediment covers the lake bottom to a depth of from 10 to 40 ft. and as removed is being transported through a large pipe-line to Giroux lake. The sediment carries about 80% water and as a result it can be pumped, and hydraulic operations will not be necessary as was anticipated. At present but little water remains in the lake, and at the present rate of pumping it would be possible to complete the work of draining by the first of the year; however, it will be necessary to close down the plant soon, due to the winter weather. The lake bottom will be trenched and prospected next summer. Three of the veins which were discovered in the lake bottom some time ago have been opened on the 140-ft. level of the No. 7 shaft of the Kerr Lake Mining Co. The extension of the main east vein of the Flemming system will be worked in the near future.

In sinking a winze on the Crown mine below the 400-ft. level, 5 ft. of vein has been opened averaging $50 per ton. The manager of the property expects to cut the 500-ft. station within the next two weeks. At the 300-ft. level the vein showed a continuous length of 600 ft. According to Mr. Cohen, the general manager, there is at present ore to the value of $1,700,000 blocked out above the 400-ft. level, all of which has been developed from one shaft. A second shaft is being sunk to the south of the main working, which when completed will be 1000 ft. in depth. The diamond-drill exploration work in this part of the property has been most satisfactory and has proved the ore to a depth of 300 feet.

Yukon

During the third week in October, ice was flowing heavy on the river at Dawson, although no snow had fallen. The Yukon Gold Co. has dismantled two dredges. One at 62 Below on Bonanza will be moved during the winter to No. 12 Gold Run and rebuilt. The other will be moved from the Anderson concession to No. 41 on Hunker creek, a distance of five miles. The Company had about 40,000 cords of wood delivered in the summer for thawing on Hunker and Bonanza creeks, while more will be hauled this winter. Frank Neill hauled 17,000 cords to Dawson, and 15,000 cords were brought down the Klondyke for the Yukon Gold Co. by N. A. T. and T. Labbe and Chisholm.

CHILE

(Special Correspondence.—The plant of the Sociedad Beneficiadora de Condoriaco, Ltd., has been sold to Mark R. Lamb, who, with D. C. Woodward, T. L. Slaughter, and F. Karl Lamb, is now operating the plant as a custom mill. The plant was built to treat a dump containing 80,000 tons of low-grade material, but so far has operated only as a custom mill. The ore is gold-silver in about equal proportions in value, and nothing of less value than $20 is purchased, while some of the sorted ores are worth $100 per ton. The plant is to be increased in capacity and a modern slime plant and filter added, so that a profit can be made on the low-grade material which it is expected will average $10 per ton. The district has a big record and possesses several mines which will probably now be reopened, as there is an opportunity to dispose of ores. The camp is some 30 miles from Marquesa, the nearest railway station, and is at an elevation of 5000 ft. The purchase price was $30,000 (U. S. cy.), besides which it will be necessary to install more equipment.

Santiago, Chile, October 3.

Decisions Relating to Mining

Specially reported for the MINING AND SCIENTIFIC PRESS.

MINING CORPORATION—AUTHORITY TO MORTGAGE

The defense that a mortgage upon the mines of a coal mining company had been executed by the directors without a vote of the stockholders as required by the Colorado statute, cannot be raised by the corporation as a defense in an action to foreclose the mortgage, but is available only to the stockholders.

Firestone Coal Co. *v.* McKissick, (Colorado) 134 Pacific, 147. July 14, 1913.

NEVADA CORPORATIONS—OFFICERS

Under the laws of Nevada, a corporation organized in that state must have not less than three trustees or directors, who in turn must elect a president, a secretary, and a treasurer. There may be as many additional directors and officers as the corporate by-laws provide for. The duties of these officers are not prescribed by law except that the secretary is required (Section 1126 Revised Laws) to record all the acts and votes of the corporation and its members and stockholders in a book kept for that purpose.

PHOSPHATE LEASE—ROYALTIES

Where a lease conveying the right to mine and remove all the merchantable phosphate rock from beneath certain property, provided that in case the lessee should mine and ship less than a specified minimum amount, that he should nevertheless pay a specified sum every quarter as 'ground rent,' if after the lease is executed it turns out that there is no phosphate rock on the land, the lessee is excused from paying any royalty or ground rent whatever. The lease was held to have assumed and contemplated the existence of the rock as its subject matter, and when that failed the obligation failed.

Ross *v.* Savage (Florida), 63 Southern, 148. July 1, 1913.

MINING LEASE—CONSTRUCTION

Where under a lease of certain lands for the purpose of mining coal and manufacturing coke, the lessee proceeded to construct certain buildings on the land for the future use of its employees, and pending such use leased said buildings to another company without accounting to the lessor of the land for the rents from the buildings so leased, there being a clause in the original lease permitting the lessee to exercise any rights not reserved by the lessor and no inhibition against leasing buildings constructed by the lessee, it was held that the law would not imply such an inhibition and that no accounting for rents could be required.

Stonegrep Colliery Co. *v.* Kelly & Vicars (Virginia), 79 Southeastern, 341. Sept. 11, 1913.

SEVERENCE OF MINERAL RIGHTS—CO-TENANTS

The general owner or owners of land may grant all the minerals therein or any particular species of them, while still retaining title to the surface, or they may grant the land and reserve the minerals, thus creating a separate estate in the minerals, distinct from the land in which they are found, but one of two or more tenants in common cannot convey his share by metes and bounds, nor can he convey the mineral rights and reserve the surfuce to the prejudice of his co-owners. The grantee under such a deed to mineral rights from one of several tenants in common under the law of Virginia becomes himself a tenant in common with the others. Where a stranger to the title thereafter accepts a deed from all the remaining co-tenants, purporting to cover the entire tract of land, goes into possession under such deed and to all intents and purposes remains the sole owner in fee and in possession for more than 30 years continuously thereafter, he is held to have acquired by adverse possession, prescriptive title to the mineral rights as against the grantee under the said deed of mineral rights from one of the original co-tenants.

Virginia Coal & Iron Co. *v.* Hylton (Virginia) 79 Southeastern, 337. Sept. 11, 1913.

Personal

Professional men are invited to send news of their engagements and travels. Such news is interesting to friends.

F. G. COTTRELL has gone to Butte.

MAX. J. WELCH is at Los Angeles.

HARRY R. JOHNSON was in San Francisco Monday.

C. C. BRAYTON has returned from Nome for the winter.

F. B. WEEKS was in San Francisco from Shasta county this week.

SEELEY W. MUDD was in San Francisco Thursday from Los Angeles.

LEO VON ROSENBERG has been in Nevada and Sierra counties, California, recently.

L. V. WATERHOUSE is now at Queenstown, Tasmania, for the Mt. Lyell M. & R. Company.

M. W. VON BERNEWITZ is visiting the Mother Lode mines and the dredging fields of California.

FRANCIS DENNIS is in New York, having completed his professional work in North Carolina.

W. A. WILLIAMS has returned from Arizona and will make San Francisco headquarters hereafter.

GEORGE W. EVANS has completed his work at Matanuska, Alaska, for the Bureau of Mines and has returned to Seattle.

C. E. GRUNSKY, JR., has returned from Bodie, where he has been acting as superintendent for the Standard Consolidated.

E. V. DAVELER, formerly mill superintendent for the Ray Consolidated, is now mill superintendent for the Alaska Gastineau.

J. E. BREAKELL is general superintendent for the Socorro G. & S. M., Ltd., in Honduras. W. S. MANN is erecting the cyanide plant.

R. T. MISHLER is assistant general manager for the Tigre Mining Co., and not superintendent as erroneously announced October 30.

R. N. DICKMAN has joined the staff of R. W. Hunt & Co., and is engaged in examining gypsum and coal properties in western Canada at present.

HENNEN JENNINGS, W. J. RICHARDS, A. E. MONTGOMERY, and M. E. KEMMERER were elected directors of the American Mining Congress at its meeting at Philadelphia last week.

Obituary

ARTHUR WILKINSON, a member of the Institution of Mining and Metallurgy, and consulting engineer for the Colombian M. & E. Co., and the Sekondi & Tarkwa Co., Ltd., died September 29.

M. JASPER MCDONALD, one of the pioneer miners of California, died suddenly on the night of October 30, in his eighty-third year. Mr. McDonald was a well known figure on the Stock Exchange of San Francisco, of which he had been a member for many years. For more than 20 years he had operated the Keystone mine in Amador county, succeeding his brother James. He also was owner of several other mining properties in various parts of the state and was one of the early-day operators on the Comstock Lode. He was for many years an active member of the Bohemian Club of San Francisco.

FRANK P. SWINDLER, a resident of Salt Lake City, died at Los Angeles, October 13, from cardiac asthma due to inhalation of stone dust while operating a dry-crushing mill years ago. The dust in his lungs had given him much trouble during the past few years, although few of his friends were aware of his condition. He was a native of Pennsylvania and before going to Utah was identified with mining at Leadville. He was well known in the West, having held positions as general manager of the De La Mar property in Nevada, in behalf of the Bamburger interests general manager of the Ohio Copper Co. at Bingham, manager of the Opex company at Tintic, and had examined and reported on many properties.

The Metal Markets

LOCAL METAL PRICES

San Francisco, November 6.

Antimony	10—10½c	Quicksilver (flask)	$39
Electrolytic copper	17½—17¾c	Tin	44—45½c
Pig lead	4 60—5.55c	Spelter	7—7½c

Zinc dust, 100 kg. zinc-lined cases, 7½ to 8c. per pound.

EASTERN METAL MARKETS

(By wire from New York.)

NEW YORK, November 5.—The fourth being a holiday, public interest was devoted solely to the elections and the market received no consideration, everyone taking a day off to elect a new mayor. The copper market opened weak today and but few sales are reported. Lead is active and spelter is quiet. The tin market is quiet with spot and November quoted at 40.15 to 40.35. Trading in tin has been moderately active but the market has been subject to irregular movements, this being especially true of the London market.

SILVER

Below are given the average New York quotations, in cents per ounce, of fine silver.

Date.		Average week ending	
Oct.	30	Sept. 24	61.59
"	31	Oct. 1	61.68
Nov.	1	" 8	61.27
"	2 Sunday	" 15	61.12
"	3	" 22	61.14
"	4	" 29	59.98
"	5	Nov. 5	59.52

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	56.25	63.01	July	60.67	58.70
Feb.	59.06	61.25	Aug.	61.32	59.32
Mch.	58.37	57.87	Sept.	62.95	60.53
Apr.	59.20	59.26	Oct.	63.16	60.88
May	60.88	60.21	Nov.	62.73	....
June	61.29	59.03	Dec.	63.38	....

Samuel Montagu & Co. report October 23 as follows: Lack of animation continued to characterize the market for the greater part of the week, although the undertone remained steady. Until today, movements in prices had been confined within very narrow limits; in fact, the total variation in the cash price since the beginning of the month had been only 5/16d. China was inclined to figure as a seller, but 'bear' covering operations and a demand for the Continent and elsewhere was sufficient to absorb the modest amounts available. Today heavy offerings of silver from China and India, coming on an unwilling market, resulted in a sharp fall of 3/8d. in the cash quotation, and 5/16d. in that for two months. During the last six weeks, bar silver to the value of over £300,000 has been shipped to Germany and Russia. Spot supplies remain relatively scarce, and the premium on cash silver rose to 1/8d. on Oct. 20, fell back the following day to 1/16d., and repeated the movements on Oct. 22 and 23. It is expected that a substantial shipment will be made by this week's P. & O. steamer for account of the Indian Government. The Indian currency return received on Oct. 17 showed an increase in the holding of silver rupees of 145 lacs, which is to be accounted for by the release of 150 lacs of silver rupees from the standard reserve, by the transfer to that reserve of 150 lacs of rupees in gold from the holding of 'gold in India.' The stock in Shanghai has fallen from £6,220,000 to £6,195,000 and that in Bombay from £420,000 to £365,000, while the offtake at the latter place is rather better at 75 bars per day. A shipment of £50,000 of silver has been made during the week from San Francisco to Hongkong. The quotations today for cash and 2 months delivery are 7/16d. lower than those fixed a week ago.

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.		Average week ending	
Oct.	30	Sept. 24	4.69
"	31	Oct. 1	4.61
Nov.	1	" 8	4.33
"	2 Sunday	" 15	4.40
"	3	" 22	4.35
"	4 Holiday	" 29	4.35
"	5	Nov. 5	4.20

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	4.43	4.28	July	4.71	4.35
Feb.	4.03	4.33	Aug.	4.54	4.60
Mch.	4.07	4.32	Sept.	5.00	4.70
Apr.	4.20	4.36	Oct.	5.08	4.37
May	4.20	4.34	Nov.	4.91	....
June	4.40	4.33	Dec.	4.20	....

COPPER

Quotations on copper as published in this column represent average wholesale transactions on the New York market and refer to electrolytic copper. Lake copper commands normally from 1-5 to 1-4c. per lb. more. Prices are in cents per pound.

Date.		Average week ending	
Oct.	30	Sept. 24	16.41
"	31	Oct. 1	16.29
Nov.	1	" 8	16.27
"	2 Sunday	" 15	16.11
"	3	" 22	16.38
"	4 Holiday	" 29	16.55
"	5	Nov. 5	16.25

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	14.09	16.54	July	17.19	14.21
Feb.	14.08	14.93	Aug.	17.49	15.42
Mch.	14.68	14.72	Sept.	17.56	16.23
Apr.	15.74	15.22	Oct.	17.32	16.31
May	16.03	15.42	Nov.	17.31	....
June	17.23	14.71	Dec.	17.37	....

The New York market was featureless last week, and at the end of October the only interest displayed was in speculating regarding the statistics for September, which will be issued on Oct. 7, as Oct. 8 falls on Sunday. Throughout the early part of last week prices were held by sellers at 16⅞c., not much 'second hand' copper being offered. At the middle of the week there was a fall in price on the London market, which is speculative, but there was no change here, and the week closed with the nominal quotations unchanged and but little business being done. Much has been made of the fact that the world's visible supply on Oct. 1 was equal to only about 12 days consumption, and the strikes at Rio Tinto and on the Cerro de Pasco railway have been featured as 'bull' arguments on the price of copper. Less attention is called to the fact that the European demand is slackening, exports during October having been but 27,689 tons, as compared with 24,670 tons last year, and the American demand is very poor at present. Some of the mills in the Naugatuck valley are only working at half capacity, and the American Brass Co., one of the largest consumers, has greatly slackened its demand. We do not look for any marked improvement in the price of copper this month.

ZINC

Zinc is quoted as spelter, standard Western brands St. Louis delivery, in cents per pound.

Date.		Average week ending	
Oct.	30	Sept. 24	5.50
"	31	Oct. 1	5.39
Nov.	1	" 8	5.24
"	2 Sunday	" 15	5.28
"	3	" 22	5.10
"	4 Holiday	" 29	5.25
"	5	Nov. 5	5.13

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	6.42	6.88	July	7.12	5.11
Feb.	6.50	6.13	Aug.	6.96	5.51
Mch.	6.57	5.94	Sept.	7.45	5.55
Apr.	6.63	5.52	Oct.	7.36	5.22
May	6.68	5.23	Nov.	7.23	....
June	6.88	5.00	Dec.	7.09	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California, being the largest producer The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending			
Oct.	8	39.50	
"	15	39.00	
Oct.	22	39.00	
"	29	40.00	
Nov.	5	39.00	

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	43.75	39.37	July	43.00	41.00
Feb.	46.00	41.00	Aug.	42.50	40.50
Mch.	46.00	40.20	Sept.	42.12	39.70
Apr.	42.25	41.00	Oct.	41.50	39.37
May	41.75	40.25	Nov.	41.50	....
June	41.30	41.00	Dec.	39.75	....

TIN

New York prices control in the American market for tin, since the metal is almost entirely imported. San Francisco quotations average about 5c. per lb. higher. Below are given average monthly New York quotations, in cents per pound:

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	42.53	50.45	July	44.25	40.70
Feb.	42.96	49.07	Aug.	45.80	41.75
Mch.	42.58	46.95	Sept.	48.64	42.45
Apr.	43.92	49.00	Oct.	50.01	40.61
May	46.05	49.10	Nov.	49.92	....
June	45.76	45.10	Dec.	49.80	....

The Stock Markets

SAN FRANCISCO STOCKS AND BONDS

(San Francisco Stock and Bond Exchange.)

BONDS

November 6.

Listed.	Bid	Ask	Unlisted.	Bid	Ask
Associated Oil 5s	$ 97½	99½	General Petroleum 6s	85½	86½
E. I. du Pont 4½s	83½	84½	Natomas Dev. 6s	60	—
Natomas Con. 6s	—	70	Pac. Port. Cement 6s	99½	—
Unlisted.			Standard Cement 6s	99	—
Am. Oil 5s	78½	—	Santa Cruz Cement 6s	82½	—

STOCKS

Listed.	Bid	Ask	Unlisted.	Bid	Ask
Amalgamated Oil	77	—	Mascot Copper	—	2½
Associated Oil	38½	38¾	Noble Electric Steel	2½	—
Giant	86	—	Natomas Consol.	5	10
Pac. Ost Borax, com.	—	100	Pacific Port. Cement	63	75
Pacific Crude Oil	—	35c	Riverside Cement	45	—
Sterling O. & D.	75c	—	Santa Cruz Cement	44	47½
Union Oil	55	—			

NEVADA STOCKS

(By courtesy of San Francisco Stock Exchange.)

San Francisco, November 6.

Atlanta	$ .12	Mizpah Extension	$ .29
Belcher	.21	Montana-Tonopah	1.05
Belmont	7.40	Nevada Hills	.67
Big Four	.18	North Star	.42
Cash Boy	.06	Ophir	.25
Florence	.25	Pittsburg Silver Peak	.36
Goldfield Con.	1.47	Round Mountain	.38
Goldfield Oro	.08	Sierra Nevada	.10
Halifax	1.30	Tonopah Extension	1.76
Jim Butler	.65	Tonopah Merger	.58
Jumbo Extension	.09	Tonopah of Nevada	4.60
MacNamara	.10	Union	.19
Mexican	1.40	West End	1.30
Midway	.38	Yellow Jacket	.29

COPPER SHARES—BOSTON

(By courtesy of J. C. Wilson, Mills Building.)

November 6.

	Bid	Ask		Bid	Ask
Allouez	$ 34½	36	Mohawk	$ 41	42
Ariz. Commercial	4⅜	4¾	Nevada Con.	14½	15½
Butte & Superior	30½	30¾	North Butte	23½	23¾
Calumet & Arizona	63	63¾	Old Dominion	47½	48½
Calumet & Hecla	415	420	Osceola	77	78
Copper Range	37⅛	37½	Quincy	57	59
Daly West	2	2½	Shannon	6¾	7
East Butte	11	11½	Superior & Boston	2⅜	2¾
Franklin	3	3¼	Tamarack	27	29
Granby	69¾	70½	U. S. Smelting, com.	36	37
Greene Cananea	33	—	Utah Con.	8½	8¾
Isle-Royale	17½	18½	Winona	1¼	2
Mass Copper	2	3	Wolverine	42	43¾

NEW YORK CURB QUOTATIONS

(By courtesy of E. F. Hutton & Co. Kohl Building.)

November 6.

	Bid.	Ask.		Bid	Ask
Braden Copper	6⅝	6⅞	McKinley-Dar.	1¼	1⅜
Braden 6s	130	140	Mines Co. Am.	2	2¼
B. C. Copper	2¼	2½	Nipissing	7½	7⅝
Davis-Daly	1½	1¾	Ohio Copper	¼	½
Dolores	2	4	San Toy	18	22
El Rayo	1	2	Sioux Con.	1	2
Ely Con.	4	⅝	So. Utah	¼	⅜
First Nat.	2⅝	2⅞	S. O. Calif.	191	193
Greene Can.	6	7	Tri Bullion	⅛	¼
Giroux	1⅛	1½	Tuolumne	¾	1
Iron Blossom	1.10	2.00	United Copper	¼	¾
Kerr Lake	4¼	4⅜	Wettlaufer	8	10
La Rose	1⅝	1¾	Yukon Gold	2	2¼
Mason Valley	4	4¼			

NEW YORK STOCK EXCHANGE

(By courtesy of J. C. Wilson, Mills Building.)

November 6.

	Bid	Ask		Bid	Ask
Alaska G. M.	$ 21½	21¾	Miami	22	22¼
Amalgamated	69¾	70	Nat. Lead	43½	45
Anaconda	33½	33¾	Quicksilver, com.	2	3
A. S. & R.	62	62¼	Ray Con.	17¾	18
Calif. Pet.	16¾	18¾	Tenn. Copper	28¼	28⅝
Chino	37	37⅛	U. S. Steel, pfd.	104¼	104¾
Guggenheim Ex.	44	44½	U. S. Steel, com.	64⅛	64¼
Mexican Pet	44¾	45	Utah Copper	49⅞	50⅛

LONDON QUOTATIONS

(By cable, through the courtesy of Catlin & Powell Co., New York.)

November 6.

	£	s.	d.		£	s.	d.
Alaska Mexican	1	17	[illegible]	Kern River Oilfields	0	6	3
Alaska Treadwell	[illegible]	0	0	Mexico Mines	5	5	0
Alaska United	3	12	6	Messina	1	7	6
Arizona	1	17	6	Oroville	0	6	3
California Amalg.	0	1	3	Pacific Oilfields	0	2	6
California Oilfields	6	0	0	Rio Tinto	72	12	6
Camp Bird	0	13	9	Santa Gertrudis	0	15	0
El Oro	0	13	9	Stratton's	0	2	6
Esperanza	0	15	0	Tanganyika	2	1	3
Granville	0	11	3	Tomboy	1	6	3

AUSTRALASIAN

November 6.

	£	s.	d.		£	s.	d.
British Broken Hill	2	0	0	Mount Boppy	[illegible]	16	9
Broken Hill Prop.	1	17	6	Mount Elliott	4	10	0
Golden Horse-Shoe	2	12	6	Mount Lyell	1	5	0
Great Boulder Prop.	0	12	6	Mount Morgan	3	10	0
Ivanhoe	2	18	9	Waihi	2	17	6
Kalgurli	1	7	6	Waihi Grand Junc.	1	5	0

L. Vogelstein & Co.'s Metal Report*

TIN

There has been an almost entire absence of demand for tin from America. This is partly due to the generally pessimistic feeling pervading all markets and also to conditions specifically affecting tin—chiefly the fact that tin plate prices for the ensuing year have not yet been fixed. Last year they were fixed as early as September. Immediately this is done, a large volume of orders automatically goes on the tin plate makers' books. As soon as there is a change in this respect, a greater activity is expected, and it is not impossible that higher prices will prevail. It must be admitted that the statistical position is not encouraging. Deliveries here in the last quarter of the year will probably be 1000 tons less than during the corresponding period of 1912, and London, Holland, and the Continent will shrink a like amount. Consequently the visible supply December 31 is not likely to show any decrease compared to September 30, whereas last year there was a decrease of 2000 tons.

LEAD

While sentiment in respect to lead, as is the case with other metals, is in a depressed state and buying is only of a hand-to-mouth character, it is doubtful if prices will go any lower. This opinion is based on the fact that the foreign and domestic markets are now on almost an exact parity, and any decline here, unless coincident with lower prices abroad, will be followed by exports. The New York price of 4.35 for common desilverized lead is equivalent to £20, and lead has been selling in England and on the Continent at £20 or better for the past six months. Present high prices abroad are charged principally to the smaller quantities coming from Mexico. According to reliable authorities, the normal production of that country, approximately 10,000 tons per month, has been reduced about 75%. There is no promise of an early solution of the Mexican troubles.

Concerning the domestic situation, there is every reason to believe that consumption exceeded production by a wide margin in 1912. This year, while consumption has only slightly increased, supplies promise to be larger—not sufficiently so to make the situation unsound, but enough to make it easy—especially in view of the lack of confidence now prevailing and the almost universal indisposition to undertake future commitments.

SPELTER

Spelter has, as usual, fluctuated over a wide range of prices. It opened above 7c., went below 5c., reacted to about 5¾c. or 5⅞c., dropped back to 5⅛c., and is now about 5¼ to 5⅜c. Subsequent to Government statistics covering the first half of the year, no authentic information is obtainable concerning the position of this industry. These statistics disclosed a slight increase in production and considerable falling off in deliveries.

*Circular of October 27.

Concentrates

Most of these are in reply to questions received by mail. Our readers are invited to ask questions and give information dealing with the practice of mining, milling, and smelting.

In counteracting acidity 1.4 parts of lime, or 2.6 parts of carbonate of soda, is equivalent to 1 part of caustic soda.

Pumice is not a material sold in the general market, and prices cannot be quoted. Manufacturers who use it for making various sorts of scouring and polishing preparations, usually control their own supply or buy direct from the producer.

The output of manganese alloys, ferromanganese, and spiegeleisen from American works last year was 227,939 long tons, against 178,615 tons in 1911, and shows a healthy activity in this branch of the mining industry. In addition, more than 100,000 tons was imported.

Iron ore reserves to the extent of 30% of the total available are owned in Michigan by the United States Steel Corporation, according to C. K. Leith. The Cleveland-Cliffs Co. owns about twice as much old range ore as the Corporation, according to the same authority.

Iron pyrite has little or no effect on cyanide, and the cyanidation of a highly pyritic ore of this nature presents no difficulties provided that partial oxidization of the pyrites has not preceded treatment, and that the ore has been fine enough ground to expose the gold or silver to the solvent action of the solution.

Copies of patents granted by the United States may be obtained at small expense direct from the Commissioner of Patents at Washington, D. C., provided the number of the patent is known. Otherwise it is best to make application to a patent attorney who will make search of the files and obtain the needed information.

Trainloads have increased rapidly upon American railroads in recent years, due largely to the initiative of James J. Hill of the Great Northern. On that system of railroads the average trainload has increased from 357 tons in 1900 to 635 in 1913. An important factor in bringing up this average has been the development of the iron ore traffic in which the average trainload is approximately 2200 tons.

Iron ore forms 50% of the revenue tonnage of the Great Northern railroad, despite the extent of that system. The profit in handling it amounts to 12% of the gross and 20% of the net earnings. One mile in the iron country contributes the same number of carloads as required to handle the whole wheat crop of North Dakota. The total iron ore handled by this road this year amounted to 15,000,000 tons, equal to 65% of the total wheat crop of the United States.

In estimating the amount of gold in a specimen, as shown on this page in the issue of November 1, where g_1 represents the specific gravity of the specimen, g_2 the specific gravity of gold, and g_3 the specific gravity of quartz, and x the percentage of gold in the specimen, according to L. J. Hohl, of San Francisco, the equation for x would be:

$$xg_2 + (100 - x)g_3 = 100g_1$$

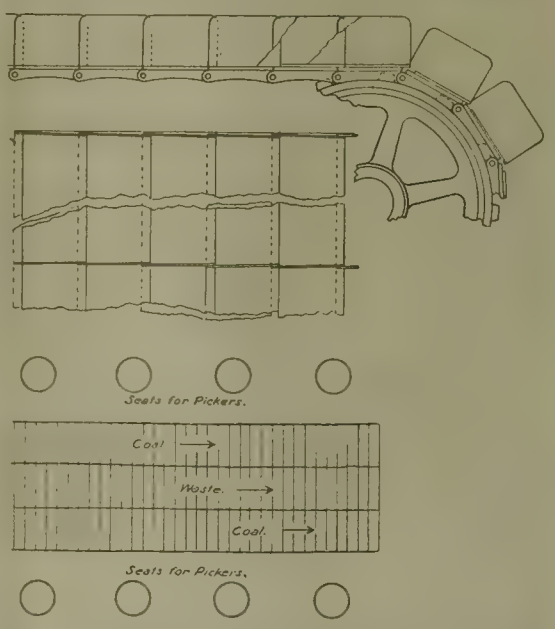
from which

$$x = \frac{100(g_1 - g_3)}{g_2 - g_3}$$

Brazilian iron ores grade up to 69% and are very low in phosphorous, according to C. K. Leith. In the Riodoce valley he estimates that 600,000,000 tons of high-grade ore is available above the lowest outcrop, and that above a depth of 600 ft. the reserve amounts to 1,000,000,000 tons. Of soft ore analyzing about 64%, there is in the same locality 365,000,000 tons proved and about 1,000,000,000 tons probable above 600 ft. depth. In Brazil as a whole there are estimated to be 4,000,000,000 tons containing 64% iron or more.

The plasticity of clay is directly determined by the character and amount of the colloid matter in the clay, consequently, by measuring and controlling the colloid matter present, the plasticity of the clay will be easier controlled, according to H. E. Ashley, of the Bureau of Standards, Washington, D. C. The process of coarsening or sedimentation of particles in pulp is commonly termed flocculation, the opposite process, deflocculation. The latter term has come to mean a decrease in the rate of clearing, and suspensions are said to be deflocculated when they settle slowly or not at all. These terms are relative only, as there is no direct measure of the extent of flocculation. It is, however, convenient to speak of the degree of flocculation. Thus, when it is said that addition of an alkali decreases the degree of flocculation, it is understood that an alkali tends to deflocculate a pulp; or, in other words, to decrease the size of the dispersed particles and so to render the suspension more permanent. The deflocculators, which comprise only the hydroxides, carbonates, and other highly hydrolyzed salts of the alkali metals, all of which have a strong alkaline reaction, also show a 'threshold concentration' effect.

Picking belts of various types are used at many mines. Below is presented a plan and elevation of a particularly good design adopted by the Mitsui Co. at the Miike colliery in southern Japan. The coal is here fed in continuous stream to a horizontal pan conveyor divided into three parallel channels. The pickers, in this case neatly dressed and white-capped girls, sit facing their work with a stream of coal before them. The waste channel is in the centre. Consequently there is no need for awkward turning or throwing back of refuse. With the simplest



and most efficient of motions, each girl picks the slate from the stream of coal in front, raises it the few inches necessary, and drops it into the middle channel of the conveyor. As the coal is dropped upon the conveyor through a hooded chute and the picking shed is large, well lighted, and well ventilated, the working place is clean and cheerful. There are 40 pickers. The total amount handled is 2200 tons per day, equivalent to 55 tons per worker. From this 2½% or 1⅓ tons of waste per girl is sorted out. The wages are 17½ to 20 cents per 8-hour shift; but this is not the whole compensation, since, as is customary in Japan, the Company assumes responsibility and considerable expense for living conditions.

Book Reviews

MINERAL DEPOSITS. By Waldemar Lindgren. P. 883. Ill., Index. McGraw-Hill Book Co., New York, 1913. For sale by *Mining and Scientific Press*. Price $5.

When Mr. Lindgren resigned as chief geologist of the United States Geological Survey, there was consolation for the loss sustained by the public service in the thought that he would now find time to digest and summarize, at least in part, his many observations and the results of his wide reading. This he has now begun to do, and in the volume under review he has brought together in one orderly whole much of his material, at the same time that he has reduced to consistency and order much contributed to the literature of mineral deposits by his fellow-workers. The result is a book of undoubted significance; one which is likely to mark a definite change in the current of study. Not that there is in it much that has not been previously printed, but that the facts and conclusions are so arranged as to admit of intelligent comparison and to throw new light upon them.

It is interesting to note that Mr. Lindgren has chosen the title 'Mineral Deposits' rather than 'Ore Deposits.' Thus he reverts to the earlier point of view such as Whitney had in mind in 1855 when he wrote his 'Metallic Wealth of the United States'—that is, the unity of the subject. There is no real reason, perhaps, why the genesis of the non-metallic minerals should be studied separately from that of the metallic. Indeed, it is often difficult to say when a given deposit belongs with one rather than the other, since a vein worked for its metallic content at one time may later become chiefly valuable for the non-metallic gangue. It is also true that many metals, such as sodium, being little used in their elemental form, the earthy mineral in which they occur becomes of chief value and colors the popular conception of the character of the deposit. Originally the veins of southern Illinois were worked for lead, which is present in the form of galena; now, and for many years past, the lead has been incidental and the fluorspar is most important. The problems of occurrence and genesis have, however, remained the same. Under any system of study, these veins must be compared with ordinary lead-silver veins in the West rather than with coal beds or salt marshes. Mr. Lindgren makes the attempt to bring all this material together, though even he excludes coal and certain others including gilsonite which is found in veins as typical as ever formed of quartz. The chapters in which the non-metallics are treated, while interesting from the fact that they reflect a point of view not usual in the study of these minerals, are by no means as strong as are the others in which Mr. Lindgren discusses the things regarding which he has a first-hand and masterly knowledge.

Another feature of the book is the abandonment of the older classifications and the bold following of a genetic scheme. As Mr. Lindgren states, "opinions may differ as to whether our present knowledge is sufficient for such an undertaking." Our own is that, while there are large gaps in our knowledge and there will be much uncertainty as to the placing of many important deposits in any genetic scheme, the one here proposed is in the line of progress; that, indeed, it is much more than an attempt to classify: it is a working and workable outline. We may shift the position of the units, we may even deny the integrity of certain of the proposed groups, but in the main the usefulness of the plan, as well as the sound knowledge of its author, will lead to its adoption.

Following eleven introductory chapters in which are discussed such matters as the deposition of minerals, the flow, composition, origin, and chemical work of underground waters, the relations of mineral deposits to mineral springs, the folding and faulting of rocks, the openings in rocks, the form, structure, and texture of mineral deposits, and ore-shoots, the classification itself is outlined and typical examples of deposits falling in each class are described in fifteen chapters. Interest centres mainly upon these chapters in which the various deposits are described and classified. As to the first, "deposits formed by mechanical processes of transportation and concentration," there is little room for differences of opinion, though it is surprising that the Rand gold deposits are discussed in this chapter in view of the apparent present preponderance of evidence in favor of the introduction of gold, the significant element, after the formation of the banket. The "deposits produced by chemical processes of concentration in bodies of surface water by reactions between solutions" include the larger number of non-metallic deposits whose discussion in this connection has been noted as unusual. This, and the succeeding chapter on "deposits formed by evaporation of bodies of surface waters," are possibly the least satisfactory in the book. The "mineral deposits resulting from processes of rock decay and weathering" include many well known occurrences. We are glad to see the inclusion of a number to which has been occasionally ascribed a more complex and mysterious origin, and emphasis placed upon the capacity of simple existing agencies to produce the concentrations. Just why it is necessary to infer that most of the bauxite deposits of the United States were formed "under climatic conditions different from those now prevailing" is not entirely clear.

Deposits formed by concentration of substances contained in the body of the rocks in which the ores are found, are further divided into (a) those formed by means of circulating waters, (b) those resulting from regional metamorphism, and (c) copper deposits formed by zeolitization of basic lavas. There will be much confusion between the first mentioned class and the one next to follow, that is, those formed in sedimentary rocks by circulating waters but without the influence of igneous activity. It is, to us at least, a matter of grave doubt whether a circulation active enough to concentrate into a workable body of ore the minutely disseminated particles of mineral found in sedimentary rocks, is in fact often confined to one formation, and whether, in those cases where it does occur, there is any significance to be attached to the fact. Similarly, we doubt the value of the class assigned to deposits formed by regional metamorphism. While perhaps pressure and temperature changes might convert a rock into an ore, we can not conceive of any considerable body being formed except by transfer of material, in which case surely solutions would come into play. Mr. Lindgren seems to have found this a difficulty, since even with his wide knowledge of deposits and literature, he is able to assign but few deposits to this class.

When the group of deposits formed under the influence of igneous intrusions is taken up, Mr. Lindgren places the bulk in three classes, and states frankly that opinion is divided as to the origin of the heated ascending waters which are the main agency in their formation. In his discrimination of these three classes lies, we believe, one of the main practical results of his work, and we would call attention to the fact that this assignment of individual deposits rests upon no theoretical or *a priori* grounds, but upon the solid basis of thorough geological studies of the regions involved. The Cripple Creek ores are placed in the class formed at shallow depths at which presumably ascending and descending waters would mingle, not because of any special peculiarity of the deposits, but because reconstruction of the Cripple Creek volcanic cone shows that the present surface is probably less than 1500 ft. below the original surface. In the same fashion, the locus of the Mother Lode ores of California in the intermediate zone, is based upon reconstruction of the geology of the Sierra Nevada. These depths once fixed upon independent evidence, certain conclusions as to pressure became permissible. The third group is that of deposits formed by processes of igneous metamorphism, or the deep-seated ores of the general class formed by ascending waters. There are still the mineral deposits of the pegmatite dikes, and the minerals deposits formed by concentration in molten magmas or, as others prefer to call them, the magmatic segregations. In treating all these classes, Mr. Lindgren is notably conservative. He allows no single theory to

run away with him, and yet he makes fairly definite statements and builds up clear concepts.

Metamorphosed deposits are treated separately, and the oxidation of ores is discussed as a later and separate process rather than as part of ore genesis itself. There are those that argue that since it was usually the secondary enrichment which converted the mineral deposit into an ore deposit, that process is the one of most significance and should be made the basis of classification. Mr. Lindgren evidently thinks otherwise; it is a case where opinions differ. The book closes with a chapter on the calculation of rock analyses, and a serviceable index.

The work as a whole is one that will be widely read and used. Aside from the new basis upon which it has been built, and despite the fact that examples only are described in each class, it is probably the best general text on the subject. European writers have but a scanty knowledge of American ore occurrences, though America is, as yet, the great field for mineral deposits. Americans have generally only a slight knowledge of either European localities or literature, but Mr. Lindgren is well equipped in both particulars, and we anticipate that the value of his book will be recognized abroad as generously as it is sure to be here at home. H. F. B.

LETTERS AND RECOLLECTIONS OF ALEXANDER AGASSIZ. By G. R. Agassiz. P. 454. Portrait and illustrations. Houghton, Mifflin & Co., Cambridge, 1913. For sale by the *Mining and Scientific Press*. Price $3.50.

Some one has said, that to make an interesting subject for a biography, one must be of an "experiencing nature." To the commercial traveler, a trip to the city is a trip to the city—only that and nothing more; but to the lone farm woman starved for company, a trip to the city is a voyage of adventure into the unknown, a dating point in history. There are a chosen few to whom life is of such zest or whose intellectual horizon is so wide, that the whole of life is an experience, and the record of such men and their doings is more fascinating than the made-up adventures of a most heroic prisoner in Zenda. Alexander Agassiz was of that type. His biography is worth reading because he ventured into many domains of knowledge; and he had not only the intellectual curiosity that led him into them, but the intellectual power necessary to make a place for himself in each. As his son and biographer says, "in the world of affairs he was known as an extremely capable and successful mining man, who was said to employ his leisure moments in some sort of scientific study," but to the morphologist, zoologist, geologist, and museum specialist, he spoke each in his own tongue, and to each his relation to the great Calumet & Hecla mine was but a fortunate accident that gave him the means to do great things. While the relation was no accident, the scientist judged Agassiz better than the world of business. We believe that he will have his wish and will be best and longest remembered, not as an eccentric American millionaire who gave money to science, but as one who, having time and means for a free decision, chose to give work and money to advancement of abstract science as the thing most worth while. Already to the younger mining engineers, Agassiz's connection with the inception of the Calumet & Hecla is but a vague tradition, but there is no chapter in all this fascinating book more worth reading than the story of how this young museum assistant (working at the time for $1500 per year and spending much of that on his work) rescued and soundly established a nearly ruined property. Agassiz came to the Calumet & Hecla with an especial aptitude for figures, a sound technical training obtained at Lawrence Scientific School, and with some experience in mining acquired in the coal mines of Pennsylvania. Furthermore, he had the best of incentives to make good, since his own and his friends' money and reputation were at stake. He had to succeed, and he did succeed. In 1867, northern Michigan was not the pleasant accessible country that we now know, and conditions were more nearly comparable to those now surrounding development of mines in Alaska, with the added handicap of a much smaller fund of technical knowledge from which to draw and a very much smaller number of trained men. How serious was the first drawback may be indicated by the fact that the whole enterprise was nearly ruined through the attempt to use rolls in place of stamps in the Calumet mill; an attempt made against Agassiz's judgment and forced by conditions as he found them at the mine. Agassiz had to meet all the usual difficulties incident to a new enterprise in an unsettled country, including a dishonest predecessor, incapable assistants, and a hostile local population. Nothing was lacking, even to the proverbial blowing up of the dam of the mill pond when the plant was finally ready to run. This determined young man, who later became the millionaire savant and on the deck of his private yacht pored over the zoological treasures brought up by sounding the depths of the sea, had his own hard years even as other mining men. He slept with his clothes on when and where he could, he did three men's work by day and wrote his reports by night, and he ventured all he had and all he could borrow on the accuracy of his judgment and the strength of his purpose—even as other young engineers have done since, are doing now, and will continue to do so long as mining continues to be an alluring contest between trained brain of man and the stubbornness of nature. How well Agassiz succeeded is an old story, and to the world at large the hundred odd millions of dollars paid in dividends is the measure of his reward for the heavy toll the mine took of the man. We fancy that to him the victory as well as the money counted for much, for to the year of his death Agassiz kept his fingers on the keys and annually went back to study the great property between which and him there had been so much of give and take. The whole story of his life, from the small schoolboy walking from Freiburg to Lausanne because he had no money for stage fares, to the later years in the Newport home when the exact dressing of a dinner table was a matter of moment, is a captivating account of the possibilities of life in America when life meets one strong enough to fight to mastery. H. F. B.

Recent Publications

THE RESOURCES OF TENNESSEE. State Geological Survey Magazine. P. 62. Ill. Nashville, Tennessee. October 1913.

NICOLA, SIMILKAMEEN, AND TULAMEEN VALLEYS. By Frank Bailey. P. 80. Ill., maps. Princeton, British Columbia. Price 35 cents. This well illustrated publication deals with the mining and agricultural prospects of this portion of the province.

THE ECONOMIC COST OF THE SMOKE NUISANCE TO PITTSBURGH. By John J. O'Connor. Bulletin No. 4. P. 46. University of Pittsburgh, 1913. Detailed costs are given caused by imperfect combustion of coal, and the total amounts to $9,944,740 per year, equal to nearly $20 for each inhabitant of the city.

Bureau of Mines, Washington, 1913:

A LABORATORY STUDY OF THE INFLAMMABILITY OF COAL DUST. By J. C. W. Frazer, E. J. Hoffman, and L. A. Scholl, Jr. Bulletin 50. P. 60. Ill.

ANALYSES OF COALS IN THE UNITED STATES. With descriptions of samples collected between July 1, 1904, and June 30, 1910. By N. W. Lord, with chapters by J. A. Holmes, F. M. Stanton, A. C. Fieldner, and Samuel Sanford. Bulletin 22. Part I, Analyses. P. 1-321. Ill. Part. II, Descriptions of samples. P. 322-1200. Index. This bulletin gives information of value to fuel-purchasing agents, mechanical engineers, and other persons who wish to know the composition and heating value of different coals. It is not published for general distribution.

THE MINING AND TREATMENT OF LEAD AND ZINC ORES IN THE JOPLIN DISTRICT, MISSOURI. A preliminary report, by C. A. Wright. Technical Paper 41. P. 43. Ill.

FIRST-AID INSTRUCTIONS FOR MINERS. By M. W. Glasgow, W. A. Raudenbush, and C. O. Roberts. Miners' Circular 8. P. 66. Ill.

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EDITORIAL

IF a hippopotamus requires two bales of jungle grass per day, how many of this particular type of pachyderms will be needed to keep the banks of Lake Gatun free of tropical vegetation?

PLANS are already being made for the third annual mining exhibition under the auspices of the Chemical, Metallurgical and Mining Society of South Africa, which will be held at Johannesburg next April. The two previous exhibitions were visited by 30,000 persons, and the next is already arousing lively anticipations. Intending exhibitors are invited to correspond with the secretary of the society, Mr. Fred Rowland.

IN the installment of Mr. C. B. Horwood's discussion of the Rand bankets printed this week will be found charts and diagrams of unusual interest. They show representative relations of rich to poor ore in depth and along the strike in graphic form. They are of especial value in that they are based upon tracings from working maps. To American engineers, at least, no such wealth of material regarding the Rand orebodies has been previously available.

THE Fifth National Conservation Congress will meet, November 18 to 20, inclusive, at Washington. The meeting will be devoted largely to the consideration of forest conservation, but other problems such as the development of hydro-electric power, the utilization of non-agricultural lands, and the availability of water for irrigation will be discussed. When it is known that we are using three times as much timber as grows each year, that only 40 to 70 per cent of each tree that is cut down is utilized, and that fire destroys the equivalent of each year's growth, the importance of the conservation movement is realized.

NORTH DAKOTA geology was recently summarized in an excellent short sketch, accompanied by a geological map of the state, the whole prepared by Mr. A. G. Leonard, state geologist. This was published in *The Quarterly Journal* of the University of North Dakota, and while this is commendable as emphasizing the relations of the university to research as well as teaching, it is also regrettable that anything of so much general interest should be buried in a local publication. There are so many places now for publication that it is all but impossible to keep track of the literature of any subject, and the large number of unspecialized periodicals is in some ways more of a nuisance than a help.

COLORADO members of the A. I. M. E. met at a well attended dinner at Denver last week. We shall present an account of the meeting next week.

THE article upon 'Lead Salts in Cyanidation' that we print this week is of the type that we like to publish. It is based upon correspondence extending over a year and into all quarters of the globe. While Mr. von Bernewitz writes the article the facts presented have been obtained at first hand from a hundred or more metallurgists. Each has contributed from his experience to the common fund of information, and the whole constitutes a comprehensive and exact record of fact based upon the best modern practice.

FIGURES from the payroll of the Rouse mine of the Colorado Fuel & Iron Company for the month of August were recently made public as an example of the wages being paid to coal miners in Huerfano county. The figures as published show that the average wage for the month of August was $4.41 per day. Eleven of the men earned between $100 and $110 for the month; 13 between $110 and $120; 15 between $120 and $130; 6 between $130 and $140; 8 between $140 and $150; 9 between $150 and $160; 5 between $160 and $170; and 2 over $170. Seventy-two miners who worked 25 and 26 days averaged $4.75 per day. The miners have an eight-hour day and are paid twice each month. All of the men on the payroll could have worked 26 days during the month of August if they had so desired. If this is a 'starvation wage' there is surely a very large percentage of the American people who are destitute.

THE quest for new gold deposits and the seeming failure to discover any new goldfields of importance, together with the limited ore reserves known, periodically lead to a discussion as to where the future gold supply is to come from. As the future yield cannot be predicted with the certainty of a wheat crop, the answer is not to be had and probably never will be made. The alchemist sought a solution, and there is little doubt but that King Solomon puzzled over the same question as he saw his mines being exhausted. The fact remains that the law of supply and demand has been maintained until today, and there is every reason to believe that the future, at least for many years to come, will take care of itself. With Asia, a large part of Africa, Mexico, Central and South America, Canada, Alaska, and other gold-producing countries, to use a trite expression, 'scarcely scratched,' it does not require a great deal of optimism to believe that this demand will be met for many years to come. It has been the history of the industry that as old mines become exhausted, new mines are developed, and with the vast tracts of unexplored territory still at man's disposal, it is reasonable to believe that there are still great ore reserves which will be found when necessity demands. While a Rand, a Klondike, or a Kalgoorlie is not found every time a prospector goes into the hills, indeed may never be found again, yet new mines are being developed. When one region is on the decline, others are increasing their production and the balance is maintained. In our current issue the expansion of the gold-mining industry in Rhodesia is recorded by Mr. Owen Letcher. The new treatment plants and increasing ore reserves portend a healthy state of the industry and a future of promise. The production statistics of Rhodesia show that during the month of September there were two hundred gold producers with a total production of 59,535 oz., valued at £250,430. The increasing importance of the industry is evidenced by the regular increase in production for the past three years, which show a production of £2,568,198 for 1910, £2,647,894 for 1911, and £2,707,368 for 1912. The production for the present year to October 1 was £2,162,478, at which rate the production for 1913 will amount to £2,883,300. Rhodesia has been considered a disappointment, but production is growing and that country does not stand alone in this particular. There is reason to believe that the automatic adjustment which obtains with all the other commodities will continue to hold in meeting the world's demand for gold.

EVEN the most modest man is occasionally forced into the lime light when his deeds are worthy, and certainly Mr. Willett G. Miller has done things worthy of the recognition given by his fellow mining men at the Toronto Club the week before last. The occasion was a complimentary dinner and presentation of a portrait—to the man "whose great knowledge and ripe experience had been so freely, generously, and unselfishly given to the development of the mining industry in Ontario." It was characteristic that in responding to the presentation speech, Mr. Miller said that he preferred to regard the tribute not as a recognition of his personal services, but as a recognition of a period of great mining development in the province. Mr. Miller was the real discoverer of Cobalt. It is true that a blacksmith and one other had found veins and picked out ore before Mr. Miller arrived on the ground in the course of his regular geological survey work. Neither of the 'discoverers,' however, knew what he had found. The unusual combination of minerals was beyond the knowledge, at that time, of any but a well trained mineralogist. There was every opportunity for a short cut to fortune by the man who had the knowledge and who was on the ground. Mr. Miller, however, had other ideals. He gave the prospectors full information and through the years since has worked constantly and ably to promote the sound development of the mining industry of his province. As a result he has to an unusual degree the respect and confidence of a wide circle of friends, and who shall say that is not the truest and best reward.

Currency Problems In the Orient

India and China stand in a peculiar position in the matter of international monetary relations. Both countries are large exporters of raw materials and heavy buyers of manufactures; within the boundaries of each, silver currency and bullion is the chief medium of exchange, and neither is a large producer of that metal. These two countries are therefore the chief markets for silver. The resulting situation may be regarded as an interesting ex-

ample of the law of compensations, since when silver is cheap India and China are at a considerable trade advantage, as their exports are sold on a gold basis and paid for in silver, and the native exporter receives a considerably larger sum in the medium with which he makes his purchases. This stimulates exports to such an extent that the demand for silver causes it to increase in price. Even so, the price of silver varies widely, and the resultant effect is bad for trade, since it renders the export business highly speculative. The fluctuation in the price of silver sometimes is as much as 15 per cent in a comparatively brief period, and in making long-time contracts merchants are obliged to make the margin between their buying and selling prices wide enough to cover probable fluctuations. For example, an exporter at Shanghai may agree to make monthly shipments of goods of standard quality at a price in gold which will net him 10,000 local silver dollars. A few months later the return to him may be 9,000 or 11,000 local silver dollars. Ordinary commerce thus takes on the aspect of lively speculation, a state of affairs which does not conduce to the steady growth of business, and which frequently leads to disastrous failure on the part of any firm which is without sufficiently strong financial backing to stand a long period of depression.

The placing of both China and India upon a gold basis has often been proposed, and some years ago the government of China engaged Mr. Jeremiah Jenks, then professor in Cornell University, to study the problem and suggest means for its solution. More recently Mr. M. de P. Webb has advocated the creation of a central state bank in India, the building of gold mints, and the use of gold currency. By increasing the banking habit among the population, who now hoard precious metal, it would be released to serve as the basis of credits. Similarly, it has been proposed to make gold the basis of currency in China, where a central state bank is already in existence, but which has not as yet attained dominance in the financial situation in that country. The difficulty in bringing about any such radical change in the financial relations within these populous countries is threefold. The habits of the people are not subject to easy change except where the change appeals to them as immediately advantageous; there is a large element in the population, made up of small bankers and money-changers chiefly, who have everything to lose and nothing to gain by the change; and neither country possesses a large gold reserve on which to base a gold currency. To obtain this gold would require competing for it in the money markets of the world, where every other country is now trying to obtain it. According to the theories held by some, this would make gold dearer and commodities cheaper, so that we all should benefit by it; but this is an argument with little force of appeal to those who stand to lose by it, and who are most effective in preventing any such change being put into effect. There can be little doubt that both India and China would benefit from the adoption of the gold standard, and it is at least doubtful whether silver would greatly decrease in price as a result, since in both countries it would be still required for subsidiary coinage. China has a large foreign debt of which the interest and principal are payable in gold, while the income of the government is in silver. It is possible that when centralization of government in that new republic has progressed a little farther, it will be possible to place the central bank upon a gold basis and thus lead up to its adoption throughout the country.

Workingmen's Compensation

Laws designed to secure to workingmen adequate compensation for industrial accidents, and to protect those dependent upon them from want in case of the death of a worker, are being passed in many states and countries. The old theory of the law was that each should look out for himself, and there is no question but that this makes for careful and independent workmen. There are, however, a large number of accidents that can not be traced to the neglect or ignorance of the one injured, and modern industrial conditions do not permit to each man that freedom of choice of occupations that is essential to fairness in application of the doctrine of assumed risk. It is also true that each of us is careless at some time. It is impossible for even the best man to be keenly alert every instant, and a serious accident, involving hundreds of innocent people, may result from but the briefest inattention. Accidents are much more frequent in some industries than in others, and under conditions that have obtained in the past a brutal or careless employer, or a group of poorly trained and reckless workingmen, could burden a whole community with cripples and dependents.

The present tendency is to make each industry carry its own burden, as nearly as may be; to sweep aside the old 'fellow-servant' doctrine, that of 'assumed risk,' and the plea of 'contributory negligence'; and to recognize that a certain number of accidents are as inevitable as a regular amount of wasted material in each industry. The principles underlying the new laws are everywhere commended, but there is still much difference of opinion as to the best practice to adopt. We print this week a general statement of results in Germany, where the system has been more widely adopted than in any other country. Apparently, the results are favorable, and this conclusion is borne out by the observations of numerous critics. It by no means follows that the same system will produce equally good results in the United States, and it is just as well that each state is at least attempting to adapt rather than adopt the code.

The Boynton workmen's compensation act, which goes into effect in California on January 1, 1914, is one of the broadest that has been enacted relating to the compensation, insurance, and industrial safety of employees. The object of the act is to create a liability on the part of all employers to compensate injured employees and their dependents for accidental injury or death, irrespective of the fault of either party. The act further provides the means and method for enforcing this liability. The act provides for the creation of a state compensation insurance fund to insure employers against such liability, provides for its administra-

tion, and regulates accident and liability insurance by other insurance carriers. The act also contains elaborate provisions for safety in all employments and places of employment in the state. It requires reports on industrial accidents and provides for penalties where the provisions have not been complied with. An Industrial Accident Commission will be created, the organization of which and its powers and duties are designated.

Under this act, liability for compensation shall, without regard to negligence, exist against an employer for any personal injury sustained by his employees through an accident arising out of and in the course of the employment, unless the accident is due to intoxication or willful misconduct. No disability indemnity is to be recoverable for the first two weeks of such disability, but after this time has elapsed the indemnity is payable generally on a 65 per cent basis, with fixed maximum and minimum limitations, and for varying periods of time which depend upon the nature of the disability. No contract, rule, or regulation shall exempt the employer from liability for the compensation fixed by the act. Provision is made that the employer may cover the risk of his accidents with insurance companies, which of course is optional, and such insurance is subject to many regulations. Every policy must provide that the insurer shall be directly liable to the employee.

There is also created and established by this act a fund to be known as the 'State Compensation Insurance Fund', to be administered by the Industrial Accident Commission of the state, for the purpose of insuring employers against liability for compensation under this act and insuring to employees and other persons the compensation fixed by the act for employees and their dependents. This fund is to consist of such appropriations as the legislature shall make from time to time, all premiums received for compensation insurance issued, all properties and securities acquired by and through the use of money belonging to this fund, and all interest on deposits or investments. This fund, after a reasonable length of time in which to establish itself as a business, is intended to be fairly competitive with other insurance carriers, and it is expected that it will become self-supporting.

In substance, this system requires in fact, though not in terms, that every employer carry accident insurance for every employee, though farming and housework are excepted. It is expected that the state will furnish this insurance practically at cost and that suitable basal rates will be made for each industry with allowances for lower rates where the conditions of work or the care of the employer reduces the risk. Gold miners feel that they stand in a peculiar situation in this matter, since they can not add the cost of their insurance directly to the price of their product, as is possible in a number of other industries, if not in all. This problem of the gold miner was discussed in the *Mining and Scientific Press* so fully by Mr. A. J. Pillsbury in a series of articles printed in 1912, that we will not go over the ground. It is clear that much will hang upon the construction placed upon the words "willful misconduct" on the part of an employee, which with intoxication is the sole bar recognized to liability of the employer. Evidently, in any event, nothing remains but to try the system and hope for the best.

News and News

English newspaper proprietors have been engaged in a mock battle with Reuters, the great English news collecting agency. It seems that Reuters places advertisements as well as news, and recently suggested to clients that it had special facilities for securing editorial comment on companies applying to the public for capital. This becoming known, the Newspaper Proprietors' Association waxed indignant, and there was a fine show of wrath. None the less 'reading notices' continue to appear in England, just as they do in the United States, where the laws have recently been tightened up a bit as to this form of misleading the public. We are glad to believe that the sale of editorial and reading space is becoming rare. It is a short sighted policy. The only reason for wishing an advertisement to appear as a bit of news or comment is because of the presumed greater faith that a reader has in the editor than the interested one offering material or shares for sale. The insertion of reading notices, however, destroys that very faith in the editor which is the best asset of any publication.

Plenty of legitimate news comes from those who have something to sell and the news part of what vendors have to say has a legitimate place in news columns. So, too, in our own field, announcements of new types of machinery, of new construction, of changes in plans of operation on the part of manufacturers, all these are of interest and value and are welcomed by the Editor; they are, however, printed in the back of the paper in space reserved for them and every effort is made to discriminate between the claims of the maker, the established facts, and the comment of the Editor, when any is made. Within a year or so an excellent description of a new plant was furnished to the leading mining papers, by the firm that built and equipped it. We printed it with great pleasure in the department reserved for such material. We are told that the editor of one of our contemporaries returned the manuscript with the usual note of regrets, whereupon the manufacturer, who chanced to be an advertiser in the particular paper, sent it to the publisher with a short note asking that it be printed. It was, and in big type. We believe such mixtures of business and editorship will eventually undermine the influence of any paper.

There is only one basis upon which to accept or reject material submitted for publication, and that is its intrinsic worth. Editors are fallible and will make enough mistakes while following that simple rule, and in the inevitable rush of press day or when a holiday in the print shop has upset the schedule, enough unchecked material will slip through. Doing his best, an editor will frequently fail, but for a guiding principle there is none better than that adopted by the *Mining and Scientific Press*, namely, 'tell the truth and make it interesting.'

Lead Salts in Cyanidation

By M. W. von Bernewitz

While the chemistry of the use of lead salts in cyanide treatment has been thoroughly discussed by J. E. Clennell,* less has been written about the practical results of their application. The following notes, compiled from inquiries made from widely scattered millmen and from other sources, are devoted to this phase of the subject.

Uses of Lead Salts

Lead acetate is useful in assaying cyanide solutions, testing roasted ores for sulphur, correcting working solutions of cyanide, and in aiding precipitation. When soluble sulphides are formed by decomposition of certain minerals in ores, or sulphides are present as an impurity in the cyanide salt used, the addition of a determined quantity of lead acetate to mill pulp will convert them into sulphide of lead, which is insoluble and comparatively innocuous. Other salts of lead, such as lead nitrate and litharge, have been used successfully, and their cost is less than the acetate for the unit of lead contained. When the presence of soluble sulphides in an ore, or in the potassium or sodium cyanide used is known, it is well to add lead salts to the ore or the solution at the beginning of experimental work. Soluble sulphides, if not counteracted, will form with the KCN, KCNS, which, though a solvent of gold, is not so active as the free KCN; while the sulphides also absorb oxygen from the solutions. Lead salts retard the formation of this compound, and so when estimating the consumption of cyanide, parallel tests should be made, and the quantity of lead salts necessary to reduce this consumption determined. As an aid to precipitation, J. E. Clennell states in his 'Cyanide Handbook' that when the zinc-lead couple is used, the matter of weak solutions is of less consequence, and very weak ones can generally be precipitated by it. T. L. Carter found that solutions of 0.005 to 0.008% free KCN could be satisfactorily precipitated with 90 to 95% extraction of the gold, using the couple and a drip of strong KCN at the head of boxes. Other workers using the couple have found this drip unnecessary. Occasionally a drip of lead acetate has been used. A 1 to 5% solution on zinc shavings causes an immediate deposit of finely divided lead on the surface of the zinc. This forms a powerful galvanic couple which is capable of depositing gold from solutions of cyanide, much weaker in free KCN than can be precipitated by ordinary zinc shavings. Where copper is present, the couple is often advantageous. W. A. Caldecott has shown that lead acetate acts as a carrier, the eventual result being that the sulphur reacts on the KCN to form KCNS, leaving PbO free for further action. Mexican metallurgists have stated that the amount of lead salt required equals a corresponding amount of sulphur present in solution from the silver sulphide dissolved. Litharge has been used by C. M. Eye to good advantage, instead of lead acetate in treating reground tailing containing arsenopyrite, pyrrhotite, and the chalcopyrite. Only 1.5 lb. of the former salt was used, against 2.5 lb. of the latter; the litharge cost half as much and showed a saving of 30%. For the purpose of clearer comparison, the consumption and cost of using the corrective agent is shown under the headings of gold ores, silver ores, gold-silver ores, and tellurides.

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Gold Ores

The Homestake mine produces a garnetiferous hornblende schist containing 7 to 8% pyrite and pyrrhotite, and averaging $4 per ton in gold. At the cyanide plants, lead nitrate is preferred to the acetate, and in precipitation it is the practice to maintain a drip of this solution to the feed pipe carrying the emulsion of zinc-dust and cyanide solution; but when the silver content of the solution is above normal, the lead solution is not added. In a clean-up of 2482 lb. of dry precipitate from the Merrill presses, about 212 lb. of lead nitrate has been used.

Ore from the Rand mines may be described as a conglomerate of quartz pebbles cemented by a matrix having a dark bluish appearance when freshly mined. The banket contains up to 87% silica and 2.5% pyrite. According to 'Rand Metallurgical Practice,' before a charge of sand is transferred to the treatment vat, it is sprinkled with a solution of lead acetate. From 15 to 25 lb. dissolved in water is found sufficient to precipitate the soluble sulphides from a charge of 750 tons of current sand. In treatment of slime, previous to transferring pulp in decanting vats, some lead acetate is added for the purpose of converting the ferrous sulphide present into lead sulphide, the former robbing cyanide solution of dissolved oxygen. The quantity of acetate added varies from 5 to 20 lb. per charge of 200 tons. The lead salt is dissolved in water and poured on to the surface of the charge in the collecting vat, so as to be well mixed with the pulp during transfer. In precipitation, all new zinc shaving going to the boxes is dipped in a lead acetate solution, immediately before being arranged in them, as rapid oxidation commences as soon as the couple is formed and exposed to the air. It is also necessary to cover the zinc with solution as rapidly as possible. The use of lead salt in sand and slime treatment not only renders insoluble the soluble sulphides in the ore, but the excess passing through with the solution to the precipitating boxes tends to maintain the efficiency of the couple. The addition of a drip of strong KCN at the head of boxes, originally suggested in this connection, is not generally practised at the present day.

American and Australian Practice

In the Goldfield Consolidated mill, acetate consumption is 0.16 lb. and costs 5.8c. per ton treated, while 2 lb. is used at a cost of 16c. per ton of concentrate treated.

The Black Oak mine, California, yields a hard

silicious ore, and in the all-sliming plant 0.35 lb. of acetate or 0.24 lb. of litharge is used per ton.

At the Sons of Gwalia mine, Western Australia, the ore is a sulphide composed of quartz and schist and containing about 2% pyrite, is practically free milling, and 20% is treated by sand leaching and 80% by slime agitation and vacuum-filtration. Each charge of 170 tons in the sand-collecting vats is sprinkled with a solution of 10 lb. of lead acetate before it is dropped into the treatment vat. Each slime agitator containing 40 tons of solids has 5 lb. of lead acetate dissolved and added to it as soon as full. Until recently a small amount of lead acetate was added to the zinc-boxes, but this has been discontinued as being of no benefit. The quantity used equaled 0.102 lb. and cost 0.8c. per ton of ore milled. The pyrite in this ore oxidizes rapidly, and when sand charges are drained, a small amount of soluble sulphide forms on the top layer. The effect of this is counteracted by the sprinkling of lead acetate. It is very doubtful if the addition to the slime charges is of any benefit in extraction, and it is added to assist in the zinc-box precipitation.

Quartz containing about 1½% of mineral mainly in the form of FeS_2 constitutes the ore from the Great Fingall mine, Western Australia. Acetate is used during agitation in the concentrate treatment; also, when required, it is added at the head of the zinc-boxes. The consumption is about 1 lb., costing about 9c. per ton of product treated (concentrate). The object and result of the use of lead acetate in the concentrate treatment, is the precipitation of soluble sulphides. Its use at the head of the zinc-boxes is to improve the gold precipitation. The quantity of lead acetate used for the purpose is very small, only a few pounds per month, and it is only added immediately after the boxes are newly dressed or at times when the precipitation is bad.

At the Wealth of Nations mill, New Zealand, treating a quartz ore, lead acetate is occasionally used in the zinc-boxes. When precipitation appears to be sluggish, new zinc is dipped into a 10% solution, but the entire amount of lead acetate used in a month does not exceed 2 lb. At the Progress mill, lead acetate has not, in the past, been used, but at the present time experiments are being made, with the following results: Acetate is added to the concentrate pulp in the proportion of 2 lb. per ton of dry concentrate, and the pulp is then agitated for 2 hours before the addition of cyanide solution. At the Blackwater mill, lead acetate is not used.

Silver Ores

The ores at Tonopah, Nevada, may be described as consisting of fine granular quartz (averaging perhaps 80% silica) without noticeable quantities of sulphides, poor in the baser metals, and containing disseminated silver minerals and a little gold. The primary metallic minerals are silver sulphides and the proportion of silver to gold is about 100 to 1 by weight.

At the MacNamara mill it is interesting to note that the charge of acetate may be decreased for a considerable length of time, or even discontinued for a week or ten days, without any noticeable bad effects, there apparently being a process of regeneration of some sort from the lead salts thrown down. It has been found by experience that the charge given below is the economical one for this particular ore, this having been determined by actual experiment and not based on any chemical computation. Lead acetate is added to the pulp in agitators at the same time that cyanide is added. The quantity averages from 0.6 to 0.65 lb. per ton of dry ore, and costs 6.5c. per ton treated.

The amount of lead acetate added per ton of ore at the West End mill is 0.5 lb. at a cost of 4.8c. per ton of ore. It is added to the first of the continuous agitators. No difference in extraction can be noted whether none, 0.5, or 1 lb. per ton is added. The plant has been run two weeks without it, but though extraction remained the same, the solutions showed more sulphocyanide. A half pound was considered the correct quantity, because 1 lb. caused a heavy foam on the agitators and did not help the recovery.

At the Montana-Tonopah mill, lead acetate is added to pulp in the agitators. The quantity used is 0.52 lb. and the cost is 5c. per ton treated. General results from its use show a reduced consumption of cyanide.

The Tonopah Belmont Mill

The Tonopah Belmont mill is using about 0.4 lb. of lead acetate per ton of ore, half added at tube-mills and half at agitators, at a cost of 3.6c. per ton of ore treated. Comparative tests show from 3 to 5% better extraction on the silver with 0.4 lb. lead acetate per ton over tests run with identical treatment, but without lead acetate. Between 0.4 and 1 lb. there seems to be but little change in extraction results, although it has been conclusively proved in mill practice that too much lead is worse than none at all. As an example of this condition, it is interesting to note that an agitator charge at the Millers plant failed to go below 50% extraction in the regular agitation period and was circulated to allow more time; on going carefully into the causes it was found that the charge was made up just before midnight and that both 4 o'clock and night-shift men had added the required amount of lead for the charge. Half of this charge was then pumped to another agitator and a half charge of new pulp from collectors added to both agitators without any additional lead; 12 hours' agitation under these conditions showed 80% extraction. The lead added at this plant is governed to a great extent by the amount of zinc in solution. Whenever mill solution shows more than 0.05% zinc, less lead is added, allowing zinc to take care of alkaline sulphides until solutions are again normal, 0.05% zinc or under.

At the Tonopah Extension, lead acetate is added to the agitators when charging. The quantity used is about 0.8 lb. and the cost 8c. per ton treated. It is found that with a silver sulphide ore in cyanide solution, an alkaline sulphide is formed. Alkaline sulphide will precipitate silver out of the solution. By adding lead acetate, or some lead salt, the alkaline sulphide is removed and a lead sulphide is formed which will not precipitate silver from the solution. Formerly about 2 lb. per ton was used, and after 24 or 30 hours samples would show about 90% extraction, or say a residue worth about $1.20

per ton. A 30-hr. sample might show premature precipitation, and the value would be up to $1.50 or sometimes $2. This happened for several days, but with an addition of more lead acetate it was found that there was not only no premature precipitation, but a better extraction. It is also found that, with an excess of lead, the zinc-boxes act much better and give a sump solution with a consistent value. This is especially so with silver ores.

The Nevada Hills mill, Nevada, is treating a silver-bearing ore containing manganese, and the acetate consumed is 0.8 lb. per ton. A complex ore containing 20% silver to 1% gold is treated at El Tigre, Sonora, Mexico, and acetate is added with zinc dust to aid precipitation. In Honduras, Central America, the Rosario mill treats an ore averaging 25 oz. silver and 0.46 oz. gold per ton. About 50 lb. of acetate is added to each Pachuca vat of pulp.

Canadian and Mexican Practice

At Cobalt, Ontario, the high-grade mill of the Nipissing company is treating an ore carrying from 2000 to 4000 oz. silver, 40% arsenic, 6% cobalt, and 6% nickel, and other minerals in small quantities. The ore is ground in cyanide and the silver is amalgamated in a tube-mill, followed by filtration. No lead salts are used, as the mercury in the mill would decompose the soluble sulphides and precipitate a sulphide of mercury.

Ore treated at the El Oro mill, Mexico, is an oxidized quartz, with a small percentage of pyrite, assaying $8 gold and 3 oz. silver per ton. Lead acetate is placed in a bucket in an agitator to dissolve, using 33 lb. per charge of 100 to 150 tons dry slime. In the same district are the following plants: Mexico Mines of El Oro, the ore of which carries 12 of silver to 1 of gold; lead is added to agitators amounting to 0.25 to 0.5 lb. per ton. Dos Estrellas, at which the ore is a quartz with slightly oxidized iron pyrite, silver occurring as a sulphide with a little chloride, in the proportion of 10 of silver to 1 of gold. In No. 1 mill, the acetate consumption is 0.35 lb. and in No. 2, 0.10 lb. per ton. No. 1 mill of the Esperanza treats a sulphide ore with silver content similar to that at Dos Estrellas, while No. 2 plant treats an oxidized ore. In the former mill, crystals of acetate are scattered over the sand vats, and the consumption is from 0.05 to 0.10 lb. per ton.

At Guanajuato, the Guanajuato Consolidated company produces an ore containing 85% silica, some pyrite, and 187 of silver to 1 of gold. The silver occurs as a sulphide and sulph-antimonide, and the gold is associated with silver sulphide. Acetate consumption is 0.4 lb. per ton. At Pachuca the Real de Monte y Pachuca ore contains 27 of silver to 1 of gold. In the Loretto and Guerrero plants, consumption of lead acetate is about 0.38 lb. at a cost of 6c. per ton. The San Rafael y Anexas ores contain 70 to 75% silica and from 10 to 20% calcite. The silver, mixed with a little pyrite, is found at Ag_2S. Acetate is added to the Pachuca vats, using 0.65 lb. per ton.

Gold-Silver Ores

The Liberty Bell mine, Colorado, produces a hard ore containing 85% silica, 10% calcite, and up to 4% pyrite, the metals of value being gold and silver. Litharge is added to the tube-mills, where it can be ground. The consumption is 0.3 lb. at a cost of 8.5c. per ton treated. The gold and silver ore from the Standard mine at Bodie, California, is hard, but the numerous veins contain clay seams. Lead acetate consumption is 0.1 lb. and cost is 1.3c. per ton. Ores from the Republic district, Washington, treated in the North Washington Power & Reduction mill, consist of hard quartz with clayey matter containing gold and silver. Lead acetate is used intermittently for one week and then none for about three weeks, this being found to act satisfactorily.

Lead salts are not generally used at the Waihi company's mills, New Zealand, results of its use having been inconclusive. After clean-up, the zinc shaving is dipped into a solution of acetate, and it has a good effect in precipitation. In the treatment of 18,000 tons of ore averaging 60 dwt. silver and 8 dwt. gold per ton, 150 lb. of acetate is used in aiding precipitation on 7280 lb. of zinc shaving. At the Grand Junction mine, in the same district, the ore consists of a gangue of quartz and calcite with pyrite, and 4½ of silver to 1 of gold. Acetate is added to the stamp mortars, where weak solution is used in crushing, while the zinc shaving is dipped in a solution of lead. Consumption averages 0.5 lb. per ton.

Telluride Ores

In general, the ores of Kalgoorlie are of schistose structure, increasing in hardness and silica with depth. They contain pyrite and tellurides of gold and silver, but no minerals harmful to treatment. There is little free gold, it being mainly in the pyrite. The important constituents run up to SiO_2, 63%; Al_2O_3, 4%; $CaCo_3$, 12%; $MgCo_3$, 6%; FeO, 7%; and S, 3.5%. In the roasting plants, alkaline sulphides and thiosulphates are formed with a poor roast, and lead acetate precipitates these, forming insoluble lead sulphides and thiosulphates. In testing the strength of cyanide solutions from agitators by silver nitrate, if enough acetate has not been added at the mixers where the ore and solution first meet, a brown coloration is shown in the test. A solution of acetate is added to the pulp charge until this color does not show any more. As a rule, though, those in charge of the mixing department know when roasts are poor, and act accordingly.

Practice at the Perseverance mill is as follows: lead acetate is mixed in an agitator in 130-lb. lots and run into a lead-lined storage tank. From this it is pumped to a 200-gal. tank and allowed to drip into a mixer with barren cyanide solution, which is used for pulping the incoming roasted ore. The quantity used varies from 0.2 to 0.25 lb. and the cost is 1.35c. per ton of ore treated. The salt has been in use since 1907, and has resulted in an average improvement in gold recovery of 12c. per ton on $7.20 ore. Acetate is also used as a drip to the zinc boxes, and prevents the gypsum in the roasted ore from precipitating on the zinc.

The lead acetate at the Kalgurli mill is added as a continual stream of solution to the roasted-ore mixer; that is, where the roasted ore and cyanide solution first come in contact. Between 2 and 3 oz. is used, costing approximately 1.2c. per short ton. At the Associated the consumption averages 3 oz.

per ton treated, the lead acetate being added to the roasted ore pulp before it enters the grinding pans.

Treatment at Lake View

The ore treated at the Lake View mill is a schist, containing tellurides and about 6% iron pyrite. Lead acetate is added to the raw-slime agitators in proportion of 1 lb. per charge of 60 tons, and to the roasted concentrate agitators 6 lb. per charge of 24 tons. With the raw slime it is doubtful whether the lead acetate has any effect on the residue, but the presence of the lead salt in solution going to the extractor boxes aids precipitation. With the roasted concentrate the lead acetate acts as a corrective in the event of a bad roast. All fresh zinc, before being placed in the boxes, is dipped in an acetate solution strong enough to just color the zinc. This certainly improves precipitation and the gold slime is more easily washed off the zinc when cleaning up. The total amount of lead acetate used is 0.05 lb. and it costs about 0.4c. per ton treated.

The ore of the Oroya Links mines is a mixture of oxidized and sulphide ores, drawn from orebodies which are of the nature of impregnations of sheared zones. The gold occurs principally in intimate conjunction with pyrite, and also in combination as tellurides. Associated with the gold the following minerals occur, which are likely to cause trouble in the cyanide plant: marcasite, chalcopyrite, fahlerz, tennantite, and stibnite. Lead acetate is added to the agitators to precipitate any soluble sulphides which may be formed by decomposition of the above minerals, or which may be present as an impurity in the cyanide used. The amount found necessary is 0.2 lb. per ton of ore treated. The cost per ton averages 1.6c. of the total tonnage. The zinc shaving used in the zinc boxes reserved for circulating solution is dipped in an approximately 10-oz. solution of lead acetate until it receives a black deposit of metallic lead before being placed in the boxes. This insures a perfect precipitation from solution averaging about 0.04% KCN, and containing gold valued at $1 per ton. The solution tailing seldom assays more than a trace, less than 6c. per ton.

Stratton's Independence

The experience with lead acetate at Stratton's Independence mill, at Cripple Creek, has been confined to its use in forming the zinc-lead couple in the zinc-boxes. The zinc is cut by hand and dipped in a 3 to 5% solution of lead acetate before using. In the earlier experiments on Cripple Creek sulpho-tellurides the use of lead acetate as added to agitation tests on slime gave rather negative results, and it has not been used in the actual ore treatment since.

The Golden Cycle mill, at Colorado City, is treating about 1000 tons daily of mixed Cripple Creek ores, and about 50 to 100 lb. of acetate is used per day with about 3000 tons of solution. Its use is entirely for precipitating purposes. Acetate solution is fed into the gold-solution storage tanks and it is found absolutely essential for getting steady good results with the zinc, both shavings and zinc-dust (Merrill process). Its use in solution with the pulp to be cyanided has proved to be distinctly deleterous.

Conclusions

It will be seen from these notes that either lead acetate, litharge, or lead nitrate may be used as a corrective agent in counteracting harmful sulphides found in cyaniding various ores, although in treating some ores these salts are negligible. Why acetate should be necessary with Mexican gold-silver ores and of little use with Waihi ores, or of great help in treating Kalgoorlie sulpho-telluride ores and not so with the mixed Cripple Creek ores treated at the Golden Cycle mill, is hard to understand, and it seems to be the general opinion among millmen that lead salts are not always indispensible. It will be found that, in most cases, a solution of lead acetate aids precipitation on zinc shaving. The quantity used on free-milling ores varies greatly. At Tonopah, acetate is found necessary during agitation with the hot cyanide solutions; while at Kalgoorlie the roasted ore pulp is continually fed with a drip of acetate solution, and any variation in roasting is thereby corrected at once. While these notes do not lead to any general rule for the use of lead salts, a millman having similar ores to treat may find something to act as a guide in their use.

In conclusion, I wish to thank the many metallurgists who promptly replied to my inquiries regarding the use of lead acetate in cyanidation, and I hope that the collected data will prove of value.

Resolutions of the Mining Congress

Resolutions passed by the American Mining Congress at the recent session at Philadelphia covered the following points:

1. Favoring passage of state laws to protect minority stockholders and investigation by the Department of Justice of "scandals recently disclosed regarding securities listed on the New York Stock Exchange."

2. Proposing coöperation with the A. I. M. E., the M. & M. Soc. Amer., and kindred organizations in an effort to bring about revision of the mineral land laws of the United States.

3. Providing for appointment of a special committee to study methods of valuing mines for taxation.

4. Suggesting a conference of the heads of statistical bureaus of the United States and the states with a view to introducing uniformity as to form and time of making mining statistical reports.

5. Urging immediate passage by Congress of legislation providing federal assistance to mining schools.

6. Modification of 'anti-trust' laws as applied to natural resources.

7. Urging prompt action permitting development in Alaska.

8. Petitioning for uniform instructions to Collectors of Internal Revenue providing that a definite royalty or depletion charge be allowed in arriving at the net income of mining companies for taxation purposes.

9. Expressing sympathy to relatives and friends of those killed in the Stag Cañon disaster and to the officials of the Company concerned.

10. Urging creation of a Department of Mines.

New Treatment Plants in Rhodesia

By Owen Letcher

During the period of modern mining, the goldfields of Matabeleland and Mashonaland have produced gold valued at over $120,000,000, and, considering the erratic character of the veins, high transport charges, and, until just recently, woefully wasteful and unsound methods of company flotation and subsequent management, one can only be surprised that the output has been so large.

The New Era

Five years ago only two or three mines in the whole territory followed anything approaching a sane and businesslike development policy. Mills were built without regard to the quantity or value of ore developed. Neither was the mineralogical nature of the ores to be treated studied before the erection of plant, save in one or two instances. The inevitable result of premature crushing, and of milling equipment, generally quite unsuited to the ores, was the closing down of plants all over the country, shortly after the commencement of crushing operations.

At the present, Southern Rhodesia shows signs of considerable progress, and with the much better methods pursued it is probable that there will be a steady increase in output and dividends for the next two or three years. At several of the newer mines of the country a sound policy of development is followed. Thus, at the Shamva, 2,300,000 tons of ore has been developed; and the Cam & Motor property has well over 1,000,000 tons of fairly high-grade ore in reserve. At both of these mines the treatment plants are in course of erection, and it is evident that neither of these concerns can be accused of commencing operations without sufficient ore in reserve. Several other companies have also improved the state of development in their respective mines. Moreover, due regard has been taken of the character of the ores before proceeding with orders for plant. The auriferous deposits of southern Rhodesia vary greatly in both physical and chemical characteristics in different localities. Some ores, even in depth, are comparatively soft and friable, as for instance the talcose and chloritic schist belts which contain high gold content in some parts of the country. Others again, such as the banded ironstones, are exceptionally hard. At certain mines the ore is amenable to simple milling and subsequent cyanidation such as done on the Rand, but at others the presence of antimony, copper, pyrite, and arsenic requires roasting plants, and in some instances a metallurgical method more closely resembling Kalgoorlie than Rand practice. It has, in fact, become realized that more or less standard design treatment plants such as can be employed along the Main Reef Series of the Rand are unsuitable installations to order for southern Rhodesia, and it has been eminently satisfactory to observe at the Cam & Motor,

ERECTING POWER-PLANT AT THE GATOOMA MINE.

and one or two other properties, the employment of small testing plants and diligent study of the requirements of the ores in question before permanent installation has been ordered. There are at the present time either ordered, in course of construction, or just completed, seven different reduction and treatment plants having a combined capacity of about 1,068,400 tons per year. The outstanding features of the equipments in question and estimated yearly capacities are as follows:

Mine.	Locality.	Type of plant.	Yearly capac., tons.
Shamva	Abercorn, Mashonaland	Nissen stamps	550,000
Cam & Motor	Gatooma, Mashonaland	Ball-mills, roasters, tube-mills and slime plant	180,000
Falcon	Blinkwater, Mashonaland	Nissen stamps, concentrating and sliming plants, blast-furnace, and converters	180,000
Antelope	Southwest Matabeleland	Ball-mills, roasters, and 10 grinding pans	48,000
Bell	Jue Jue	Stamps, roasters, and slime plant	48,000
Kimberley Reef	Mazoe, Mashonaland	Six Nissen stamps, tube-mill, and sand and slime plants	36,000
New Found Out	Gadzema, Mashonaland	Similar to Cam & Motor	26,400

The Shamva's Equipment

Of these plants, that now being erected at the Shamva mine, situated in the Abercorn district, east of Salisbury, with which town the mine has recently been connected by railway, is the most important. The plant was due to start in a month or so, but there have been delays in delivery of material and it is unlikely that the Company will make any real

contribution to this year's output. A considerable proportion of the equipment is now, however, at the property, and the work of erection is proceeding with all despatch. The Shamva ore deposit, which consists in the main of conglomerate, exists in a large *kopje* known as the Lone Star hill. Many advantages will accrue in regard to working costs, as a large tonnage should be mined and delivered to the reduction works through adit-levels at small cost. Ore will be transported through the adits by means of petrol locomotives and dumped into a large storage-bin. From this it will be fed into cars and lowered by gravity to grizzlies built over three No. 7½ Gates crushers. After the oversize has been reduced in these, the whole product, fine and coarse, will be carried by a belt-conveyor to the trommels. In these the ¼-in. mesh product will be eliminated and sent direct to the tube-mills, while the oversize will be discharged into the mill ore-bin. This latter will feed 56 Nissen stamps, each of 2000 lb. weight when new, and using ¼-in. mesh screens. The intention is to crush the ore in cyanide solution. After leaving the mortar-boxes, the pulp will gravitate to the feed cones of eight 22-ft. tube-mills, fitted with Osborne liners. The underflow from these cones will pass through the tube-mills over short copper plates and blanket tables, and thence to a centrifugal pump to be elevated to the cones again. The overflow of the tube-mill cones will pass direct to eight sand cones superimposed over four others in which the sand will be removed, and, mixing with the barren solution from the slime plant zinc-boxes, will gravitate to eight 50-ft. by 8 ft. 6-in. sand-collecting and leaching tanks in which the sand will be leached, washed, and afterward dumped by endless-rope haulage in the usual way.

Overflow from the Cones

Slime and solution overflowing from the sand-cones will go to five 35 by 10-ft. Dorr thickening vats, part of the clear overflow of which will run to the zinc-boxes, and a portion back to the mill supply-tank.

The thickened pulp from the discharge of the Dorr vats will be pumped to five 45 by 10-ft. Pachuca agitators connected in series, where, after air agitation, the slime will run to the storage agitators connected with a Butters filter-plant. The latter will contain 336 leaves and has been designed for the gravity system of working. All solutions will be precipitated in ordinary zinc-boxes, and the gold melted in two Morgan gas-fired furnaces. Water-supply for the mine will be drawn from the Inyagui river, and pumped by means of an electrically-driven three-throw pump, through eight miles of 12-in. pipe. In the table of milling capacities appearing in the early part of this article, the tonnage, which it is expected will be treated monthly at the Shamva, is given as 45,000 tons, but in actual practice it is probable that this will be exceeded. It will be noticed that there will be one tube-mill to every seven stamps, an even higher proportion of tube-mills than at the Consolidated Langlaagte or the Van Ryn Deep on the Rand. Should a capacity of 50,000 tons per month be obtained, the stamp-duty would be in the neighborhood of 35 tons per head per day. In any case, it looks as if the Shamva will establish a world's record in the matter of duty for gravity stamps.

Other Experiments

The Shamva is under the control of the Goldfields Rhodesian Development Co., as are also the Antelope and the Bell mines. The two latter properties are expected to reach the producing stage this year. The Falcon, which is a gold-copper property, is unlikely to become productive before some months have elapsed, but the Kimberley Reefs plant is already working. As to the Cam & Motor, the rock-crushers are in position, all brick and iron work for the drying plant completed, and a large part of the ball-mill installation finished. The six Edwards roasting furnaces are practically ready for work, and all the steelwork for the precipitation, clean-up, and filter plant was erected some time ago.

With regard to the Antelope, which is situated in a particularly dry and arid part of Matabeleland, construction work on the dry-crushing plant is understood to be progressing satisfactorily. Metallurgists in Rhodesia are eagerly awaiting the starting of these new plants, and the comparative results secured will be noted with the greatest interest. It is not too much to say that the erection of these large mills signalizes the dawn of a new mining era in Rhodesia.

A process is now being used in Germany whereby steel is hardened by means of compressed air in cases where only certain parts of the metal require hardening. The customary methods of hardening by chilling the steel in water, oil, or special baths is not satisfactory in such cases, owing to the tension created between the hardened and unhardened portions of the treated metal. In the new process the compressed air is sprayed over the metal through specially designed nozzles, by means of which, by varying the number and spacing of the openings, the degree of hardness may be accurately regulated.

Freshly-ignited charcoal is a recognized precipitant of gold in cyanide solutions, while graphite, according to Morris Green, does not precipitate gold. The action of graphite has been the subject of considerable discussion during the last few years, and, on the whole, remarkably little experimental evidence has been adduced either to prove or disprove any contention. On the other hand, experience at Kalgoorlie has shown that the graphitic slate or schist in certain mines unmistakably precipitates gold from solutions in the mills.

Taxes in an operating company should be charged to operations, never to property, according to J. B. L. Hornblower. The amount of tax chargeable to the operation of a given mine ought to be, as nearly as may be, the tax upon the ground which will ultimately be operated through that mine, and the tax for a given year should be apportioned in equal amounts over the divisions of the year for which cost statements are made.

The present price of radium is $2,300,000 an ounce.

The Rand Banket—Part V

By C. B. Horwood

Particular Series Selected by the Solutions

It has already been shown that the numerous beds of conglomerate in the Witwatersrand system can be grouped into eight principal series,[188] three in the Lower and five in the Upper division of this system. Of the former, the Promise reef is the lowest, and is narrow, small-pebbled, and ill defined. The Coronation reef, 2750 ft. above it,[189] is a rather more prominent lode, but is also small-pebbled. These two series are unprofitable, and usually contain little more than traces of gold, or none at all. The Government reef, 1900 ft. above the Coronation,[190] is in places well defined; it consists generally of three or more beds of conglomerate; there is usually one main bed, sometimes as much as 2 ft. thick, overlain by two or three small leaders separated from it, and from each other, by intervening quartzite. Here and there it contains an encouraging amount of gold; consequently, considerable prospecting work has been done on it, but no really successful mining operations have resulted. Between this banket series and the lowest of the five in the upper series, broad persistent bands of shale, many hundreds of feet thick, intervene.[191]

The Bird and Livingstone Series

Of these five series, the Bird and Livingstone are the smallest and usually contain only traces of gold, insufficient to have encouraged prospecting. The remaining three are big and well defined, each containing several prominent conglomerate beds and leaders. The biggest of the three, and the one that throughout contains the largest pebbles, is the Elsburg series, in which a little gold is sometimes found, but not enough to have attracted much attention. As it consists of big-pebbled, wide conglomerate beds, it would have offered easy access to any mineralizer; and the reason it was not chosen for the main arteries of circulation can be explained by the fact that the up-rising solutions had already encountered the Main Reef series, more than 11,000 ft. lower in geological horizon.[192] Over 6000 ft. below the Elsburg is the Kimberley series, which, though not quite so big as the Elsburg, is a prominent group consisting of numerous large-pebbled beds and leaders. It lies about 5000 ft. above the Main Reef series and is a much larger group; its conglomerate beds are composed of bigger pebbles than the two, relatively, poorly defined Bird and Livingstone series, which lies between it and the Main Reef beds. Thus, it has been more largely favored by mineralizing solutions than the other series already described. Assays of 2 to 3 dwt. per ton can frequently be obtained; and, in places, on the Far West Rand it has been profitably mined.

The Main Reef

The series, however, that was selected by the solutions, in lieu of fissures, for channels of maximum circulation in which to deposit their mineral contents, is the one known as the Main Reef. In the Lower beds three series had already been encountered; the first two contain small pebbles and are poorly defined; consequently, they contain little gold; the next is better defined, but only poorly when compared[193] with the Main Reef conglomerates; it contains some gold, though not in profitable quantity. After these three, the solutions in their upward course reached the Main Reef series which, being in a higher geological horizon, was more porous. Further, and of chief importance, it was a well defined and well pebbled series occurring a short distance above broad persistent bands of shale that acted as an impervious layer on the foot-wall side of the channels. The great influence of underlying impervious strata, in the form of shale, is shown in a remarkable manner by the fact that, broadly speaking, the only other two series besides the Main Reef on which any considerable work has been done are the Government and Kimberley series, and these are the only others that are underlain by shales;[194] and of these two the only one on which profitable mining has been possible is the Kimberley, the higher of the two in the geological column, and immediately overlying a

[188]The strip of beds of conglomerate at Rietfontein, known as the Du Preez series, which have been proved for some two miles along their strike, are not included in the above, as their particular geological horizon is still in doubt. It is contended by many that they are a faulted portion of one or other of the above eight series.

[189]As shown in Mellor's composite, or normal, section of the Lower Witwatersrand system for the Central Rand. In his section through Witpoortje, on the West Rand, the distance between these reefs is about 1000 ft. less. 'The Normal Section of the Lower Witwatersrand System, etc,' by E. T. Mellor, *Trans.* Geol. Soc. So. Af., Vol. XIV (1911), plate XVII.

[190]As shown in Mellor's normal section for the Central Rand. In his Witpoortje section the distance is about 750 ft. E. T. Mellor, *loc. cit.*

[191]The probable aggregate thickness from the Government beds to the top of the shales underlying the coarse quartzites (125 to 400 ft. thick), locally known as the 'Red Bar' (which is immediately below the Main Reef) is 3700 ft. at Florida and Hamburg on the near West Rand; and 2000 ft. at Witpoortje. Although soft quartzitic sandstones and sandy beds alternate with slaty shales and shaly beds, the two latter account for the greater part of these thicknesses. See Mellor, *loc. cit.*, p. 129.

At Randfontein, the section from the West reef (which corresponds to the Main reef of the Central Rand) downward to the Government reef consists of 350 ft. of quartzites and sandstones with occasional bastard (or poorly developed) bankets, and diabase intrusions; followed by 540 ft. of 'foot-wall' shales; and, then some 3200 ft. of quartzites and sandstones with occasional shale bands and diabase intrusions.

[192]The distance is calculated from the section by Truscott, 'The Witwatersrand Goldfields, etc.,' by S. J. Truscott. Macmillan & Co. (1902), Chap. 3, Fig. 1.

[193]This is especially so when followed over any great distance along the strike.

[194]Neglecting the Promise reef, which is underlain by shales; but is a poor ill-defined banket near the base of the system.

thick, well defined band of shale known as the Kimberley Shales. The conglomerates have not such well defined or impervious walls as normal fissure-veins, and consequently the retaining influence of the shale has been particularly effective in confining the solutions to the main channels of circulation to the extent that the gold as deposited, was concentrated in those channels instead of the same amount being more widely distributed, and consequently being more difficult, sometimes impossible, to mine at a profit.

Extension Along the Strike

Only those who are personally acquainted with the Rand can fully appreciate the extent of this great goldfield, which produces about 38% of the world's annual output of gold.[195] At the end of the year 1912[196] the ore reserves for 50 of its mines amounted to over 87,000,000 tons. If the annual rate of crushing be taken at 27,000,000 tons, these figures show that these reserves are more than three years ahead of the stamp-batteries.[197]

The assay-values of the conglomerates that are mined vary, often within a distance of a few feet[198] between wide limits from a trace to several hundred pennyweights per ton;[199] yet fairly regular alternations between relatively rich and poor stretches of ground occur along the strike; further, it is a remarkable fact that over large areas (up to, say, one to three thousand feet, and frequently more) along the strike, the average yield is remarkably constant. Largely it is this fact that has, in the past, made the Rand such a particularly attractive field for the capitalist. The total recoverable gold contents of a given undeveloped mining area can usually, from various available evidence,[200] be estimated with a sufficient degree of accuracy to warrant the enormous expenditure required to sink shafts; to do the necessary amount of development; to erect the costly treatment-plant necessary to deal with large tonnages, and houses and other buildings.[201] This expenditure can be made with the conviction that the gold eventually to be recovered will suffice to redeem all the capital outlay and to give in addition at least a fair rate of interest on this capital during the life of the mine. In fact, the conditions are comparable not with those of ordinary gold-mining with which one is accustomed when dealing with quartz veins, but rather with those obtaining in the case of coal properties,[202] when usually the total coal contents, life, and profit per ton can be estimated with reasonable accuracy while the ground is still virgin; and therefore the expenditure of large sums of money at this stage, to exploit the property, is justified.[203]

Outcrop of the Main Reef

The actual outcrop of the Main Reef series can be traced at the surface almost continuously from the southern extremity of the farm Randfontein on the Far West Rand to the farm Modderfontein on the Far East Rand,[204] with the exception, just east of Boksburg, of a stretch of some four miles where it is covered by the coal measures. This represents a distance of over 40 miles, as the crow flies, and of over 55 miles as measured along the strike. The town of Johannesburg is situated midway between these limits. Beyond the eastern limit the outcrop dips below the Black Reef and Dolomite formations; but the sub-outcrop, sweeping round and striking southeast, has been traced by bore-

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[195] *The Mining Magazine*, Oct. 1912, 'Rand Problems,' p. 248.

[196] Where figures for that date were not available the statistics were obtained from the last published annual reports. *South African Min. Jour.*, May 24 (1913), p. 311.

[197] If to this be added the ore partly developed or partly valued the great bulk of which may be assumed to be profitable; and, also the profitable reserves in a few of the mines not included in the above, a grand total of about 110 million tons is obtained. *South African Min. Jour.*, May 24 (1913), p. 311.

[198] In sampling the drives the samples are usually taken at 5-ft. intervals; and variations in assay such as stated above often occur within these distances.

[199] On the Rand the ton used is the short ton of 2000 pounds.

[200] Such as is, for example, obtainable from general experience on the Rand, the value of adjacent properties, outcrop yield, and to some slight extent from boring results.

[201] To bring an ordinary Rand 'deep,' or second-row 'deep-level,' to the producing stage usually necessitates the expenditure of from about ½ to 1¼ million pounds sterling, according to circumstances.

For example, C. B. Brodigan states that the first sod of the Brakpan mines was cut on May 24, 1905, and the battery started on the same date six years afterward. During this period approximately £1,250,000 had been spent on the property. 'Rand Practice in Deep Shaft-Sinking,' by C. D. Brodigan, lecture delivered on Jan. 27, 1913, before the Royal School of Mines Union.

[202] Except that in estimating the probable profit obtainable, one is dealing in the case of the Rand with a final product for which there is always an assured market at a fixed price.

[203] In the management of a Rand gold mine, administrative ability is as essential as technical knowledge and skill. Apart from the difference in the actual material of the outputs in the two cases, Rand gold mining may be looked upon as a sort of glorified coal mining. It has taken long for this to be as fully recognized as it might have been in relation to actual underground mining operations. It is only within the last three or four years that colliery methods, modified where need be to suit local conditions, have been introduced underground. Their introduction has been the means of more efficiently and cheaply handling large tonnages of ore. The introduction of these methods has been mainly due to the initiative and determination of Henry Stuart M[illegible]tin, consulting [illegible] to Messrs. F. Eckstein & Co.

However, in one [illegible] mining differs from colliery wo[illegible] at to quartz mining in the fact that for the best [illegible] an intimate knowledge of the 'reefs,' coupled with close underground supervision, is essential otherwise small, often insignificant leaders that should be mined are left behind. This has, for example, sometimes occurred in the case of the South Reef Leader on the West Rand. There this leader is a small seam, varying from merely a single line of pebbles up to 3 or 4 in. thick, yet it is the principal gold-carrier of the South Reef series, without which the rest would be unprofitable. When, as has happened, through careless mining, it is left behind in the foot-wall of the stopes, the rock from these stopes is unprofitable and the grade of the mine is thereby lowered, the gold recovered for the month is less; and the profit is reduced. When gold is left behind in the stopes, it is generally lost for good, as it is the exception for the mistake to be discovered and rectified.

[204] Immediately to the east of the farm Modderfontein is the farm Geduld, on which are situated the Geduld Proprietary mines. These are the farthest east of all the mines that have as yet reached the producing stage. The lode does not outcrop on this farm, the Witwatersrand beds

holes for another 10 or 12 miles. On the Far West Rand also, to the south of Randfontein, the outcrop disappears beneath the Black Reef and Dolomite formations; but, 7 or 8 miles to the southwest, conglomerates claimed to be those of the Main Reef series have been encountered in bore-holes on the farm Gemsbokfontein. Whether these latter belong to the Main Reef series or not, the outcrop, or sub-outcrop, has now been traced for a distance of nearly 70 miles. Further, on the Far East Rand there can be no reasonable doubt that the sub-outcrop continues from the farm Palmietkuil and joins with what is known as the Nigel Reef,[205] which outcrops 10 miles farther south, and on which the Nigel mine has worked profitably for many years past. Thus the outcrop, or sub-outcrop, of the Main Reef series is known for a total distance of nearly 80 miles. From Randfontein to the eastern boundary of Modderfontein, a distance of over 55 miles, with the exception of two breaks in faulted and disturbed ground,[206] there is one continuous chain of mines. With only about half a dozen exceptions, these mines are being profitably worked, and it is a significant fact that the mines at both the present western and eastern limits of this goldfield are good.[207]

Magnitude of the Goldfield

There is no other known goldfield where the outcrop of a lode has been traced for such a long way and has proved profitable for practically the whole distance. It should be remembered that these mines, with few exceptions, work two separate parallel lodes.[208] What is regarded on the Rand as a single mine actually consists of two mines, situated side by side, separated by some 60 to 200 ft. of country rock[209] and connected with each other by cross-cuts. The unrivaled magnitude of this goldfield can be better realized if one tries to imagine this stretch of some 50 miles of twin mines pulled out tandem fashion into one long continuous line of single mines extending for over 100 miles along the strike; and then also realizes that these outcrop, or sub-outcrop, mines are succeeded by a series of neighboring and parallel deep-level mines.

The agencies that brought about such unusually extensive gold deposition, from which already, in 26 years, £347,000,000 worth of gold has been recovered, must have had a vast store of precious metal upon which to draw. It is difficult to imagine one sufficiently adequate to account for such a concentrated occurrence of gold other than the igneous rocks and their source, namely, the underlying molten magma with which in depth they are connected.[210] These rocks are well represented throughout the mines on the Rand by ancient decomposed and uralitized, longitudinal, diabase dikes. Later it will be shown that in type and chemical composition these closely resemble the Klipriversberg diabase of the Ventersdorp system, and, as has already been shown in the early part of this paper, the main structural features of the Witwatersrand clearly point to both having originated from a common magma.

Persistence in Depth

As in all deposits from mineral solution (either liquid or gaseous) that have ascended directly from great depth, or that have been given off as hot primitive solutions by cooling igneous intrusions, a fall in the grade of the ore with depth is to be expected.[211] This is the natural consequence of reduction of temperature and pressure as the solutions ascended nearer to what was then the surface. The laws governing such cases are well known and well understood.[212] In June 1905[213] the writer stated that "it is found that the average gold values of the Main Reef series for the whole of the Witwatersrand decrease slightly in depth." In illustration of this, he showed that the average yield in fine gold for the whole of the Witwatersrand for the year 1890 was 11.63 dwt. per ton, and for 1904, 9.08 dwt.; and that the average yield per year for the 6 years 1890 to 1895, inclusive, was 10.95 dwt. per ton; while for the 6 years 1896 to 1904, inclusive (omitting the war period, 1899-1901), it had fallen to 9.47 dwt. per ton. For 1912 the average gold recovery was only 29 shillings, or about 7 dwt. The following figures clearly show how the grade has steadily fallen.[214]

STATEMENT TO SHOW THE GRADUAL FALL IN GRADE

Year.	Tons milled.	Oz. fine gold.	Dwt. per ton.
1887	Not recorded	19,296*	....
1888	Probably about	173,741*	....
1889	700,000	309,646*	....

being covered unconformably by the Dolomite formation and Karroo beds.

[205]See 'The Extension of the Witwatersrand Beds Eastwards under the Dolomite, etc.,' by F. H. Hatch. *Trans.* Geol. Soc. So. Af., Vol. VII, part 2 (1904).

[206]One of these is on the West Rand, where there is a stretch of broken ground extending for about 2½ miles between the Princess Estate and the French Rand mines. The other stretches for 3 to 4 miles between the New Blue Sky and Apex mines on the East Rand.

[207]That is, those working on the southern portion of the lode (just before it disappears) on the far West Rand and the working mines on the extreme far East Rand.

[208]They work the two sub-series known as the Main Reef series proper, and the South Reef conglomerates.

[209]This term is used because it has crept into general use. To employ it is, however, to be guilty of tautology, as the simple term 'country' signifies the rock surrounding or enclosing a lode (see Le Neve Foster, *loc. cit.*, p. 10).

[210]J. F. Kemp has pointed out that "the presence of even a very small dike in any region is proof of the existence of a relatively very large reservoir of igneous rock, at some point beneath the surface, and at unknown but not great depth." 'The Rôle of the Igneous Rocks in the Formation of Veins,' by J. F. Kemp, in 'The Genesis of Ore-Deposits,' 2nd ed. (1902), pp. 681-709. The reader is particularly recommended to study this treatise in connection with the above argument.

[211]See 'The Gold Mines of the World,' by J. H. Curle, 3rd ed. (1905), Geo. Routledge & Sons, pp. 43-46.

[212]The general theory is well presented by W. H. Weed in a discussion on 'Secondary Enrichment at Cripple Creek,' in the *Eng. & Min. Jour.*, April 11, 1903, p. 553.

[213]'The Witwatersrand and Associated Beds,' by C. B. Horwood, Esson & Perkins, Johannesburg (1905), p. 63.

[214]See also, T. A. Rickard, 'Persistence of Ore in Depth,' *Mining and Scientific Press*, Aug. 31, 1912, p. 266; and earlier papers, more particularly, 'Even Methusaleh Died,' in the *Eng. & Min. Jour.*, May 2, 1903.

F. H. Hatch, 'The Past, Present, and Future of the Gold-Mining Industry of the Witwatersrand, Transvaal,' *Min. Proc.* Inst. C. E., Vol. 186 (1911).

And J. H. Curle, *loc. cit.*, pp. 94-96 and 104.

1890	702,828	413,212*	11.76*
1891	1,175,465	608,649*	10.33*
1892	1,921,260	1,023,240*	10.64*
1893	2,215,413	1,221,171	11.02
1894	2,830,885	1,639,252	11.58
1895	3,456,575	1,845,875	10.68
1896	4,011,697	1,851,422	9.23
1897	5,325,355	2,491,593	9.35
1898	7,331,446	3,564,581	9.72
1899	6,639,355	3,317,857	9.99
1900 }		War period	
1901 }			
1902	3,416,813	1,690,096	9.89
1903	6,105,016	2,859,482	9.36
1904	8,058,295	3,653,794	9.06
1905	11,160,422	4,706,433	8.43
1906	13,571,554	5,559,534	8.19
1907	15,523,229	6,220,227	8.01
1908	18,196,589	6,782,538	7.45
1909	20,543,759	7,039,136	6.85
1910	21,432,541	7,228,311	6.74
1911	23,888,258	7,896,802	6.61
1912	25,486,361	8,753,568	6.87

*Approximate.

In studying these results, it must be borne in mind that the higher yield obtained during, say, the first eight or nine years was due to work being mainly confined to the rich oxidized ore above the ground-water level.[215] Prior to the year 1904 the total tonnage milled was comparatively small, the working cost, in consequence, was relatively high, and therefore ore that can be profitably mined today had then to be rejected. From 1904 onward, the amount of ore treated annually has rapidly increased; in consequence, the cost per ton milled has diminished and lower-grade rock has continually been extracted, the average grade having been thereby reduced. The progressive drop in the yield from the ore milled is thus by no means entirely due to the decrease in richness with depth. A very satisfactory feature is the steadiness of the grade for the last four years. That for 1912 is slightly higher than that for 1909,[216] in spite of the fact that about 5,000,000 tons more was crushed in the former year than in the latter. Certainly a much larger proportion of low-grade ore is now mined, that formerly, owing to higher working costs, would have been left behind; and it is becoming increasingly necessary to be able to mine profitably rock of lower grade, because otherwise large areas of deep-level ground would not be worked at all.[217] This is being done with great success; for example, in the lower remaining portion of the Glencairn mine,[218] rock yielding about 3½ dwt., at the Knight's Deep[219] of about 3½ dwt., and at the Jupiter[220] mine of 5 dwt., or less, is now being worked at a profit. The ore reserve of the Knight's Deep mine at July 31, 1912, was given as 1,477,000 milling tons,[221] having an assay-value of 4.7 dwt., and some 46,000 tons partly developed of an estimated value of 4.3 dwt.; and those of the Jupiter at December 31, 1911, as 1,089,000 mine tons of 5.4 dwt. ore, and some 245,000 tons partly developed of an indicated value of 5.2 dwt.; in addition, there was some 230,000 tons developed, valued at between 4 and 4.5 dwt. per ton, which the consulting engineer, C. D. Leslie,[222] stated in his report was excluded from the ore reserve until such reductions in working cost are effected as will warrant their inclusion.[220]

Placer Deposits

If the auriferous bankets are placer deposits, then, as De Launay[223] pointed out, one would expect a reduction in grade as distance from the original shore-line was attained. A gradual decrease in the gold tenor with depth is only natural if the bankets represent lodes that have been mineralized by ascending deep-seated solutions (either liquid or gaseous), and, as will be shown, is in this case no cause for alarm. Against the fall in grade with depth, is the important fact that several mines are now working at a profit on low-grade ore yielding about 5 dwt. and even less, and that the working costs at several mines, including these, only average about 13s. 6d. per ton. F. H. Hatch[224] has pointed out that "working at a cost of 13.8 shillings per ton means that the cost of development, extraction, and reduction, including administration, is covered by a recovery of 3¼ dwt. of fine gold per ton. On 5-dwt. ore, therefore, this would allow a profit of nearly 7s.6d. per ton. And it is only necessary to look at the value of the ore reserves of many of the big mines given in the latest published official reports to see that this is not far from the average grade of much of the ore which the controlling engineers propose to work in the near future." As the writer

[215]The oxidized zone extends to about 300 ft. below the surface.

[216]This is probably partly due to the good grade of some of the far East Rand mines that have entered the producing stage since 1909.

[217]H. H. Webb in his 1910 report to the Consolidated Gold Fields of South Africa, stated his opinion that "about 5 dwt. is a grade which will eventually represent an average over a large area of the Rand, especially in the deeper sections."

[218]The poverty of the Glencairn mine is partly due to the fact that wide bodies of low-grade hanging-wall banket are being worked.

[219]See annual report for year ended July 31, 1912. The waste sorted equalled 3.1%. In their report for the quarter ended April 30 (1913) the directors of the Knight's Deep point out that during the first 6 months of the combined working of this mine with the Simmer & Jack East, 631,630 tons of ore, yielding 15s.1d. per ton, was crushed, giving a profit of 4s.1d. per ton, or a total working profit of £129,084. The *Financial Times*, June 28 (1913). For the month of April (1913) the full battery of 400 heavy stamps plus 9 tube-mills were at work; and 104,800 tons was crushed. No sorting was done and the total recovery was at the rate of 3½ dwt. per ton. The working cost was 10s.8d. per ton; and the working profit was £23,039. *South African Min. Jour.*, May 31 (1913), p. 335.

[220]See annual report for year ended December 31, 1911. The waste sorted equalled 9.5%. A notice appeared in the *Financial Times* for April 30 (1913), stating that the directors had decided to increase the capacity of the Jupiter treatment plant up to 60,000 tons per month "whereby it is anticipated that working costs will be reduced to a figure which will enable the ore of a mine grade of 4.1 dwt. to be treated profitably."

[221]See annual report.

[222]C. D. Leslie, who is consulting engineer to the Consolidated Gold Fields of South Africa, has played a large part in bringing about low working costs, as the costs of the deep-level mines under his technical administration testify. His success in this direction is in great measure due to his making fuller and more efficient use of small stoping machines in place of hand-labor.

[223]De Launay (1903), *op. cit.*

[224]'The Past, Present, and Future of the Gold Mining Industry of the Witwatersrand, Transvaal,' *loc. cit.*

has already pointed out (in Part IV of this paper), the amount of gold still to be profitably extracted down to a vertical depth of 5500 ft. below the banket outcrops will probably be twice the amount that has been won up to the present time; so there can be no doubt about the greatness of the Rand as a gold producer for many years to come. Each year the Rand is developing, more and more, into an enormous, well managed, low-grade goldfield, which, with increasing tonnages milled, steadily decreasing costs, and simultaneous lengthening of its life by the inclusion of still lower-grade ore within the economic limit, is still increasing its annual output of gold, probably reaching a value, for the current year, of £40,000,000.[225]

Secondary Enrichment

As is usual in normal gold-quartz veins, so also in the banket, there is abundant evidence all along the Rand of secondary enrichment in the oxidized zone, and often for some distance below it. The limit of the oxidized zone is passed at a depth of about 300 ft., and, speaking generally for the whole Rand, it has long ago been exhausted. Hence no allowance need be made for this upper area when considering the fall of grade with deep mining. Neglecting the oxidized zone, and any secondarily enriched portions extending below it, the deep-level ground is not so rich as that worked by the outcrop mines. There are numerous good examples of this, but it would be invidious to quote them while the mines are still being worked. The economic limit of normal gold-quartz veins can usually be represented by sections[226] resembling that of an inverted cone; these are often somewhat 'squat';[227] frequently, they approach equilateral shapes; and are seldom greatly elongated in comparison with the inverted bases (or outcrops). Cracks, or fissures, starting at the earth's circumference or surface and gradually, as the rocks in depth become more compact, dying out toward its centre,[228] would assume similar shapes. It would thus appear that up-rising solutions gain admission in depth to fissures through minute channels of slight lateral[229] extension. As the surface is approached, the fissures become less 'tight'[230] and the solutions, in ascending, spread out more and more on either side along the fissures. In the case under consideration the function of the fissures has been performed by big well defined beds of conglomerate, which have necessarily differed from the former inasmuch as they have formed porous channels for their *full* length down to a great depth, the immediately underlying and overlying strata (corresponding to the foot and hanging walls of normal cracks or fissures) having been kept apart by the intervening pebble-beds. Thus instead of the profitable zone tapering downward to an apex, the gold contents should in depth extend for the same distance along the strike as at the outcrop, and experience in this case shows that they do. The deepest workings of the deepest mine on the Rand are well over 5000 ft., or about one mile vertically below the surface.[231] This mine, although situated in what is recognized as a poor area, is being worked at a profit. With low working costs, the aid of electricity, and other recent improvements for stage-hoisting, with good ventilation to compensate for the slowly increasing temperature, profitable mining will doubtless be extended far beyond this vertical depth. Later it will be shown that these auriferous conglomerates may be considered as a special type of lode deposit, and that they owe the deposition of their iron sulphide and gold and their final cementation by secondary silica to neighboring igneous intrusions and the underlying magma from which the latter originated; consequently, the mineralization should continue downward toward their intersection with the main mass of igneous rock to which their mineral contents are due.[232] It will presently be shown that the available evidence indicates that the latter is represented by the Ventersdorp diabase. The intersection of the bankets with this diabase, and the extent of their mineralization in depth, will doubtless be far beyond the limit to which man is likely to penetrate.

Distribution Within the Main Reef Series

The most typical development of the Main Reef series proper is usually considered to be along the central portion of the Rand. From below upward this series can be divided into two sub-series consisting of an underlying Main Reef series proper

[225] Since the above was written a general strike of the white miners on the Rand occurred early in July (1913). Although it only lasted for a few days, yet the unsettled state of affairs that existed for some time both before and after, and its effect on white labor, together with the temporary cessation of native recruiting, will result in this figure not being reached this year; but last year's record of £37,182,795 will probably be exceeded by approximately one million sterling.

[226] Either vertical sections or sections on the plane of the banket.

[227] Compare J. H. Curle, *loc. cit.*, p. 45, where he states his opinion, with which in general the present writer entirely agrees, that "a pay-shoot is liable to extend farther in length than in depth."

[228] Research work indicates that openings cannot exist at greater depth than about 30,000 ft.; and under certain conditions very much less. 'Ore Deposition and Vein Enrichment by Ascending Hot Waters,' by W. H. Weed. *Trans.* Am. Inst. Min. Eng., Vol. XXXIII (1903), p. 750.

Also, 'On the Limiting Strength of Rocks Under Conditions of Stress Existing in the Earth's Interior,' by Frank D. Adams, *Jour. Geol.*, Vol. XX, No. 2.

And, 'Some Principles Controlling the Deposition of Ores,' by C. R. Van Hise in 'The Genesis of Ore Deposits,' 2nd ed. (1902), pp. 286-288.

[229] The term 'lateral' is here used to denote distance along the strike.

[230] That is, their walls are not in quite such intimate contact; and the fissures are consequently somewhat more open.

[231] A. E. Pettit, resident engineer in London to the Consolidated Gold Fields of South Africa, informed the writer that at the end of the year 1912, the deepest workings in the Jupiter mine were 5040 ft. vertically below the surface.

[232] See 'Ore Deposits near Igneous Contacts,' by W. H. Weed, *Trans.* Am. Inst. Min. Eng., Vol. XXXIII (1903), pp. 744-746. The mineralization should continue downward to the intersection of the deposits with the main mass of igneous rock to which they owe their pyrite and gold, provided always that this intersection is not below the zone of precipitation. If it is, the solutions in their upward course below this zone would have been under sufficient temperature and pressure to have retained in solution their mineral contents. See W. H. Weed (1903), *loc. cit.*, p. 553.

and an overlying South Reef series. The former consists of the Main Reef itself and an overlying Main Reef Leader. The Main Reef is a big body of low-grade conglomerate, assaying from about 2 to 4 dwt. per ton, and usually 4 to 12 ft. thick. The Leader is a thin but rich seam of conglomerate, often only 3 to 4 in. but sometimes as much as 2 ft. or more thick, containing quartz pebbles up to 2 and even 4 in. or more in diameter. Usually separated from the Main Reef by a thin close-grained almost impervious band of shale 3 to 8 in. thick, but occasionally also by 5 ft. or more of quartzite, it is the profitable member of this sub-series; and, where developed, is the principal gold-carrier of the whole Main Reef series. At a distance varying from 40 thick, which is of little value and for the most part is left behind, and is not included in the stoping width.

As already stated, the mineralization of the conglomerate has practically been confined to the lowest[233] of the three series lying between the Kimberley slates and the Main Reef foot-wall slates. The concentration of the gold has been principally confined, in the upper subdivision of this series, to its lowest leader, which rests on a somewhat sericitic schistose foot-wall; and in the lower subdivision to its upper leader, instead of the lower main body. The latter circumstance appears curious until it is realized that this upper leader is usually immediately underlain by an almost impervious band of

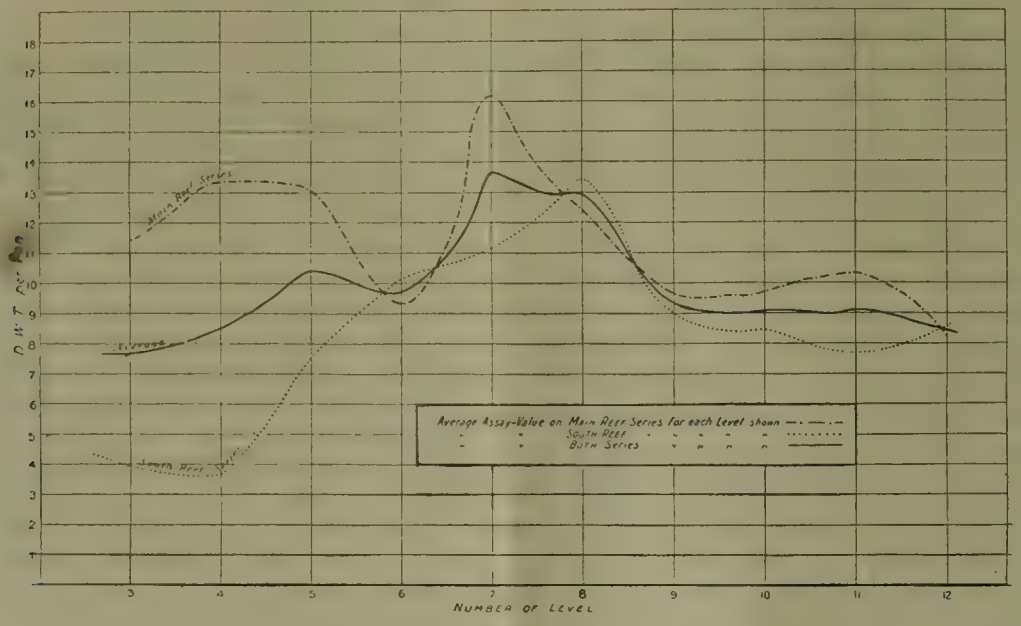


Fig. 23.

to 120 ft. or more above this is the other subdivision, known as the South Reef series, consisting typically of a thin foot-wall seam of conglomerate, varying from a single line of pebbles (which are occasionally as much as a foot apart) up to a band 5 or 6 in. thick. The matrix of this leader and its overlying quartzite is usually black, compact, crystalline, and sharply defined from the softer light-gray quartzite on which it rests and which is usually somewhat sericitic and often exhibits a tendency to a schistose structure. This foot-wall leader is known as the South Reef Leader. Generally containing the biggest pebbles, and the average size of its pebbles as a rule being greater than those of the other bankets of this subdivision, being also the lowest leader of the sub-series and usually resting on a somewhat sericitic foot-wall, it contains nearly all the gold, and so constitutes the richest member of this subseries. Its gold contents are, however, much more erratic than those of the Main Reef Leader. About 8 in. above is the Middle Leader, which is 6 to 10 in. thick; this usually contains a few pennyweights of gold per ton and is stoped with the South Reef Leader. About 12 in. or so above this Middle Reef is the Hanging Wall Reef, often about 10 or 12 in. shale; and, in addition, it is the biggest-pebbled conglomerate of the whole series.[234]

Distribution of Gold Between the Main and South Reef Series

It has just been stated that the gold in the Main Reef series proper has been principally concentrated in two small leaders, one at the top of the lower sub-series, the other at the bottom of the upper subseries. Practical experience from end to end of the Rand has indicated that when one of these leaders is poor that portion of the other leader (in the other sub-series) opposite to it is often rich, and *vice versa*; or, in the words of the miner, "the values have gone from the one reef to the other." This

[233] That is, the Main Reef series.

[234] And consequently would have been more porous per unit-area of cross-section. The reader is referred to the discussion on J. W. Gregory's paper, 'The Origin of the Gold in the Rand Banket,' by J. Malcolm MacLaren, who shows by clear reasoning that the conglomerates were undoubtedly more permeable than the sandstones and quartzites. *Trans.* Inst. Min. and Met., Vol. XVII (1907-1908), pp. 50-52.

The same reasoning demonstrates that the coarser the conglomerate the more permeable it would have been.

knowledge frequently influences the scheme adopted in planning the development work of a mine. Although this idea is prevalent throughout the Rand and is borne out by practical experience, yet few really careful observations have been made, or accurate data obtained, to substantiate this view. Fortunately, W. L. Honnold and C. E. Knecht,[235] some years ago, compiled some interesting statistics and curves illustrating this relationship between these two gold-carriers of the two sub-series of bankets, which, as Walter McDermott has observed,[236] is not an uncommon feature in parallel fissure-veins and in lenticular masses, the values jumping from one to the other, or changing between the two walls of veins. Considering in cross-section the Main Reef

Influence of Pressure

As previously mentioned, according to Riecke's principal, where pressure is greatest, there solution is most active. Thus where mineralizers, ascending under pressure encountered obstructions in the form of occasional reductions in the size of one of the channels, there dissolution of the walls and of the banket would, doubtless, commence, causing increased precipitation of the mineral and metallic contents of the solutions. Such considerations do not, however, fully explain the regularity of the alternations in value between one layer of banket and another. The assay-values seem to oscillate from seam to seam with a periodicity so regular that

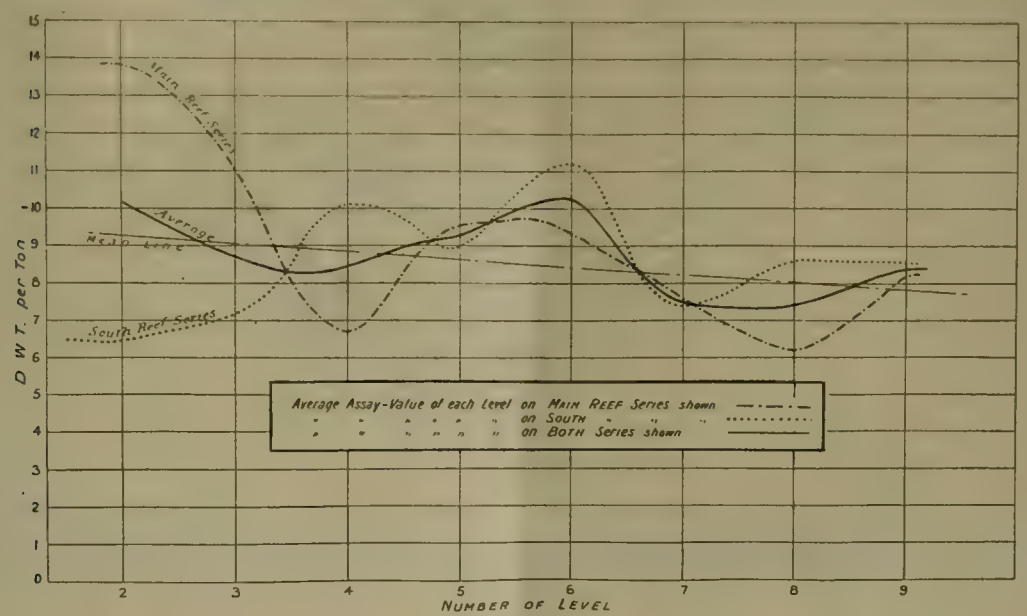

Main Reef Series
Average Mean Line
South Reef Series
DWT. per Ton
Average Assay-Value of each Level on Main Reef Series shown
on South " "
on Both Series shown
Number of Level

Fig. 24.

series as a whole, at the time the mineralizing solutions were coursing through it, then for any section a certain quantity of solution would have passed in a given time, from which, presumably, a definite amount of gold would have been precipitated. Therefore, if through any cause more was precipitated on, say, the Main Reef Leader side of the section, less would be precipitated on the other, or South Reef Leader, side. It is easy to understand how slight mineralogical variations, or variations in the width of the conglomerates, might cause greater or less precipitation; the former for chemical, the latter for physico-chemical reasons. For example, greater precipitation due to great frictional resistance might occur where one of the channels was restricted.[237]

it should have some fairly simple explanation. Probably this is due to the influence of what are usually known as 'pitching troughs and arches': the conglomerates do not present a strictly plane surface; crumpling of the strata has produced, along the direction of the strike, a series of flexures, which would have presented to circulating solutions a series of crests and troughs, and these may have affected the deposition. These flexures are especially noticeable in the drives underground. When the banket is carried, say, shoulder high on the foot-

[235]It is to be hoped that Messrs. Honnold and Knecht (managing director and consulting engineer, respectively, for the Consolidated Mines Selection Co.) will publish the results of their investigations on this important matter.

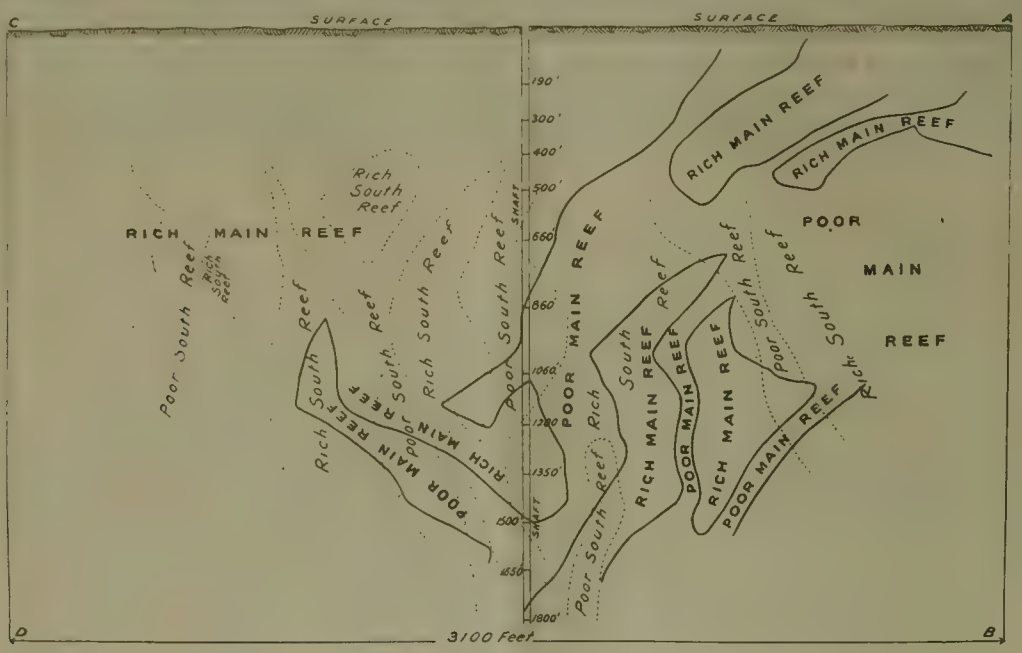
[236]Discussion on J. W. Gregory's paper, 'The Origin of the Gold in the Rand Banket,' *loc. cit.* p. 56.

[237]In this connection it is interesting to compare the horizontal quartz veins, or ore-sheets, in the dolomite of the Pilgrim's Rest district of the Northern Transvaal. These reefs are worked by the Transvaal Gold Mining Estates Ltd., and by others. They vary in thickness from 1 or 2 in. up to about 2 ft.; but are sometimes much thicker over considerable distances; and in this case it is these thicker portions, long and relatively narrow, termed ore-channels, that are usually richer than other parts of the 'reef' (see 'The Dolomite Formation of the Transvaal,' by C. B. Horwood, read before the British Association, 1905). In this case the horizontally-moving solutions would doubtless have been under less pressure and have been more sluggish than the up-rising mineralizers in the bankets. The enrichment is presumably due to greater precipitation owing to lessened rate of flow where enlarged portions of the channels were traversed. (See Posepny, *loc. cit.*, p. 14.) Similarly, the speed of a river is checked on entering a lake and precipitation of suspended matter is thereby increased; the difference merely being that in the former case the material was in solution, while in the latter it was in suspension.

wall side of the drive, the resulting drive will not be straight, and will be represented on the mine-plan by gently curving lines, as shown below:

Considering the two leaders and one of the folds when, for example, the South Reef Leader forms an arch, that is, when it is on the convex side of a fold, its radius of curvature being somewhat greater it will have suffered somewhat greater tensile deformation than the corresponding portion of the Main Reef Leader, which being on the lower, or inner, side of the fold, will, relatively speaking, be under compression, will consequently have been slightly more porous. When it forms a trough, that is, when it is on the concave side of a fold the reverse will have been the case, it will relatively have been subjected to compression. These alternations of greater and less porosity may have influenced the deposition of the gold.[238]

The following is a good example illustrating how the gold contents of the two sub-series vary in relation to each other. The ore reserves of one mine for the two lodes above and below a given level were calculated separately. The vertical depth of the bottom of the mine below the surface was about 2300 ft. and of the 9th level about 1200 ft.; and the ore reserves were calculated for each lode, separately, above and below this level, with the following remarkable results:


C
SURFACE
SURFACE
A
RICH MAIN REEF
RICH MAIN REEF
Rich South Reef
RICH MAIN REEF
Poor South Reef
Rich South Reef
Rich South Reef
Poor South Reef
Rich South Reef
Poor South Reef
Rich South Reef
Poor

These figures show clearly that, for the mine as a whole, above the 9th level the upper series is the richer; but below that level, as it becomes poorer, so the lower series simultaneously become richer. That there is not exact compensation between them is clear from the curious coincidence, shown in the mines which are shown, in vertical section, in Fig 25 and 26, respectively. They illustrate how the gold content of one sub-series of banket goes up, as the other goes down, and the reverse. The gradual decline of grade in depth is distinctly indicated by the mean line shown in Fig. 24.

FIG. 27a.

third statement, that the combined value of the two both below and above the 9th level are the same; but, since the tonnages developed on each lode are different, it follows that there is not exact compensation as regards assay-values. Fig. 23 and 24 are of curves[239] compiled from data relating to two

Fig. 27 shows three curves compiled about 7 years ago for one of the deep-level mines of the Central Rand.[240] Unfortunately, only a small portion of the total area of the mine had as then been worked and it had a long life ahead of it, so that the up-

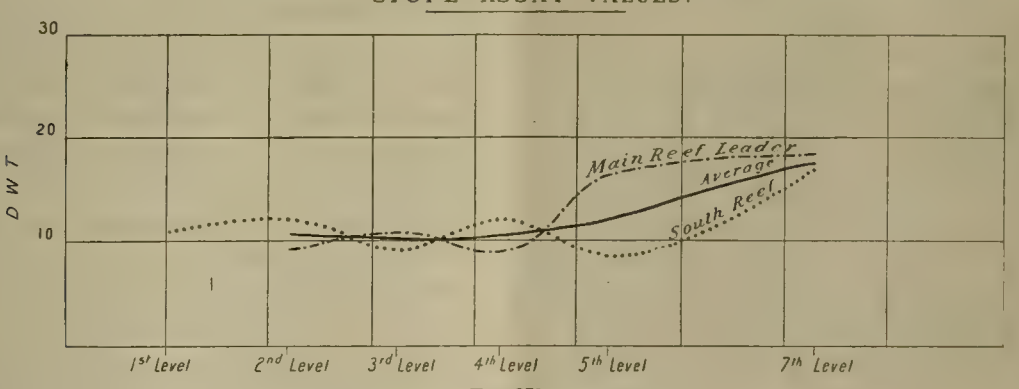


FIG. 27b.

[239]These curves were made to accompany the plans shown in Fig. 25 and 26, and were constructed in the following manner. The average for each level was obtained by averaging the assay-values shown for every 50 ft. along the whole length of each level. The data so obtained were plotted. In the case of the 7th level on the Main Reef series, shown in Fig. 23, one of its two drives had only been advanced a short distance from the cross-cut from the shaft, as it had encountered a poor patch of ground, known to be of considerable extent. The part already driven was in rich ground. The corresponding drives above and below extended a long way beyond where this 7th level drive ended. The average value for each of these two drives, beyond this point, was therefore added to the average value of the 7th level drive, and the average of these three values was taken as the average for this lode on the 7th level.

[240]It is a pity that these curves have not been brought up to date. They should be compiled and kept up to date for every mine on the Rand, as they would afford most valuable information.

ward tendency of the grade from the 4th to the 7th level, as shown in curves a and b, does not imply that the mine as a whole is becoming richer in depth; in fact, since then the grade has gradually dropped, as one would except. Curve c in Fig. 27 shows the gradual drop in the width of both lodes from the 2nd to the 7th level from an average of about 30 in. down to an average of about 18 in., and suggests the greater compactness of the strata in depth as the cause.[241] The first curve shows the inch-pennyweights; that is, the assay of each

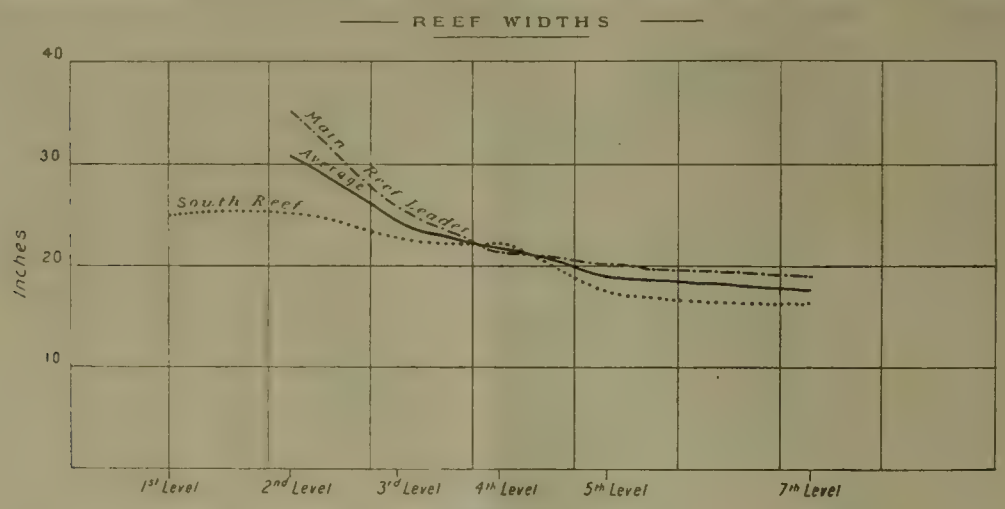


FIG. 27c.

'reef' in pennyweights of fine gold per ton multiplied by its thickness in inches. The second shows the stope-values for each lode. Both clearly indicate how as the curve for the one 'reef' ascends, that for the other descends, and conversely.

Zone of Secondary Enrichment

A noticeable feature of the first two curves is that they indicate the presence of a zone of secondary enrichment below the oxidized zone, which ends at a vertical depth of about 300 ft. Fig. 23 and 24 showed that the richest portions of this zone are at the 7th and 6th levels, respectively, of the two mines for which these curves were compiled. Curve a in Fig. 27 shows that the richest portion is below the 7th level, and curve b of the same figure suggests that it is probably in the neighborhood of the 8th level of the deep-level mine to which they relate.

Fig. 25 and 26 were made from the large assay-plans[242] of the two mines before-mentioned. In each case, tracing-cloth was put over the full-size mine assay-plan of the one lode and the profitable and unprofitable zones were indicated as accurately as possible. The same cloth was then placed over the assay-plan of the other lode of the same mine, and its profitable and poor areas were marked on it; these were then photographed down to the present size. They illustrate clearly how each lode alternates regularly, along the strike, between poor and rich zones or shoots.

When comparing the Rand with other goldfields, the fact is apt to be overlooked that gold-quartz mines usually have only one vein on which to rely, while the mines of the Rand are double, or twin, mines, with two lodes superimposed. If the alternations between good and poor zones were less frequent, and if there were not a second lode on which to fall back, then extensive good zones or shoots would alternate with extensive unprofitable zones and the conditions would approach more closely to those of ordinary fissure-veins.[243] With agencies so potent that they mineralized two parallel neighboring lodes to such a degree that they are profitable for a distance of about 55 miles,[244] extensive areas of unprofitable ground can, fortunately, hardly be expected.

(To be Continued)

State aid to mining in New Zealand has included the use by prospectors of the government diamond-drills and two Keystone placer drills, which are loaned free of charge save the cost of wages, repairs and material used. During 1912, 156 holes were drilled a total of 6670 ft. in gravel, and 3 holes a total of 1158 ft. in search of coal.

Gold produced by hydraulicking in New Zealand in 1912 was worth $1,280,000.

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[241] This confirms C. R. Van Hise's investigations that fissures gradually die out in depth. (See Van Hise, *loc. cit.*).

[242] The scale of the original working plans from which they were made was 1:500.

[243] However, extensive areas of poor, and even of unprofitable, banket do occasionally occur. This is especially so with the South Reef Leader, and would result in unprofitable mines were it not for the fact that there is still the Main Reef Leader, which is generally sufficient in itself to result in productive mines. On the Far East Rand the lower of the two lode series, which is correlated with the Main Reef series of the Central Rand is locally known as the Van Ryn series. The gold of this district is largely confined to the lowest member of this series, which rests on a shaly talcose foot-wall. The available evidence indicates that in this portion of the Rand the alternations between rich and poor ground are less frequent; that is to say, the poor patches are of greater extent, but they occur less frequently, and so the differences in grade should, over larger mine areas, compensate each other, as they do over smaller stretches of mine ground along the Central Rand.

[244] Corresponding to a total length of single lode of nearly 110 miles. See, however, that portion of the previous footnote which refers to the far East Rand.

Steel Ore Passes at Broken Hill

By John M. Bridge

*Up to the present time timber has been used in underground operations to the almost total exclusion of all other materials; a fact which is accounted for by its universal distribution, by the ease with which it is worked by simple appliances and comparatively unskilled labor, and by its strength and resistance to wear, to decay, and to the action of mineral waters. But the exhaustion of the supply of cheap timber, combined with the increasing production and decreasing cost of steel, and the appliances for working it, is bringing the latter more and more into competition, especially when the duty is heavy and the wear and tear great. So, wooden rails and cars have long since disappeared from metal mining, and now steel and reinforced concrete are coming forward as mine supports. It is not surprising, therefore, that this tendency should extend from the rails and trucks to the chute door, chute lip, and finally to the chute itself.

Requisites of an Ore Pass

The essential requisites of an ore pass are, that it must have a life at least equal to that of the stope it serves, a minimum tendency to 'hang-up,' a fitness for stoping conditions, and the universal desiderata of small first cost and maintenance. Before considering the steel pass in particular, it is as well to note some of the other means adopted as a link between stope and level. The following are some of the methods by which the problem is being solved: (*a*) Square cribbed passes of round or square timber, with plain or joggled ends, either built by themselves, or immediately inside the legs of square sets, and projecting over the caps and struts for additional support and rigidity; (*b*) square-set passes lagged outside, and lined inside with vertical timbers spiked on to each set, or with the cribbing just mentioned; (*c*) circular stone passes hand-packed, sometimes bonded and strengthened by occasional timbers placed radially; (*d*) circular wooden passes of radially-shaped timbers placed vertically, the grain of the timber being parallel to the axis of the chute in line with the fall of the ore; (*e*) circular steel passes. These passes have been used on the South Blocks mine, Broken Hill, for the past five years, and continue to give satisfaction under the conditions existing there. The first to be installed were 16 in. diam. by $^3/_{16}$ in. thick, being rolled from 4 by 4-ft. plates. The vertical joint was made by riveting a cover plate on the outside, and the lugs for fastening one length to the one below were also riveted.

As these proved too small, 20 in. diam. rolled from 4 by 5-ft. plate were tried, and met with a similar fate. Next 30 in. diam. by ¼ in. were tried, made from 4 by 8-ft. plates, and similar in construction to the others. The size of the latter proved adequate, but the riveting was a source of weakness, as the heads of the rivets got worn off, partly by abrasion, but mainly by the constant jarring of the falling ore. This loss of rivets, in the case of the longitudinal joints, allowed the tube to bulge, and caused the chute to hang up, and the defect was aggravated by firing the chute at this point to bring the ore down. In the case of the lugs becoming detached, the tube to which they belonged slipped down, and left an annular space, in which the ore again collected and hung the pass up. To overcome this defect the present type of tube was adopted, having no rivets at all in the lugs, and those in the longitudinal seams being placed far enough back from the side of the chute to deaden the jarring effect.

The sections as now used are made by cutting the 4 by 8-ft. plates by means of an ½-in. slotting punch, the final cut in every case being made with a round instead of rectangular punch, so as to give a round root to the lugs to prevent tearing. The circular holes for riveting, and for attaching the slings, are punched at the same time, and by the same machine. Provision is made for three lugs on each longitudinal and also on each circumferential seam, the bottom longitudinal lug also serving as an additional circumferential support. After cutting, the plates are bent uniformly in the rolls, until the opposite edges about touch. The various lugs are next put on, in all cases being bent cold by hand, by means of a dog made of a 3-in. head, having a slot in it 4 in. deep by ½ in. wide, and provided with a stout iron handle. The lugs of the longitudinal seams are bent out square in one operation, but those for the annular joints are first bent out square to the axis of the tube; then the hold of the dog is shortened, and they are bent back parallel to the axis. The edges of the longitudinal seams are then pulled up together and riveted.

The Starter

The first section of each pass, or the 'starter', as it is called, has the same longitudinal joint, but the lugs are replaced by 4 by 4 by ½-in. angle-iron feet which rest on the chute timbers, and form the foundation for the pass. Riveting is again avoided by attaching the feet to the tube in the following manner: Three pairs of circumferential slots, 2½ in. long by ½ in. wide, are punched, 2-in. centres; the 1½ in. metal left between is then sheared in the centre, and the two pieces of metal forced back to make two 1½ by 1¼-in. lugs. Over these is placed a 5-in. length of 4 by 4 by ½-in. angle iron, slotted to fit the lugs, and these lugs are then hammered back to grip the angle iron. Half, and three-quarter tubes are also used, being made from 2 by 8-ft. and 3 by 8-ft. plates, the object being to suit the height of the filling in the stope. The end dimensions of these short tubes are the same as the ordinary ones, but the central longitudinal joint has to be dispensed with, from lack of room on the plate. The different lengths of the slots and lugs on the top and bottom circumferential seams, gives the required taper to each tube. The top of each section has a minimum inside diameter of 2 ft. 5 in., and the bottom a maximum outside diameter of 2 ft. 4¾ in., to allow of fitting each tube

*Abstract from *Proc.* Aus. Inst. Min. Engineers.

into the one immediately below it. Three thicknesses of plate are used, ⅜ in. for the first 60 ft. above the level, $^{5}/_{16}$ in. from 60 ft. to 110 ft. and the remainder ¼ in.; the cost complete of each section, from 4 by 8-ft. plate, being respectively $19.20, $18, and $15.60.

Construction

In starting from the level, two foundation pieces of 10 by 10-in. Oregon pine of a length to suit the conditions, are first put in, resting on a 2-in. projection of the caps of the level sets; an additional hold sometimes being given by spiking a 4 by 10-in. piece on to the legs vertically. Two pieces 7 ft. by 10 in. by 10 in. are next placed transversely to these, blocked 2 ft. 5 in. apart, and then two 5-ft. pieces parallel to the foundation pieces, and likewise blocked 2 ft. 5 in. apart. The starting tube is fitted between these, the lugs resting on the top of them, and the whole is made rigid by packing with filling. The passes are placed 30 ft. apart along the level, and in some cases have been taken up 140 ft. above the back of the drift, in stopes averaging 30 ft. wide, representing a tonnage handled per pass of about 15,000 tons, without any renewals or repairs. Some of the passes have been lost, but most of these were 16 and 20-in. tubes, the balance being ruined by firing with gelignite when clogged. Repairs are difficult, but provided care is taken to avoid sharp bends, which allow the ore to pound out the under side of the bend, and no firing of clogged passes is permitted, no repairs are necessary where the passes are properly spaced for economically handling the ore in the stopes. When hung up, the ore can in every case be brought down by shooting with a 'cannon,' made by boring a 2-in. hole in a piece of 5-in. shafting, and using gunpowder to fire a projective at the mass. Clogging is to a great extent avoided on the South Blocks mine, as skip haulage is used, and it is not necessary to use the passes for ore storage, as the shaft-bins serve that purpose more effectively. The advantages of these passes are: (*a*) Their moderate first cost and great wearing qualities, which eliminate renewals and repairs; (*b*) the small size they can be made, without an undue tendency to clog, lessening the chance of accident by falling into them; (*c*) their adaptability to stoping conditions, as no special care is needed when firing ground on top of them; (*d*) their impervious nature, which prevents any very rich ore being lost, and also confines sand filling to the stope, which is a matter of great difficulty in very wet mines; and (*e*) the ease and cheapness of installing each section, as each tube is made so that it fits the previous one.

The result of the use of these passes on the South Blocks mine has proved that for the conditions existing there, the steel pass can do its work quite as well as any form of timber pass, and the question of its adoption is one which depends directly on the relative prices of steel and timber.

Queensland's gold production in September amounted to 22,220 oz. fine, according to the *Government Mining Journal*. The value was £94,385, and the month showed a decrease of 7037 oz. and £29,891 as compared with September 1912.

German Workingmen's Insurance

*The avowed object of workingmen's insurance is to safeguard the working population in its economic existence against the unavoidable dangers and injuries connected with its calling. Within the German empire every working man and working woman is, without any distinction of nationality, insured in accordance with the law of the land against sickness, accident, invalidity, and old age. At the present time persons industrially employed in their own homes, agricultural laborers, and domestic servants are not yet subject to compulsory sick insurance. Accident insurance applies in the main to persons employed in factories. The larger number of persons employed in domestic industrial work are likewise still exempt from invalid insurance.

Sick Insurance

Insurance under this head is effected by means of sick insurance funds formed severally for each particular branch of employment and restricted to small districts. Such funds are administered jointly by employers and employed under the supervision of the state. Of the entire cost of such insurance employers pay one-third and employed two-thirds. The benefits assured by the insurance to an employee falling sick are: gratuitous medical treatment and medicine (including the provision of spectacles, trusses for ruptures, etc.), also sick-pay beginning on the third day of sickness. In case of death, burial money is allowed to the family. In cases of confinement benefit is allowed for the space of six weeks. Since its creation in 1885 sick insurance has insured to working folk (in 1909 there were 9,946,585 men and 3,457,713 women) the following benefits:

	Million marks.
For medical treatment	845.1
For medicine, etc.	615.9
Sick-pay to invalids	1736.2
Sick-pay to those dependent on them	39.5
Confinement pay	63.7
Maintenance of hospitals	510.6
Burial money	122.0
Other expenses	61.4
Total	3994.4

The disbursements in 1909 alone under this head amounted to 342,200,000 marks. And the accumulated surplus under sick insurance figured at the close of 1909, at 286,525,100 marks.

Accident Insurance

Accident insurance (applying in 1909 to 14,854,000 insured men and 8,913,000 insured women) is effected by means of insurance funds formed severally for distinct groups of employment. These funds are administered by the employers alone, who are called upon to pay the entire expenses occurring, under supervision of the state.

The benefits accruing under this head to an employed person disabled by an employment accident (sick insurance being afforded him or her during the first thirteen weeks) are: medical treatment, medical

*Abstract from a government report and printed in the *Bull.* Amer. Assn. Com. and Trade, Berlin.

requisites such as, crutches, invalid appliances and the like, and, during the period of disablement, a pension, all beginning in the fourteenth week after disablement. In cases of total incapacity an allowance equal to two-thirds of the money previously earned in employment is paid as a full pension; in cases of only part disability a pension is paid in proportion. Should the accident have proved fatal, burial money is allowed and the surviving dependents also receive pensions. The insurance fund issues regulations for the adoption of measures and appliances designed to prevent accidents in the places of employment concerned, for the better protection of the persons employed in them, more particularly, protective devices for machinery. The insurance funds also employ all conceivable care to bring about a perfect recovery of the injured workpeople and to preserve their capacity for earning wages. With this end in view they have, among other things, established special hospitals.

Injured working folk may refer claims to specially instituted tribunals for adjudication in matters of workingmen's insurance, and beyond these to the workingmen's insurance department for the empire or else for the particular state.

Since its first creation in 1885 the accident insurance department has expended the following sums of money in carrying out the duties entrusted to it:

	Million marks.
On treatment for recovery	44.7
On care during the first 13 weeks	10.6
On hospitals and orthopædic institutions	67.2
On pensions to dependents during treatment	18.3
On pensions to injured people	1304.2
On capital commutation to natives	12.4
On burial money	10.4
On pensions to dependents	324.4
On compensation, specifically to widows	12.2
On compensation to foreigners	3.9
Total	1808.3

In 1909 alone 162,266,000 marks were expended in this class of insurance. The accumulated surplus of the funds amounted at the close of 1909 to 510,737,000 marks.

Old Age Pensions and Invalid Insurance

Insurance of this kind (embracing in 1909 10,707,100 men and 4,737,200 women insured) is effected by means of insurance institutions established for large districts (provinces or independent states) and administered by public officers of superior position assisted by representatives of both employers and employees, under the supervision of the empire. The expenses are borne in equal shares, one half each, by employers and employees, the empire adding to each insurance a fixed grant of 50 marks per year.

Working folk insured receive pensions, upon disablement (invalidity) being shown, or else upon attainment of their seventieth year. They are likewise allowed pensions in cases of sickness after the close of the first 26 weeks. Up to that time sick insurance funds provide for them. In cases of sickness the insurance institutions also apply very carefully conducted curative treatment, in order to prevent, if possible, sickness degenerating into permanent invalidity. With this end in view the insurance institutions maintain a considerable number of hospitals, sanatoria, hospitals for consumptives and the like, entirely for their own use. Also they send incapacitated working folk to watering places, or else provide them with artificial limbs, trusses, stays, boots for defective feet, and the like. The same institutions furthermore devote a considerable portion of their accumulated surpluses to the promotion of establishments ministering to the well being and health of the German working population generally, more particularly for housing purposes. Working folk coming under this insurance are entitled to adjudication of their claims by tribunals similar to those constituted under accident insurance.

Since its establishment in 1891 old age and invalid insurance has secured to the working folk whom it affects the following benefits:

	Million marks.
Curative treatment	131.5
Extraordinary benefits	6.1
Treatment in hospitals	2.9
Invalid pensions	1186.0
Sick pensions	25.9
Old age pensions	423.5
Return of contributions made	95.7
Total	1871.6

In 1909 alone expenditures amounted to 189,029,000 marks. At the close of 1909 the accumulated surplus stood at 1,574,111,000 marks. Out of this surplus the following investments had been made:

	Marks.
Investment for purposes of common utility	829,324,554
Hospitals, sanatoria, and recreative homes	445,934,433
Workingmen's dwellings	280,517,984
Agricultural credit	102,872,139

German Workingmen's Insurance as a Whole.

From the time of its first introduction to the close of 1909 workingmen's insurance has disbursed for the benefit of working folk:

	Marks.
Sick insurance	3,994,400,000
Accident insurance	1,808,300,000
Invalid and old age insurance	1,871,600,000
Total	7,674,300,000

In 1909 the disbursements were as follows:

	Marks.
Sick insurance	342,200,000
Accident insurance	162,266,000
Invalid and old age insurance	182,029,000
Total	693,495,000

Accordingly German workingmen's insurance paid to working folk 1,900,000 marks per day. Accumulated surpluses amounted at the close of 1909 to 2,371,373,000 marks.

During the twenty-five years of its existence German workingmen's insurance has shown itself to be, in fulfilment of the words of the imperial message of November 17, 1881, and written by Emperor William I, an effective "institution for the furtherance of the well-being of the working classes." Beyond that, it has become a pillar and cornerstone of the measures taken in the German empire for the promotion of public health. Under it employer and employees have been brought together for common administration.

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Zinc Smelting in Australia

The Port Pirie plant of the Broken Hill Proprietary Co. is described at length by F. W. Reid in the *Mining and Engineering Review*, of October 6. This plant was built as the natural result of successful application of flotation to Broken Hill ores. The concentrate as received at the smelter contains about 46% zinc, 8% lead, 13 oz. silver, and 30% sulphur. It is roasted in Hegeler furnaces fired with gas from Duff producers. The capacity of the double, 7-hearth furnace is 48 tons per 24 hours.

For the distilling plant retorts and condensers are made on the ground, as is customary in the United States. The retorts are hydraulic pressed, dried, and fired as usual.

The Spelter Plant

The plant comprises 10 furnaces, 8 of which are at present in commission. The furnaces are of the Rhenish type, having two tiers of retorts, back to back, with three rows of 24 retorts in each tier, or 144 retorts on the whole furnace. The outer wall on each side is built with 3 rows of 12 openings, each accommodating 2 retorts. The outer ends of the retorts rest on the tiles forming the sills of these openings, while the inner ends are supported upon corresponding sills of an interior frame-like wall. They are set with a slight inclination toward the front, and, being supported at the ends only, the flames can play freely round them. The retorts are 5 ft. 6 in. long, and 13 by 7 in. elliptical cross-section. The condensers, which are open at both ends, are made of the same material, and in the same moulds as the retorts, being simply the latter cut in two. When the retorts are in position in the furnace their ends, which have been beveled on the outside, are well smeared with clay, and the condensers, with their ends beveled in the opposite direction, forced up against them. The condensers rest upon the tiles which support the front ends of the retorts.

The furnaces are gas-fired, there being a producer for each furnace. The air for combustion of the producer gas is preheated on the counter parallel current system, being forced, by means of a fan, through an intricate system of flues and round the furnace itself, before reaching the burners. The latter, of which there are four, are built in the form of large Bunsen burners in the hearth of the furnace, between the two tiers of retorts. They are 18 in. diameter, with gas inlet 9 in. diameter, at the bottom, and air ports at the side. Both air and gas can be regulated.

In running the furnace, one man works 24 retorts. The charge consists of roasted zinc concentrate, with fine coal and coke as reducer, the latter amounting to 40 to 45%. A typical charge is 10,000 lb. ore, 3000 lb. coke, and 1500 lb. coal. Condenser chippings and oversize blue powder are also added to the charge. After being mixed on the furnace floor, the charge is shoveled into the retorts through the condensers. The retorts of the top and middle rows receive the regular charge, while the bottom row, which is not so strongly heated, is charged mainly with dross—a mixture of coke, blue powder, and metallic zinc, scraped from the condensers during tapping operations.

After charging the retorts the ends of the condensers are stopped by luting on cast iron tiles lined with fireclay on the inside and provided with a hole for outward passage of vapors. Over a projecting collar surrounding the hole is fitted the small end of a conical sheet iron 'prolong,' the other end of which is supported by a moveable bar resting on brackets on the front of the furnace. The prolongs serve to collect blue powder. The carbon monoxide escapes at a small hole at the outer end of the prolong. When the prolongs have been fixed in position the furnace is fired and distillation allowed to proceed. The temperature is taken at hourly intervals by means of a Wanner pyrometer. It is raised gradually until it reaches a maximum of 1325 to 1350°C. An hour or two before the day shift comes on the prolongs are removed and the contained blue powder collected. The furnace is then ready for tapping. The tile on the end of the condenser is removed, the molten zinc allowed to run into a cast iron ladle placed to receive it, and the condenser thoroughly scraped to remove all zinc and dross.

Raking out the retort residues is the next operation. For this purpose counterbalanced sheet iron aprons are pulled down in front of the furnace and rakes inserted through openings opposite the retorts. The residues, deflected by the apron, fall through an opening in the floor close to the front of the furnace, and run by a chute into trucks below. They are sent to the lead blast-furnace for recovery of the lead and silver contents.

The furnace is next tested for cracked retorts. This is done by simply turning on the gas, when cracks can be detected by the flame coming through into the interior of the retort. Damaged retorts are replaced by new ones, and after fitting the latter with condensers, recharging is commenced. The cycle of operations on the furnaces occupies 24 hours.

The capacity of each furnace is 5 tons of roasted material per 24 hours. The zinc recovery in spelter and marketable blue powder is said to range from 80 to 85 per cent.

The blue powder averages about 12% of the total furnace product, and is of very good quality, containing 92½% metallic zinc. It is screened through a 100-mesh screen, and boxed for export to San Francisco or Japan, its two markets. Blue powder is used in the galvanizing process known as 'sherardizing,' and also finds an application in the Merrill process for precipitation of gold and silver.

Refining the Spelter

The spelter contains 2 to 3% lead, and is sent to the refinery, where it is liquidated in a reverberatory furnace. The charge is about 20 tons. The lead sinks to the bottom, and is allowed to accumulate for a week or more before it is tapped. It contains 0.7 to 0.8% zinc. The spelter is ladled out at one end of the furnace, having first to pass under a baffle plate, which, dipping into the bath, holds back the dross. The latter, which is small in quantity, is skimmed off and returned to the zinc plant. The spelter, now ready for export, contains less than 1% lead, and approximates 99% metallic zinc.

Discussion

Readers of the MINING AND SCIENTIFIC PRESS are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment. Insertion of any contribution is determined by its probable interest to the readers of this journal.

Nitrogen Supplies

The Editor:

Sir—In an editorial in the *Mining and Scientific Press* of September 20, 'Trailing the Nitrogen Atom,' it is stated that at the present rate of production (3,000,000 tons per year) the nitrate deposits of Chile will not last over half a century more. I wish to rectify this assertion by quoting from a speech of Secretary of the Treasury, Sr. Arturo Alessandri, delivered at the session of the Congress of Chile of July 5 last. Sr. Arturo Alessandri said:

"The Government Nitrate Land Office has surveyed and prospected, up to this date, 1,452,750 acres of nitrate lands and the nitrate ore there available, if mined and reduced according to the methods now in use, will yield 270,410,000 tons of commercial nitrate. In making this calculation, nitrate beds of over one foot in thickness and assaying over 15% $NaNO_3$, have only been accounted for, leaving out of consideration all the nitrate beds below the specified minimums. The nitrate lands extend over a territory 430 miles in length, covering a surface of over 50,000,000 acres; of this territory, as stated above, only 1,452,750 acres have been prospected, that is to say, only 1/34 of the whole surface."

JUAN BLANQUIER.

Berkeley, California, September 29.

Under-Estimating the Cost of Milling Plants

The Editor:

Sir—In reference to Mr. Additon's paper and Mr. Hutchinson's comments, I hope you will allow me a few lines. Most writers refer all their estimates and data to milling plants of large size. The truth is that most gold-milling plants erected are five or ten-stamp mills. It is easy enough on a big job to have a head for each department and systematize the working so that the mine superintendent has nothing to do but wait for the complete job, but the fact is that the majority of mills built are small affairs, and also most of the mills have not been justified by the condition of the mine, and a large per cent of mills have been financed by companies with insufficient capital to build a proper mill.

The reason why many companies prefer their superintendent to erect the mill is that the money is not on hand to pay a machinery house or a contractor, for while the promoter or 'head push' may be able to raise sufficient money for monthly wages, he cannot raise the amount necessary for the payments demanded by the machinery house. It may be asked, why not wait until all the money is in? The answer to this is that the money will not come in unless the mill is under way. Why? Ask the buyers of mining stock. It is their way of investing.

There are machinery houses manufacturing stamp-mills that make poor plans, and there are mine superintendents who know nothing about constructing a mill. In respect to the former, to use the words of the immortal poet, "I could a tale unfold whose lightest word would harrow up thy soul, and each particular hair to stand on end." As to the latter, so long as mine superintendents and mining engineers exercise their profession without regulation by the state, it must be expected that men with no qualifications will be running mines and building mills.

If all the factors entering into costs of construction were known, it might be an easy matter, by following Mr. Additon in detail, to estimate very closely the cost of constructing a given plant; but these data, or at least some of them, are never known beforehand. Take a few examples. I send for an estimate on the cost of corrugated iron f.o.b. Chicago. When I come to order my iron, say in two months' time, the price has increased, and so my estimate is off that difference. Again, my plans call for 71 inches between battery-post shoes. When the mortars arrive, I find the factory allowed 72 in. I must then take out an inch. In the case of cast iron battery-post shoes, I chip half an inch from each shoe at a cost of $50 per battery. You will say, why not recover this from the machinery house? The answer is that the machinery house has been paid, and without a lawsuit the money cannot be recovered, and it is not worth the cost of a suit. You might say, 'But why was all the money paid to the machinery house before the mill was delivered on the ground?' The answer to this is only that it was paid by the directors without your advice. But look at the delay and cost which was not reckoned in the cost sheet. Then again, the motors sent, while supposed to run at a certain speed under full load, for one reason or another exceed or go under the necessary speed, requiring a change of pulleys on the transmission shafts. The machinery house again? No, the power company this time, for the frequency of the alternations at the power-house is over what you expected, and the power company has no agreement to supply you with any certain frequency or constant voltage. The truth of the matter is that some machinery houses are very careless, both in respect to plans and sending machinery in first-class shape, and I am prepared to back this up by proofs; but these facts are known to all constructing engineers. Four machinery houses with whom I have dealt in putting up a mill added an extra cost to a 10-stamp mill of $1500 indirectly and $500 directly on repairs and alterations. Quite an item to be charged against you. This does not count the weeks of delay with running expenses being charged to construction account.

There is one item of cost, or at least it should be considered as an additional cost, that has not been touched upon at all. This is when money for building a mill comes to the superintendent in small amounts. For example, he has instructions to build a mill, and the ore in the mine justifies such a course. Money is sent for the first payment on machinery, and then it is a constant struggle to pay men and buy machinery. You dare not send away for expert

workmen for fear of not having the money to pay railroad expenses, and local talent must be relied upon. A mill that could have been put up for $20,000 in three months, drags along to from six to eight months, and the cost has gone away over the estimate. The superintendent is blamed, but not rightly; for when his estimates were made, it was on the basis of all the money being on hand to complete the mill and the work was not to be extended over a long period, with the big running expenses being charged to construction. The increased cost will amount to from 20 to 40% where the money is not on hand.

Now, as to who should build a mill—the superintendent or a machinery house—I should say that the plans should be made by the machinery house and submitted to the criticism of a metallurgical engineer (whose business was mill construction) in conjunction with the mine superintendent, and then the erection should be done by a contractor under the supervision of the superintendent. My reasons for such a procedure are as follows. The machinery house has a staff of trained draughtsmen who are accustomed to such work, and they have probably designed many mills. At the same time, the machinery houses often lag behind in the use of new structural material and the relation of their machinery to other machinery in the mill made necessary by the process to be used. Here is where the knowledge of the metallurgical engineer is necessary, one whose business has taken him to many camps where new ideas are being tried, whose scientific training gives him a rapid insight into construction details, and who is not tied to any set form of construction. But neither the machinery house nor the metallurgical engineer knows the details of the character of the ore, the amount of ore on hand, nor the financial condition of the company, so well as the superintendent, and as the latter must eventually use the mill and be responsible for all its defects, his voice must be final.

Few mine superintendents are fitted by nature or experience to erect a mill, nor is it a good plan for them to do so, for other work must be neglected. There are cases where he must do it, and even cases where the cheapest machinery and structures are justified. I may cite a case. This company had on the dump 25 tons of ore and not another ton in sight in the mine. To be able to raise money to continue development, it was necessary to erect a mill. The superintendent advised against this, and told the directors that in two days after the mill started it would be useless; but it was a case of go ahead or lose his job, so he put up a mill. Now in this case a machinery house could not do any sort of a job and be able to put up a mill for 25 tons of ore as cheap as the superintendent could. No; the superintendent put up the mill to run through 25 tons of ore, and there the mill is to this day. Any other expense than absolutely necessary was not justified, and if the mill as it now stands is not a model, do not blame the mine superintendent, but blame the directors of the company.

ALGERNON DEL MAR.

South Pasadena, California, September 10.

Revision of the United States Mining Laws

The Editor:

Sir—The report of the committee of the Mining and Metallurgical Society of America upon the revision of the United States mining laws sets forth conclusions which are in accord with prevalent opinion in the mining states of the West, and the recommendations are excellent as far as they go.

It is a recognition of the advance which has been made in geologic knowledge to propose the abandonment of the old provision of the law requiring that an actual discovery of valuable mineral should be made antecedent to the valid location of a mining claim. Although favorable 'indications' may not be followed by discovery of workable mineral, our present state of knowledge admits of drawing conclusions from superficial conditions that are more significant than were possible in times past. It is manifestly correct to encourage the application of geologic knowledge by giving to prospectors the right of establishing valid claims under such circumstances. On the other hand, the right to locate claims prior to the discovery of valuable mineral opens an avenue to serious abuses unless the public welfare be protected by suitable safeguards.

The object of giving to a discoverer of metalliferous deposits a prior right to possession is to encourage the development of the natural resources of the country. The sum paid for the land when patent finally issues is of less material importance than the addition which is expected to be made to the national wealth by the exploitation of the newly discovered deposit. A considerable proportion of the value of the deposit is distributed to the general public in the form of direct wages paid and of supplies purchased. These far exceed the nominal fixed value for which the Government confers the right of private ownership, and is of larger economic benefit to the commonwealth. The aim of the law clearly has been, and should always be, to stimulate not only development but actual exploitation. Unfortunately, the working of the law in practice has resulted in a great deal too much desultory and useless so-called 'development', whereby large areas of the public domain are held by individuals in a vague hope that some one sometime may be induced to buy the claims, or that adjacent mining companies may be compelled to buy them in order to get rid of objectionable neighbors.

No one with actual knowledge of conditions in the mining districts can doubt that the great bulk of the annual assessment work performed on mining claims in the United States is either dishonestly done, or is done perfunctorily without regard to effective development of the mineral deposits. A too common motive is to do as little work as will suffice to comply with the strict letter of the law and thus bar others from validly locating the same ground. This surely is not in the public interest; neither is it the intent of the statute. It would seem that this evil might be cured readily by requiring a locator of a claim to proceed to patent within a period after location sufficiently long to give a reasonable opportunity for development and yet sufficiently short to make it too costly

to acquire patent without having discovered a deposit that promises to be worthy of exploitation. The prospector would thus be put upon the same footing as the homesteader, who has a limited period within which to 'prove up' on his land.

The committee also does well to insist upon such record of locations of mining claims as shall admit of others ascertaining whether or not any certain piece of ground has been previously located. Every operator has experienced the evils of our present system with regard to this matter. The lack of uniformity in methods of recording from state to state and from one mining district to another complicates the difficulty. The 'mining district', as provided for under the existing law, has no reason for continuance now that the West has become well settled, with transportation facilities bringing every part within a short distance of the railroads. It would seem that in these days of swift communication there remains no need whatever for recording locations of claims on the public domain within the county or state in which the location may lie until the property shall have been patented and thereby made subject to local state and county taxation. Neither is there any reason for recording primarily in the local United States Land Offices. Many prospectors would not know, nor could they reasonably be expected to know, the exact jurisdiction of local Land Offices, but all citizens know that the Department of the Interior has jurisdiction over all the Government lands, and therefore Washington would seem to be the logical place for making record of locations.

Every postoffice might be constituted a receiving station for location notices, empowered to accept such documents and the corresponding fees, receipting to the depositor for the money paid and transmitting the papers and proper fees to the Interior Department. This would bring the facilities for prompt and easy recording to the very doors of the people most nearly and keenly interested, and would prevent many of the abuses and difficulties resulting from delay in receipt of notices sent for record and from actual fraud in recording which are not infrequent under existing conditions. There would no longer be opportunity for sidetracking a notice for the benefit of some favorite as occasionally occurs today in the offices of mining district recorders. Whether such use of the postoffice be feasible or not, record of location with the Interior Department at Washington would solve the problem in the simplest manner, and information covering any desired area could be obtained in the usual way through persons or corporations making a business of abstracting. At the present time it is often practically impossible to obtain data as to locations since many mining districts and counties make no pretense of indexing in accord with geographical position. One must know the name of the supposed locators or the names of the claims in order to find the record. If he knew that much, there would be comparatively little object in looking up the record except to ascertain the precise limits of the locations conflict with which it was desired to avoid.

Furthermore, the intent of the mining law is that monuments should be conspicuous as a warning to others that the ground is located. In practice it is altogether too common to place the monuments in the least conspicuous places in order not to attract attention. We might well pattern after the Mexican law in this particular, which requires that each claim be so monumented that it be possible to see two other monuments from any one. This constitutes a great improvement over our system of monumenting only the corners, the end-centres, and the discovery point. There can never be doubt whether one is upon land that is open or located when the claims are defined by a string of monuments easily traceable around the boundaries.

Finally, it may be asked by what process of reasoning the locator of a placer claim, under any circumstances should be subject to loss of right to ground which may legally be taken up by a subsequent locator of an interfering lode claim? To accord the placer miner a prior right to locate a lode traversing his property seems inadequate protection. It might prove to him an unnecessary expense and a useless complication. The discoverer of a lode should locate subject to the rights of any prior placer locator to work his placer mine without interference from the operation of a subsequent lode locator. It is reasonable, and not without precedent in the case of ordinary land titles in many states and foreign countries, that a placer patent should be subject to a right of subsequent location of metalliferous lodes which may cross the detrital deposit, since the placer mine is necessarily temporary, while the lode mine may support a relatively permanent industry; but there would seem to be no reason why the conflicting interests should not be harmonized under the law instead of giving to one the right of practically destroying the other.

COURTENAY DE KALB.

Tucson, Arizona, November 5.

The Rand Banket

Sir—The title of the series of articles written by me, and which you are publishing, is 'The Rand Banket.'

I am surprised to see, in your issue of October 11 that you have changed this to 'The Rand Banket and Its Gold Content.'

I must request you to alter this title to 'The Rand Banket' and to insert this letter in a prominent position in the next issue of your magazine.

C. B. HORWOOD.

London, October 22.

[On October 21 we received a cablegram from T. A. Rickard asking us to correct the title to 'The Rand Banket' simply. This was done.—EDITOR.]

Next to gold the principal metal product of California is copper, the production of which decreased from 36,316,136 lb. in 1911 to 33,451,672 lb. in 1912, but the value increased from $4,539,517 to $5,519,526. The relatively small production of silver is recovered largely as a by-product in the copper mines.

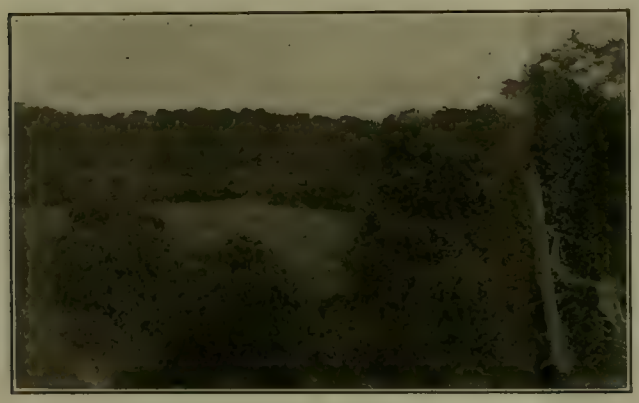
The total value of the mineral products of Arkansas in 1912 was $6,258,726, as against $5,864,822 in 1911.

Special Correspondence

PHILIPPINE ISLANDS

ANXIETY REGARDING GOVERNMENT POLICY.—ECONOMIC INDEPENDENCE MOST NEEDED.—DREDGING AT PARACALE.—MASBATE MINES.—BENGUET.

The new Governor General with his new policy (which is diametrically opposed to that of the past Republican administration), has now, in the middle of October, arrived. What ultimate effect the radical changes will have on the mining industry, it would be difficult to predict. The immediate effect is to depress stocks and to make capital exceedingly timid. There are enough uncertainties and drawbacks to the country, such as typhoons, labor troubles, distance from supply houses, etc., without adding the still worse features of possibility of unstable government and fear of confiscation of property. What capital has already experienced in Mexico, it has the right to expect here in tenfold degree. If the Filipino could but once realize that political independence must depend in large measure upon economic independence, and that they should foster legitimate mining in every way, there would be hope for those who have capital, energy, and trained knowledge. On the other hand, if these islands are turned into a political grab-



PARACALE DREDGING GROUND.

bag or into a political experiment station, then the 'jig is up.' It is to be hoped that the Filipinos of larger vision will be forthcoming to save what looks like a desperate situation.

During this week the well known local mining man, D. M. Carman, has returned with hydraulic machinery and an engineer, Mr. Shaw, for his property in the Cansuran district in the Surigao peninsula, Mandanao. In the Paracale district, Ambos Camarines, there are five dredges at work as follows: (1) the old Risdon dredge on the Malaguit river; (2) the old Stanley, or Maximilo, dredge on the headwaters of the Paracale river; (3) two dredges belonging to the Paracale Bucket Proprietary in the lower part of the river; and (4) the New York Engineering Co. dredge on the Gumaos river. One of the new dredges intended for operation on the Paracale river sank last May. The machinery is being recovered, but it will have to have a new pontoon. The Gumaos dredge, which had been digging rather successfully for a time, has had to put an extension of 25 ft. on the ladder to reach the 'pay.' Some anxiety has been felt by stockholders and it has been intimated that the Division of Mines of the Bureau of Science might be asked to make a thorough report. This has been proposed in Shanghai papers, in which city a good deal of the stock is held. The production of this dredge has fallen from nearly 2000 oz. per month to 220. The steel hull and machinery for the new dredge on the Umiraf river has arrived in sections from Australia and is being set up.

In Masbate everything seems to be progressing satisfactorily. The new Keystone plant using Lane slow-speed mills has just begun operations. The Colorado mine and mill are reported to be running steadily. The Syndicate mill is progressing toward completion. This mill will comprise crushers and Hardinge ball-mills, but will dispense with stamps. Renewed interest is being shown in the well known Benguet Consolidated property and it is possible that development will shortly be resumed there. The Headwaters mine has proved a complete fiasco and has given another black eye to the mining industry here. The Benguet district is now temporarily 'out of the running.'

The Division of Mines of the Bureau of Science has recently issued two press bulletins and a preliminary report on its findings in the Tayabas oilfield. The report is conservative and hints that those with limited capital should stay out of the field. It is rumored that two large companies have representatives on the ground investigating the possibilities. A new company consisting of Filipino capitalists has been organized to develop the Constancia property in the Angat iron district of Luzon.

PORCUPINE

HOLLINGER AND DOME REPORTS FOR SEPTEMBER.—PORCUPINE CROWN DEVELOPS SATISFACTORILY.—MCINTYRE, HOLLINGER RESERVE, AND JUPITER.

The report of the Hollinger gold mines for the four weeks ended October 7 shows gross profits for the period amounting to $131,510. The mill ran 88% of the possible running time and treated 11,850 tons, of which 164 tons was for the Acme gold mines. The average value of the ore treated was $17.39 per ton and an approximate extraction of 96.7% was obtained. Mining costs were $2.94 per ton, and milling costs $1.59 per ton. During the period, approximately 100 ft. of driving was done on the 425-ft. level of No. 1 vein, and the value of the ore and width of the vein indicate that there has been no falling off in either. Work has been started upon a winze which will be carried to the 550-ft. level. The report of the Dome mines for the month of September shows that 10,790 tons of ore was milled, which had a gross value of $70,135. Good progress is being made with the addition to the mill, and the management expects to have the work completed in the early part of the new year. Recent development work on the Porcupine Crown property, which is controlled by the Crown Reserve Co. of Cobalt, has been satisfactory, and in the winze, which has been sunk 60 ft. below the 400-ft. level, the vein shows an average value of $80 per ton over a width of 5 ft. The general average of the mine, however, is in the neighborhood of $22 over a stoping width and the management states that, to date, ore to the value of $1,700,000 has been developed above the 400-ft. level. The clean-up from the 10-stamp mill in September returned bullion to the value of $29,000, and with the addition to the mill in operation when the plant will have a total capacity of 100 tons per day, the earnings will be much greater. A new shaft is being sunk 1000 ft. south of the present workings, where ore has been proved at a depth of 300 ft. by means of diamond-drilling.

The September statement of the McIntyre mine shows that there was treated a total of 2786 tons of ore, from which was recovered bullion to the value of $28,015. Total operating costs were $28,127. This property suffers from long-distance mismanagement. The capacity of the mill is being increased, and it is expected that returns for October will be more satisfactory. The Hollinger Reserve mine is under option to the Lewisohns of New York and is now being developed by them. No details as to the terms of the option have been given out, but it is known that there were outstanding debts amounting to about $50,000 which the Lewisohns paid, but which is a first charge against the property in the event of their not exercising their option. They are also to have the privilege of developing the property for six months before any payment of the purchase price is due.

The Jupiter mine was examined a short time ago by P. A. Robbins, the manager of the Hollinger, at the request of a number of the large shareholders. It is stated that his report did not bear out the figures given by the

Company's engineer. The Jupiter which was being financed by the Drummonds of Montreal has been closed for some time on account of their financial difficulties.

KALGOORLIE, WESTERN AUSTRALIA

Howe Process—Development of the Associated Northern Co.'s Victorious Mine.—Improvements at the Corinthian North.—August Returns.

After further expenditure of time and money, Ben Howe, manager of the Gwalia Consols, has had to admit that the success of his volatilization process of gold saving is as far from the realization of his dreams as ever. In June Mr. Howe stated to an interviewer that he was quite satisfied that, when he cleaned up the result of his continuous run of 60 hours, in which 45 tons was treated, he would get a theoretical return of 90%. Eventually, the return was published as $187.60, equivalent to $4.17 per ton. The assay-value of the ore was $8.64, so that the extraction was only 50%, instead of the 90% predicted. Shareholders of the Company have been called upon to pay 2 cents per share to enable experiments to be continued. In connection with the volatilization of gold, I. H. Niemann, of Melbourne, claims that he has discovered that the presence of selenium in the ore causes gold to become easily volatile.

Malcolm Maclaren has completed his examination of the Great Fingall, Fenian, Ivanhoe, and Sons of Gwalia mines and has left for Queensland to report on the Great Fitzroy copper mine. Just before leaving Kalgoorlie, the directors of the Associated cabled instructions to Mr. Maclaren to report on that mine, and he will return here to do so. On his recommendation, the directors of the Ivanhoe are to continue sinking the shaft another 600 ft. to 3500 ft., at which depth Mr. Maclaren predicts that the porphyry bar and graphite, which impoverished the lode below the 2200-ft. level, will pass out of the ore channel to the west. Should Mr. Maclaren's prediction be fulfilled, the Ivanhoe directors intend prospecting the Ivanhoe Junction lease on the west, into which Mr. Maclaren asserts the quartz dolerite intrusion, which precipitated the gold, will dip at a depth of 2000 to 3000 feet.

Developments at No. 5 level of the Associated Northern Co.'s Victorious mine at Ora Banda have proved disappointing. Instead of the rich ore indicated by the winzes sunk below No. 4 level, the continuation of the ore-shoot at No. 5 level averaged only $14.16 over a distance of 108 ft. The average value in the winzes was $26.16 per ton, and the average depth 54 ft. or half way between the levels. Owing to the walls of the open-cut collapsing, there was a creep between No. 1 and No. 2 levels, and the inspector of mines has prohibited any further working at those levels. Owing to this prohibition, the return for August only averaged $4.58 per ton, and the profit fell to $5000. No improvement in returns need be looked for till the first unit of the sulphide plant is in operation. The shaft was temporarily in jeopardy, but the inspector considers that the danger is now past.

F. W. Morgan, manager of the Bullfinch mine, died suddenly a week ago in the train on his way to Perth. Mr. Morgan had a large mining experience in New Zealand, and at Broken Hill, and from the latter field introduced the American system of square-set timbering on the Bullfinch. The metallurgist is temporarily in charge of the property. The complete plant is now at work, and when running smoothly is anticipated to treat 6000 tons per month of $11 per ton ore at a profit of $40,000 to $45,000 per month. On January 1 the Company owed the bank $180,000, but, up to the end of August, had earned a profit of $246,000, and dividends may shortly be looked for. The No. 3 lode is still developing well at the 310-ft. level, and in a winze just started below that level the first 10 ft. sunk averages $10.50 per ton.

The Ridgway filters on the Corinthian North are now in position and will be running next month, but the full capacity of 6000 tons per month is not expected at once. The ore recently developed is much better than it was at the time the Company was floated, when it was estimated to be worth $6 per ton. Since the mill started, 10,983 tons has been treated, yielding $36,200, but the residue is estimated to contain $56,800 more, making the ore worth $8.46 per ton, or nearly 50% above the original estimate which appeared in the Company's prospectus. The lode on the Corinthian North is as much as 20 and 30 ft. wide, and has been proved by trenches and test pits for a distance of from 2000 to 3000 feet.

After drilling for nine months, the Government has only succeeded in putting down one bore-hole 1160 ft. and a second 610 ft. at Frasers mine at Southern Cross. The remaining bore-holes will be sunk by contract by the Goldfields Diamond Drilling Co. W. J. Loring, of the firm of Bewick, Moreing & Co., secured an option on the property before sailing for London early in May, and since then no results of the bore-hole developments have been published. However, it is hardly likely that contracts to continue boring would have been entered upon if the outlook were not promising. The ore-shoot on this property was mined for a distance of 4000 ft. with two small breaks above the 150-ft. level, but little development was done below that level, and the deepest shaft is only 375 ft., at which depth it has remained for over a dozen years. The gold recovered from treating 334,000 tons realized $3,662,500, but costs were so high that shareholders received only $238,700 in dividends.

The new wages agreement, which was made some time ago, was signed during the week. The agreement is fixed for a period of three years, from April 16, 1913, to April 15, 1916. As both sides are bound by penalties to adhere to the terms arranged, there should be three years of industrial peace.

MIAMI, ARIZONA

Development at the Castle Dome Property.—Progress at the Boston & Superior.—Union Refuses to Strike at Miami.—Heavy Flow of Water at the Boston Commercial.

At the Castle Dome property a second adit has been begun 100 ft. below the one in which rich ore was recently found. As in the workings above, a stringer of rich ore was found near the entrance of the adit and at present the entire face of the adit shows mineralization, which occurs as small stringers of high-grade ore in the form of chalcocite, chalcopyrite, and galena, and some gold and silver. On the extreme west end of the Duquesne property an adit has been driven 100 ft., and in the face the contact shows a strong quartz lead.

The vigorous régime at the Superior & Boston is bearing results, last month being the most prosperous month in the history of the mine, the shipments of more than four thousand tons to the El Paso smelter yielded returns well above all expenses. Raising has been started from the point on the 1000-ft. level where the ore was found in September. On the 800-ft. level a raise has been started 300 ft. east of the raise connecting the 800 and 600-ft. levels, through which the bulk of the mine's ore is now being extracted. The new raise is about 25 ft. high and will be continued until it reaches the stope level of the intermediate, where driving and stoping will be commenced. Diamond-drilling to explore the country east of the present workings was begun about the first of November and good progress is being made. At the Southwestern Miami, drilling is going on as usual. Hole No. 5 is 1170 ft. deep, and the casing is being pulled and the drill rig moved to the site of hole No. 18. Hole No. 16 is 883 ft. deep in the schist, and No. 17 is 468 ft. in the conglomerate. After the recent strike notice, issued by the Miami Industrial Council, the Miami carpenters' union refused to be governed by the action of the council and withdrew from that body, advising its members to return to their work at the Inspiration mill.

The Iron Cap property is in good condition. From present shipments it may be predicted that November's output will exceed that of October, which was considerably larger than that of the preceding month. The raise on the 800-ft. level has reached a height of 85 ft. The recent advent of water at the Arizona Commercial has temporarily checked the program of rapid development. The Company has not

given out any data as to its intentions regarding the increased pumping equipment that is to be installed. It is possible that by concreting the shaft considerable of the inconvenience caused by the flow would be obviated, especially on the 1200-ft. level, where the flow is at the rate of 100 gal. of water per minute. On the 700-ft. level driving has been discontinued and a raise has been started. Previous work at this point showed the vein to carry from a seam to 5 ft. of sulphide ore and the raise is in the nature of exploratory work to ascertain the possibility of the vein being of commercial value above the 700-ft. level. Driving on the 1000-ft. level continues east.

COBALT, ONTARIO

Arsenic Limit and Shortage of Smelting Capacity.—Gould Shareholders and Peterson Lake.—Energite Explosives Assessed Damages.—Nipissing Stock.—Power Shortage.

The recent decision of the A. S. & R. Co. to put a 7% arsenic limit on Cobalt ores, combined with the small capacity of the Canadian high-grade smelters, has resulted in a serious handicap to several of the mines. A very considerable proportion of the Cobalt ores carry in excess of 7% arsenic and several mines are now faced with the problem of marketing their product. Practically all the high-grade ore shipped from Cobalt was sent to the A. S. & R. smelter at Perth Amboy, the Pennsylvania plant at Carnegie, and to the Canadian smelters at Thorold, Deloro, Copper Cliff, and Orillia. During the past year, however, the smelters at Carnegie and Copper Cliff have been closed and the Orillia plant was destroyed by fire, while the other two Canadian smelters have only a limited capacity. The Deloro plant, which is controlled by M. J. O'Brien, gives preference to the ores from the O'Brien mine in Cobalt and the Miller Lake-O'Brien in Gowganda, and the remainder of the capacity is fairly well taken care of by the contracts already existing with other properties. The Thorold plant is owned by the Coniagas mine, and also has a contract with the Townsite mine, and has only a limited capacity in excess of the requirements of these two properties. It is understood that the Orillia plant will be rebuilt, and while this will relieve the situation to some extent, it will still leave a considerable tonnage of ore to be taken care of. Efforts are being made to develop a market in Saxony, where there are smelters for the treatment of ores similar to those in the Cobalt district, and which for some time have been running at reduced capacity on account of the failure of local ores. There is also some talk of erecting a customs plant at Cobalt, similar to those in operation at the Nipissing and Buffalo mines, where the high-grade ores are treated by a combined amalgamation and cyanide process, and where the results are claimed to be more satisfactory than can be obtained at the smelters. The output is in the form of silver bullion and the Cobalt residues find a ready market. The difficulty experienced in marketing ores is reflected in the shipments from the district for the week ended October 25, which constitute a low record since 1905.

On the 200-ft. level of the Gould property, a 2-in. vein of high-grade ore, which is the extension of the Worth vein on the Seneca-Superior lease, has been found. The original lease on this property from the Peterson Lake Mining Co., was transferred to the Gould Consolidated, which had a capital of $3,000,000 in $1 shares. When the funds of this Company were exhausted, the Porcupine Syndicate, with a capital of $500,000, was formed to take over the lease. Last spring, the Porcupine Syndicate also ran short of money, and in order to carry on the work, $20,000 worth of ore certificates were issued, redeemable for $150,000, and constitute a first charge against the property. After the ore certificates have been redeemed and the operating expenses paid, the Porcupine Syndicate and the Gould Consolidated are each entitled to one-half of the proceeds. As the Peterson Lake Mining Co. receives a royalty of 25% of the gross value of all ore produced, it would appear that Gould shareholders are not in a particularly favorable position.

In a recent suit brought against the Energite Explosives Co., whose plant was destroyed by an explosion a year ago, in which several lives were lost, one of the plaintiffs, a widow, was awarded $3300 for herself and $400 damages for her son, with costs against the defendants. There are also several other cases pending against the Company. The jury found the Company negligent on the following points: in not having the crushing room properly isolated from the mixing and finishing room; in not having confined the known dangerous operation of crushing compounds of sodium within properly constructed fireproof walls; and in permitting an unnecessarily large quantity of finished product to be stored in the finishing room where several employees were engaged.

During the first days of November the stock of the Nipissing Mining Co. experienced a considerable decline and fell from about $9 per share to $7.40. The action of the stock has given rise to a rumor that there is a possibility of the bonus being cut off when the next dividend is paid. At the present time Nipissing is paying 5% regular, with a 2½% bonus every quarter, which calls for a disbursement of $1,800,000 per annum. According to the recent statements of the Company, however, there does not appear to have been any falling off in the earning power, and the cash surplus has been increased. The Temiskaming company has announced its intention of discontinuing the payment of dividends and also of stopping work on the North Dome property in Porcupine on account of insufficient finances. The financial statement as of September 30 shows cash in the bank and liquid assets of $195,420. Development on the lower levels, however, has been very disappointing, and while several rich pockets of ore have been opened up, they are as a general rule of small extent and far apart, so that the cost of production is excessive. Owing to the dry summer and fall and the consequent shortage of water, the Northern Ontario Light & Power Co.'s plants at Matabitchouan and Ragged Chutes are short of power, and it has been found necessary to shut down the mills in the district in rotation for 24 hours each. It is believed, however, that this difficulty will be of short duration and that a little rain will give a sufficiency of power.

PLATTEVILLE, WISCONSIN

Prices and Production.—Much Ore Held in Bins.—Work at Highland Resumed.—Field Reports a Big Find.—Marsden Begins to Ship.

Fluctuating conditions marked the month of October in the Wisconsin zinc-lead field. While the production was equally as good as that reported for any month so far this year, only half of the active producers figured in the selling and shipping transactions for the month. For the first time in three years the price of zinc ore fell to a base under $40 per ton for 60% standard ore. Leading operators attribute the decline to tariff changes. Low-grade producers are shipping just enough to meet their payrolls and operating expenses. Average prices for zinc ore for the month, supplied by one of the leading ore buyers in the field, obtained as follows: 30% concentrates, $15 to $16 per ton; 35%, $17.50 to $19; 40%, $24 to $25; 50%, $26 to $29; 55%, $30 to $35; 60%, $39 to $43.

Sales were made during the month as follows: to Mineral Point Zinc Co., 135 cars, 5033 tons; National Separating Co., Cuba, 41 cars, 1648 tons; Grasselli Chemical Co., Clarksburg, West Virginia, 40 cars, 1471 tons; Empire Roasting Co., Platteville, 33 cars, 1271 tons; Illinois Zinc Co., Peru, 18 cars roasted ore, 694 tons; Matthiessen & Hegeler Zinc Co., roasted ore, 16 cars, 313 tons; Linden Zinc Co., green ore, 17 cars, 470 tons; total, 300 cars, 10,900 tons.

Lead ore deliveries were light, because of reduced prices, much of the lead ore was held in bins at various points in the field at the close of the month. Shipments were made almost entirely to the Federal Lead Co. as follows: Saxe-Pollard, Linden, 54,450 lb.; B. M. & B. mine, Mifflin, 65,000 lb.; Milwaukee-Shullsburg, 55,700 lb.; N. H. Snow, 61,000 lb.; mixed lots, Linden, 63,400 lb.; Eddy mine, West Hanover, Illinois, 31,390 lb.; Northwestern Zinc Co., Day Siding, 80,000 lb.; total, 421,480 pounds.

Iron pyrite fell below the production reported for September, Linden shipping to Grasselli Chemical Co., East Chicago, Indiana, 688,520 lb.; National Separating Co., to General Chemical Co., Hegewisch, Illinois, 1,508,830 lb.; Wilkinson mine, Benton, to General Chemical Co., 634,600 lb.; to Grasselli Chemical Co., 1,917,400 lb.; total for all, 4,749,350 pounds.

Gross production of concentrates from mines for the month aggregated 10,253 tons; 'refined' ores and shipments direct to smelter of other ores, 6060 tons; the Mineral Point Zinc Co. delivered to its smelter from the roasting plant at Mineral Point 40 cars of high-grade spelter ore, 1470 tons. The stock of raw ore held in bins in the field is roughly estimated at 3000 tons.

The Mineral Point Zinc Co. has begun operations in the Kennedy mine at Highland after a six months' shut-down for alterations and improvements in the central power and milling plant. The C. M. & St. P. railway purchased the Mineral Point & Northern railway from the New Jersey Zinc Co. interests. At Platteville the West Hill Mining Co. found ore on lands adjoining the Big Jack mine. Drills penetrated ore on the Hill estate near the old Enterprise mine. The Klar-Piquette has found ore from its new shaft. The Vinegar Hill Zinc Co. has found ore on the Martin land and removed the Rowley mine equipment and rebuilt at this point. The Field Mining & Milling Co. has published results of drilling on the Thompson land; a body of zinc ore 1100 ft. long, 40 ft. thick, and from 100 to 160 ft. wide is reported. In the Galena district the Mineral Point Zinc Co. got started at the famous Black Jack or Marsden; the first two cars of zinc ore went to track the last week in October. In the Potosi district the Wilson Mining Co. began shipment of ore showing 58% concentrate. Extensive improvements were made here in the Preston Point equipment now doing service for the Wilson people.

NEW YORK

Copper Market News.—October Production.—Granby at Valdez.—Mason Valley.—The Southwest and Mexico.

The week that ended November 8 was disappointing to the copper interests. Share prices sagged badly under the debilitating influence of the decline in the London price of copper which, curiously enough, though largely speculative, has a stronger effect on the prices of copper shares than actual sales for consumption here exert. As the London price has dropped nearly £6 in the past couple of weeks, closing on November 7 at £69 12½s. spot and £68 15s. for futures, as compared with £75 and £74 7s. 6d. on October 23, the share market has gone down in sympathy. Of course such a movement is illogical, for the worth of shares is determined by dividend rates, which exhibit no such variations, but the ups and downs of share prices may be taken as speculation on the possibility of changes in the dividend rate. The figures for increased output are really entitled to an equal effect on share prices, since increased output means lower working costs and increased operating profits. Nearly all the companies are doing a rushing business in turning out copper. The Anaconda figures for October show a much smaller decrease than was expected from the shut-down at the beginning of the month to repair the flues at the Washoe smelting plant, and ore is now going to the plant at a record rate. The Mason Valley shows an increased output for October, and the Phelps-Dodge properties are turning out copper at a rate that will make their total for this year far exceed any preceding year. Utah Copper has shown a steady increase since July, Ray and Chino have been on the increase as compared with the early summer, while Miami's October yield was nearly a million pounds more than in May, when it was in trouble. There seems little prospect indeed of any 'copper famine' for a while yet.

The Granby is carrying on a vigorous campaign of exploration for good new properties, and has options on a number of mines in British Columbia. Not long ago the Midas mine, near Valdez, Alaska, was taken over on terms said to be very favorable. Good progress is being made in equipping the property, in which the ore is said to run 5% copper, and regular operation will probably begin next summer. The Company has given up its option on the Mt. Andrew mine, on Prince of Wales Island. This property was at one time under lease by the Britannia company, which failed to keep it. Excellent progress is being made at Anyox (Hidden Creek) and the Granby should soon be in a much stronger position.

The recent low price of Mason Valley shares is due, according to officials of the Company, to bear raids on the stock. The Mason Valley is in a somewhat peculiar position, in that it uses its mine as a regulator for the smelter. Besides its own ore it smelts that of the Nevada Douglas and a large number of smaller mines. Equal quantities of Mason Valley and Nevada Douglas ore make a fluxing mixture, and this does away with the necessity for using barren limestone as a flux. When the supply of Nevada Douglas ore is short, limestone is added to the charge, thus decreasing the output of the smelter. To keep smelting costs low it pays the Mason Valley company to decrease the output of its own mine when the supply of outside ore is short. Just now about 2500 tons per week is being sent to the smelter. The intelligent management which the Mason Valley has had is almost as great an asset as its ore reserves.

Philadelphia is proverbially inactive, but something has recently occurred there to galvanize into activity the Keane Wonder, and its shares advanced in a few days from 8 to 17c. The property is in Inyo county, California, nor far from Rhyolite, Nevada, and has a 20-stamp mill; it is claimed that it has made an output of $1,000,000 gross from medium-grade ore. The ore occurs in lenticular bodies along the contact between volcanics and schists, and carries a small amount of galena. The Butte-Duluth has started to enlarge its leaching plant to 1000 tons capacity, as drilling has proved the existence of considerable quantities of ore. It seems probable, however, that the management is not yet completely out of the woods in the study of its treatment problems. The Consolidated Arizona has arranged to build a 250-ton flotation plant in connection with its mill at Humboldt, Arizona. The Consolidated Arizona has been doing little more than mark time for years, since the frenzied whirls through which C. W. Morse and Thomas W. Lawson put it. Capitalized for $17,500,000 in 1906, the working capital on hand in 1910 was stated at $225,409. Some time ago the Company engaged A. S. Dwight as consulting engineer to straighten out its technical difficulties, but evidently found that the best of smelter experts cannot put ore into a mine. Everyone agrees that the plant is well situated to develop a good custom business, but the ore so far seems to have failed to come in. In the meantime the Inspiration 600-ton flotation plant is nearly completed, the Burro Mountain and the Old Dominion companies have signed contracts, and there is a wide interest in the process. The Nevada Consolidated made a poor showing in the third quarter of this year, reporting a deficit of $95,000 between net earnings, and dividends and depreciation. The output of copper was 15,835,563 lb., an increase over the first quarter of the year, but a decrease as compared with the second quarter. This decrease was due to the lower grade of ore handled, 1.53% as compared with 1.76%, it being necessary to take ore during the autumn from the places which are less easy to work in winter. The cost of production went up to 10.09c. per pound, as compared to 8½c. for last year. The stock of copper on hand and in transit is given as 22,000,000 lb., inventoried at 13.615c. per pound.

A note of optimism in the general Mexican gloom is sounded by the announcement that the dividend rate of the Lucky Tiger Combination, or El Tigre, is to be increased from 5 to 6c. monthly, corresponding to an annual dividend payment of $515,043. Much is hoped from the new vein, called the Kelley, which was cut by diamond-drilling on the third level and which gives assays of $500 per ton. Cross-cuts are being driven on the 100, 200, and 400-ft. levels, and it will soon be known how extensive the rich new discovery actually is.

Proposals to transfer the Bureau of Mines to the Department of Labor call out counter suggestions that a new Department of Agriculture and Mining be created to stimulate production of basal materials.

General Mining News

ALASKA

FAIRBANKS

At a recent meeting of the board of directors of the Newsboy Mining Co. it was announced that the property had shown a net profit for the month of September of $2652, which is considered an extremely good showing. The total amount of the clean-up was $8375.

TREADWELL

The report of the Alaska United Gold Mining Co. for the month of September presents the following statistics as to the work done by the Company during this period:

	R. B. Claim.	700 Claim.
Tons ore crushed	19,054.00	18,060.00
Tons concentrate saved	495.20	381.12
Estimated gross value of free gold	$25,115.20	$23,839.46
Estimated gross value of concentrate	21,083.64	20,250.94
Estimated total production	46,198.84	44,090.40
Estimated realizable value	45,736.86	43,649.50
Operating expenses	24,727.81	26,299.17
Estimated operating profit	21,009.05	17,350.33
Construction expenses, etc.	5,180.08	1,923.43
Estimated net profit	15,828.97	15,426.90
Yield per ton of ore milled	2.42	2.44

The development work on the Ready Bullion Claim amounted to 122 ft., and that on the 700-Ft. Claim amounted to 440 feet.

VALDEZ

Reports from the Boston Consolidated Mines Co. indicate that the Company has had a successful summer. The work was somewhat impeded by the small hydraulic plant, which was not of sufficient size for the best results. The Company is planning to install two giant hydraulic plants next summer that will have a 36-in. flow of water. The plants this year were 10 in. smaller.

Announcement has been made that Moore creek, a tributary of the Kuskokwim river, is to be worked next summer by a giant dredge. The ground has been under examination for some time past, and the reports made on the property have been favorable. An order for the dredge has been placed, and it is expected that it will be constructed soon after the opening of navigation next year.

ARIZONA

GILA COUNTY

(Special Correspondence.)—The Miami Copper Co., during October, milled 91,613 tons of ore, and its copper production reached 2,956,952 lb. The additions to the crushing plant at the concentrator are working without a hitch, as is everything about the smoothly running plant. Underground, everything is being carried ahead at an even rate of progress, development on the Captain orebody amounting to 1126 ft. The Miami pipe-line from Burch pumping station to the Miami mill was recently changed because of the evil effects feared from vibration from trains traveling above it on the Inspiration line. Concrete is being placed at the lower tailing dam, but with few minor exceptions there is nothing unusual in the way of new work at the property.

Miami, November 7.

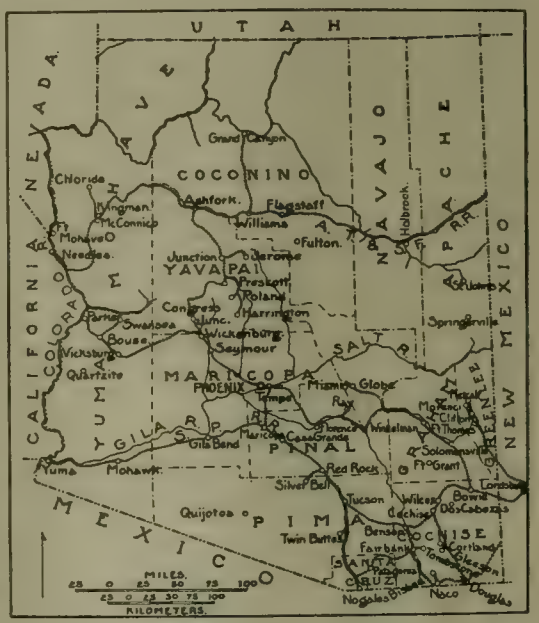
Excavation is now well under way for the power-house which the Inspiration Consolidated Copper Co. is to build in Webster gulch. Work is now moving along evenly, all steel being in place for about two-thirds the length of the bins, which will be completed within a short time. Steel for the crushing plant will shortly arrive, and work will be started on this next, in conjunction with the headframes for the main shafts. Within a few weeks the new test-mill will be ready for operation, as practically all the machinery is now in place and the crushing plant at the Scorpion shaft is almost completed. Work underground is moving along as well as can be expected. The recent cave-in in the West Main shaft was no more than was expected by the Company, and everything was in readiness to care for it. No doubt this shaft will be concreted, and then there will be no further trouble along this line. New headings are still being started, and within a short time the Company will be mining ore to supply the new test-mill.

MOHAVE COUNTY

The California Nevada Exploration properties near Chloride, Arizona, are idle at present. Two shipments are said to have been made to the smelter at Needles, and the returns are said to have netted $1350. Considerable work has been done on a number of claims, and there is a gasoline hoist and other equipment available.

YAVAPAI COUNTY

The smelter that is being constructed by the United Verde company at Clarksdale will be one of the most complete plants for the smelting and refining of ores in the United



MAP OF ARIZONA.

States. This plant when completed will cost over $6,000,000 and will have an initial capacity of 2500 tons per day, or more than twice the capacity of the Company's smelter at Jerome. The smelter equipment of the Clarkdale plant will consist of six roasting furnaces, three 19 by 100-ft. reverberatory furnaces, four 48 by 32-in. blast-furnaces, and four Allis-Chalmers 12-ft. upright basic converters. The smelter site is on a branch of the Verde at an elevation of 2400 ft., which is sufficiently high above the river to afford ample dumping ground for slag. The main shaft of the mine is connected at a depth of 100 ft. by a tunnel with the smelter. All of the ore from the mine will be transported to the smelter through this tunnel.

CALIFORNIA

AMADOR COUNTY

(Special Correspondence.)—The Oro Water, Light & Power Co. is prospecting gold-bearing gravel with a Keystone drill, on the Amador county side of the Mokelumne river, about two miles below the Penn mine. The Company's dredge, with 9-cu. ft. buckets, is handling 160,000 cu. yd. of gravel per month at Camanche, about five miles from Campo Seco, on the Calaveras side of the river. Electric power is used for all purposes on the boat.

Camanche, November 9.

(Special Correspondence).—On No. 36 level of the Kennedy mine, the cross-cut has just entered a new ore-shoot, the hanging wall of which is a graphitic slate. Between No. 33 and 36 levels stoping is being done on a wide vein, in one place there being 15 ft. of solid quartz. Generally, the mine is in a healthy condition. Construction of the

wheels, to elevate the tailing from the mill over to some ground bought by the Company is proceeding at a good rate, and Webb Smith, the manager, expects this to be nearly complete in 30 days. At the Zeila, only 20 to 25 stamps of the 40 in the mill are working. The future scope of operations has not been decided upon yet.

Jackson, November 11.

(Special Correspondence.)—Work at the Plymouth has been reduced, temporarily, to a minimum, and but few men are working. The special funds set aside for development have been largely spent, and with such encouraging results that W. J. Loring has returned to London to make arrangements for operating the mine. In the meantime, advance work underground has been suspended and Gelasio Caetani is preparing plans for a new mill.

Plymouth, November 11.

CALAVERAS COUNTY

(Special Correspondence.)—The three dredges here have been shut down since October 16 on account of shortage of water in the Calaveras river. The recent rains have not been sufficient to float them. One boat is of 3.25-cu. ft. bucket capacity and has been handling about 50,000 cu. yd. of gravel per month, while the other two, with 6-cu. ft. buckets, have turned over from 60,000 to 80,000 cu. yd. each per month.

Jenny Lind, November 7.

(Special Correspondence.)—At present the Calaveras Copper Co.'s mine, concentrating plant, and smelter are shut down, pending payment of debts in Stockton and other places and a practical reorganization of the Company. The property is reported to have been badly mismanaged, but is now in charge of J. G. Hadley who has only a small staff with him. Shipments of concentrate to the Selby smelter have been made until recently from stocks at the mill, but there is a shortage of water preventing further ore treatment. The mine is opened to 1000-ft. depth, and on this level some rich copper ore has been opened, and the property itself is said to be good. There is over 50,000 tons of 3% ore reported on the dumps ready for milling. The reverberatory furnace that was erected was a complete failure. The property is situated 16 miles by stage from Milton, the terminus of the railroad from Stockton, and in the winter transport of freight is difficult, so in all probability the mine will not be reopened until next spring. Boston people are interested in the Company.

Copperopolis, November 7.

MERCED COUNTY

(Special Correspondence.)—With a view to continuing its operations when the present area of ground is worked out, the Yosemite Dredging & Mining Co. is prospecting some gravel from two to three miles from Snelling. A Keystone No. 3 drill is used, and the work is being done in a systematic manner. J. H. White is manager.

Snelling, November 6.

COLORADO

CLEAR CREEK COUNTY

(Special Correspondence.)—There was a gain of 66% in tonnage for the month of October over that of September, while the local sampler paid out $47,000 for ore. The principal part of the product came from the Gem, Little Mattie, and Specie Payment mines. John Peterson, leasing on the Silver Age mine on Seaton mountain, is marketing smelting and concentrating ore. The first-class is worth $60 per ton. Another contract for 100 ft. of driving will be awarded by the Honest John M. M. & T. Co. during the next few days. The adit is now in 2150 ft. The Pozo-Gilpin mine is being developed through the Newhouse adit. At present about 1000 tons of ore is being extracted each month.

Idaho Springs, November 5.

GILPIN COUNTY

The shaft on the East Notaway property of the Square Deal Mining Co. has reached a depth of 870 ft. and will be continued 90 ft. deeper before the work of cross-cutting to the vein is commenced. A station is being cut on the 850-ft. level. Several good shipments have recently been made from this property to the Globe smelter.

TELLER COUNTY

An electric hoist is about to be installed on the 1100-ft. level of the American Eagle property of the Stratton estate. A review of the Vindicator Consolidated Gold Mining Co.'s operations for the past quarter is of particular interest from the statement that the drifts in the 1600-ft. or present deepest level in the main or Vindicator No. 1 shaft have been carried to such a length as to warrant the assertion that these drifts indicate a lengthening of the oreshoots. Stockholders have been advised that the Company is making preparations to deepen its main shaft an additional 200 feet.

IDAHO

SHOSHONE COUNTY

(Special Correspondence.)—A joint meeting of the Spokane and Montana local sections of the American Institute of Mining Engineers will be held at Wallace, Idaho, November 15 and 16. A train will leave Spokane at 8:40 a.m., Saturday, November 15, arriving at Wallace at 12:50 p.m. The afternoon and evening will be devoted to the reading and discussion of papers, and to the election of members to the executive committee of the Spokane local section. It is proposed to change the name of the Spokane local section to Columbia local section as more representative of the area covered by the organization. Sunday, November 16, will be occupied in visiting mines and mills, this portion of the program being in the hands of a local committee of which J. F. McCarthy is chairman. A smoker will be held Sunday evening and the visiting members will return home Monday morning, November 17.

Spokane, Washington, November 1.

One of the most important Coeur d'Alene mining deals consummated recently is the bond and lease taken by the Idora Hill Mining Co. on the property of the Tuscumbia Mining Co. at a price of $225,000. Not all of the stock of the Tuscumbia was covered by the present option, but enough to give the Idora company working control of the property. The consolidation of the two companies is of great advantage to the stockholders and promises greater convenience in working them. The Idora is equipped with a mill, which is running steadily on ores taken from the Idora, but with the addition of the Tuscumbia, which is in shape for immediate production, the mill can be run to its capacity and the snipments of ore correspondingly increased.

The Interstate company, in Nine Mile cañon, in the Coeur d'Alene, is equipping the mine with electric haulage for a distance of 4000 ft. The milling plant is now running at its full capacity of 300 tons per day. Five 4-horse teams are busy hauling the crude ore and concentrate to Bunn station, the shipping point. Work is also progressing on the construction of 12 new bungalows and a 75-room hotel for employees. All buildings will be equipped with steam heat, baths, and all modern improvements.

The H. E. & M. company is considering a plan to erect a concentration plant near the mine on the Coeur d'Alene river. The Company recently started a new lower tunnel, which will furnish a means of delivering the ore direct to the new mill. The orebody has been opened by three tunnels and enough ore blocked out to warrant the erection of a milling plant. Several cars of the ore have been shipped crude under leases.

CUSTER COUNTY

The Empire Copper Co. is working about 150 miners at the present and the property is being worked at 32 different points. The showing throughout the property is very satisfactory and it is expected that the production for the present year will greatly exceed that of last year.

MICHIGAN

HOUGHTON COUNTY

Four months after the commencement of the strike in the local copper mines, finds the Calumet & Hecla company producing its normal tonnage of 'rock.' The last week of October the rock tonnage was increased to 7300 tons per day, within 1000 tons of the average before the strike

started. The Calumet & Hecla does not now need any further additions to its underground working forces. The new trammers are better, on the average, than the workmen who continue to strike, in that they can do better work and less time is required to oversee their operations as they understand instructions in English. While the other mining companies have not succeeded as well as the Calumet & Hecla, tonnages at all of them have shown steady increase, and some of the subsidiaries are now running about normal. Superior made a shipment November 1 of 50 tons of rock, and one Monday of 450 tons. This is a remarkably good showing. The Copper Range Consolidated mines, Trimountain, Baltic, and Champion are operating short handed. F. W. Denton held off longer than any of the other mine managers before sending outside for trammers and miners. He was particularly anxious to give all of his old employees the first chances at the jobs, feeling that they were unfortunately misled into the strike and that should not be made to suffer. However, the Copper Range received large additions to the working forces this week. Most of these men came from Chicago, where the steel plants are laying off men rapidly. A few are coming from the iron mines of the Crystal Falls district, where they are suspending operations at some of the mines and curtailing forces at some others.

At the Naumkeag and the Phoenix shaft-sinking is in progress. At the Naumkeag the exploration shaft is down and the first cross-cut well advanced. Both the shaft and the cross-cut are in the ore formation. It is not, however, showing any remarkable richness in copper content. At the Phoenix property of the Keweenaw Copper Co. a temporary hoist is in operation while the permanent hoist, removed from the Mandan, is being erected. A force of 25 men is employed.

The operations on the White Pine property, a Calumet & Hecla subsidiary, in Ontonagon county, continue to be satisfactory. Two shafts are in use and a third will be working before long, as the underground openings, including an upraise, have been extended. The Nonesuch lode continues to show commercial copper in the lower workings. The lode is narrow, but unusually rich, and the probability of securing a substantial amount of copper is not doubted. There has been no interference with the operations at this mine because of the strike.

MISSOURI

Jasper County

Incorporation papers have been issued by the Secretary of State for the organization of the Kentucky Lead & Zinc Co. of Joplin. The capital stock of the Company is $1,000,000. Preparations are being made to conduct extensive mining operations on the Chitwood property. A mill will be moved to the property and be in operation within the next few weeks. A good tonnage of ore has been developed, and is ready to be milled.

The Investors' Realty Co. recently purchased thirty acres of ground from the Queen City Lead & Zinc Co. The ground is considered most desirable property. It is understood that development work will be started at once.

A second shaft is being sunk on the Snapp property at Thoms station. The ore which has been mined has shown a recovery of 10% zinc. Several drifts have been made in the formation at a depth of 177 ft. which are all in ore. The ground is soft and requires much timbering.

The Imperial mill, which is being operated by the firm of Weeks & Briggle on the Kelly property to the north of Webb City is producing a large weekly tonnage of both lead and zinc concentrate. The ground which is being worked contains two sheet formations, one at a depth of 165 ft., which is from 12 to 15 ft. thick, and the other at a depth of 182 ft., which is 12 ft. thick.

Unless the large pumping plant at the Providence mine in the district north of Webb City is kept in operation, fear is expressed that a large part of the mines of that district will be flooded due to the rising waters in the old Yellow Dog mine. The water will affect 17 of the largest mines in the district. At present the pumping plant at the Providence is draining this ground, and as no remuneration is being received for this work, the Providence company is reported to be about to close down the pumping plant unless the mines which are being drained by this plant will pay a part of the operating expense. The danger from water began when the Underwriters Land Co. closed down the Yellow Dog mine. The pumping plant at that mine discharged 3000 gal. of water per minute and the water was kept below the level where mining operations were conducted. When the big pumps were taken out and the land abandoned the water gradually began rising in the drifts until the underground workings of the Yellow Dog mine are a great lake, covering forty acres of land. The water has risen and overflowed the abandoned drifts on other tracts of land north of Webb City and has now reached a sufficient height to endanger every mine in that part of the district.

A new discovery was recently made by O. W. Sparks, 300 ft. to the east of the Yellow Pup mine. The new shaft is above the plant at the Yellow Pup mine and a tramway has been completed from the shaft to the mill. Ore is trammed to the hopper by gravity and it is only necessary to haul the empty cars back up the hill. The tramway is about 300 ft. long. The new deposit of ore is said to be richer and thicker than those being worked at the Yellow Jacket and Yellow Pup mines. Apparently, the run of ore in the new shaft covers a wide area and that being taken from the drifts shows a good mill recovery. The ore taken from the two mines is of high grade and is not penalized, save for moisture. There is no iron and the metallic content always is above 60%, sometimes running as high as 63%. There is a 200-ton mill at the Yellow Pup and one of 150-ton capacity at the Yellow Jacket mine. During the past few months considerable development work has been done at both mines and some new ground has been opened.

MONTANA

Silverbow County

(Special Correspondence.)—The Anaconda Copper Mining Co. is making preparations to reopen the shaft on the Nettie-Philadelphia group in the West Butte district. During the past week four large boilers have been transported to the property and numerous buildings have been built on the surface. It is proposed to sink the shaft, from its present level of 450 ft., to a depth of 2000 ft. This will develop the old silver belt on which not much work has been done since the closing of the old Blue Bird mine in the nineties. At that time some 20,000 tons of silver ore from the Nettie was milled in the old Colorado mill, but owing to the fact that a great deal of the silver mineral floated in the slime, a recovery of a little better than 50% of the silver content was the best that could be made by concentration. A process of double concentration and cyanidation has since been developed by John E. Rothwell and Carl J. Trauerman and experimented with in the Butte Central mill. By this process it is possible to treat the silver ores of the West Butte district and make a recovery of practically all of the gold and 85% of the silver at a small treatment cost. This treatment has been claimed to be successful even in the presence of 30% zinc and 2% copper, when in the shape of sulphides. It is possible that the reopening of the Nettie, together with the successful working out of the process to recover the gold, silver, copper, and zinc from these ores will mean the rejuvenation of some of the old silver mines of Butte, such as the Lexington, Spruce, Travona, Little Darling, Blue Bird, and Germania. A great many options have lately been taken in this district on properties to the north of the Nettie, and it is said that a company to take over these options and reopen the mines has been formed by ex-Governor McDowell of Montana.

Butte, Montana, November 8.

A reorganization of the Butte Central company is under way in Boston. Plans have been submitted which are said to have been accepted by the principal interests in the Company, and the revamping of the enterprise is assured. The capitalization of the new Company will probably be about $750,000. It will start business, apparently, with all the overhanging indebtedness cleaned up, some money in the treasury, a splendid type of mill, and a mine opened up to the 500-ft. level. At last accounts it was

understood that the basis of reopening the property would be the operation of the new mill, built by John E. Rothwell, as a custom plant for the concentration of Butte argentiferous ores, and the mine would be worked by lessees for the present, the earnings from these two sources to be used in developing the property below the 500-ft. level, as the prospects of finding copper are considered good by practically all the engineers who have made examinations. The presence of the Rarus fault zone at the 500-ft. level has occasioned some dispute as to upon which side of the fault the orebody occurs.

MADISON COUNTY

The Idaho Development Co. is prospecting the placer property of the Alder Gulch Consolidated Mining Co., situated in Alder gulch near Virginia City. A drilling machine is working under direction of E. A. Thurston.

NEVADA

ESMERALDA COUNTY

The estimated October production of the Goldfield Consolidated Mines Co. is as follows:

Total tons mined	30,483
Gross value recovered	$337,000
Operating expenses	183,000
Net realization for month	154,000

Work has been suspended in the 509 drift on the 500-ft. level of the Hornsilver Mining Co. because of a lack of timbers. The vein at this point is 24 ft. wide and contains about two feet of milling ore. The ore which has been developed on the 300-ft. level has shown some good assays, although the average assay shows that it will be difficult to stope ore of a milling grade. A winze was sunk from this level for a depth of 51 ft., but has failed to develop ore of a shipping grade, the average assay being about $6 per ton. Work on the 303 drift has developed a good grade of ore, some of it assaying as high as $38 per ton; this ore, however, occurs in pockets. While the work, to date, has yielded no direct results in the way of smelter returns, Weldon B. Morris, the general superintendent, is hopeful and believes that the present outlook is encouraging.

The Nevada Wonder Mining Co. recently declared a dividend of 10c. per share, which is the second to be paid by the Company. The Company has been operated on a profit-making basis for the past year. Announcement has been made that dividends will be paid semi-annually in the future. The Company is making regular shipments of bullion to the mint.

LINCOLN COUNTY

The Amalgamated Pioche Mines & Smelter Corporation has shipped 70 cars of ore, since last August, having a value of about $25,000. A number of improvements are being made, and there is ample evidence that the owners of the property have faith in its future.

LYON COUNTY

It is reported that no dividend will be declared this year on the shares of the Mason Valley Mines Co. The Company is shipping from 2000 to 2500 tons of ore per week, and the development work which is being done is putting in sight more ore than is being shipped. It is believed that the report for this year will show that large profits have been earned.

The last round of holes shot in the face of the Ludwig 8th level of the Nevada-Douglas property broke into ore running 10.4% copper. This ore is a secondary chalcocite mixed with about an equal amount of native copper in a sugar quartz gangue. It means that the 8th level is in the zone of secondary enrichment; that the primary ores have not yet been encountered, and that from the 800 to the 700-ft. level the ore is of about the same character and richness as on the 700-ft. level.

On Douglas hill a drift has been started from the Iowa raise toward the Orem winze. This drift is 25 ft. below the Douglas tunnel level and is in 50 ft. in ore, and with the present face showing ore running 5% copper. As this ore dips down and toward the Orem winze, a drift has been started which will cut it on its dip. The production of copper for the month of September was 426,101.97 lb., which at 16¾c. per pound (the present selling price of the metal) shows a gross income of $71,371.91 for the month. The month also shows a gain in the gross income of $10,941.21 over the month of August.

NYE COUNTY

The new orebody which was recently opened on the 600-ft. level of the Tonopah Mining Co.'s property gives promise of becoming a good producer. The vein was encountered in a south cross-cut from the end of the southwest drift of the Mizpah shaft in the Valley View claim and close to the eastern boundary of the West End mine.

It has been announced that the Jim Butler company will begin sinking the Wandering Boy shaft from the seventh to the eighth level and develop the orebodies which are known to exist at this depth. It is also proposed to start a north cross-cut from this level for the purpose of cutting the extension of the new orebody which has been exposed by the Tonopah Mining Co. in the Valley View claim. It is believed that this vein enters the Jim Butler property at a depth of from 700 to 800 ft. The Company is also planning to cross-cut from the Desert Queen shaft on the South vein of the Tonopah Mining Co. up to the Jim Butler boundary line. In the Desert Queen mine, from the 700-ft. level to the 1000-ft. level, the ore was from 4 to 8 ft. wide and of good grade, and there is therefore every reason to believe that a good grade of ore will be opened from the same vein on the Jim Butler property.

Development work on the 400-ft. level of the Tonopah Extension property has resulted in opening what is believed to be the western extension of the North Vein, which has now been penetrated for a distance of seven feet without finding the foot-wall. The vein occurs in a trachyte formation, and it is estimated that it will only be necessary to do about 50 ft. of cross-cutting from the main west drift of the mine to open it on the 500-ft. level, which work will be commenced immediately. Another important development in the property was in stope 51-6 west, on the 500-ft. level, where on the hanging wall of the stope a splendid body of ore, 6 ft. wide, has been broken into. The full extent of this orebody is not yet known, as the metal extends into the hanging wall formation of the vein and sufficient exploration of the vein has not yet been done to determine the full width of the ore. Development from the new main working shaft continues to be most satisfactory.

WHITE PINE COUNTY

A new company has been organized, which is known as the Silver Mining & Leasing Co., to operate in the White Pine district. The Company has purchased the Zadow group in Rocco cañon. A good production from one of these claims was made a number of years ago. The development work consists of a shaft 265 ft. deep, from the bottom of which a drift was run for a distance of 100 ft. This drift will be continued, as it is believed to be within 50 ft. of one of the principal ore-bearing fissures.

NEW MEXICO

SOCORRO COUNTY

(Special Correspondence.)—Four bars of bullion were expressed to the mint last week from the Deadwood mines. Ore treated during the period was 380 tons. A regular daily shipment of 40 tons from the Little Charlie mine to the custom mill has been maintained for the past two months. A large ore reserve has been developed. The property is owned by the Mogollon Gold & Copper Co. and operated by a Los Angeles firm of lessees which also holds a bond to purchase. The Pacific Mines Co. is shipping 25 tons of ore per day to custom works. Development in the mine is quite encouraging and the ore reserves are increasing. The electrical equipment purchased several months ago is being installed. Lessees of The Oaks Co. have sunk B winze in the East End tunnel group 25 ft., obtaining approximately 26 tons of ore from same. An additional 25 ft. will be sunk, after which stoping will be commenced. During October, 33 bars of bullion, weighing approximately 1¾ tons, were shipped to the mint from the Socorro Mining & Milling Co. and a large

amount of concentrate was sent to the smelter. The ore treated was about 5400 tons for the month. The deepest heading in the mines, 900 ft., continues to yield a good grade of mill ore; occasional pockets of high grade are encountered. An auxiliary water-supply has been established at the Ernestine Mining Co. by sinking a well in the cañon about one-half mile from the mill and installing an electric pump. Sinking of the main shaft is progressing nicely. The mill is now treating from 160 to 175 tons of ore per day.

Mogollon, November 3.

OREGON

Josephine County

(Special Correspondence.)—The winter rains have started a number of the hydraulic placers. Thomas Wilson, of Nevada, has bought the Grand Prize placer, of Sucker Creek district, discovered by T. M. Anderson last February. The price to be paid is $100,000, of which a substantial part was handed over; Mr. Anderson to retain one-fourth the net profits of the mine till settlement is made in full. The Grand Prize is in a dry gulch well up on the Siskiyou, near the California line. There being no water available, Mr. Anderson has followed the plan of packing the dirt by burro down the mountain over a rough trail to the nearest stream. It has yielded average returns of $25 per yard. The deposit is reported 200 ft. wide and over 1500 ft. long, and has been opened to a depth of 200 ft. The new owner has already begun the placing of hydraulic equipment and will operate one or two giants with water brought from Lake creek. The Almeda smelter, on Rogue river, near Galice, has managed to keep in operation for some time by running a line of motor trucks between the property and the Beaver cement plant, near Gold Hill. Each truck makes a round trip every day, hauling a load of lime to the smelter, and on the outward trip taking a load of matte as far as Merlin, where it is loaded on the cars for shipment.

Grants Pass, November 8.

UTAH

Salt Lake County

A meeting of capitalists from various parts of the United States and Canada was recently held in Salt Lake City for the purpose of formulating plans for the development of the iron and coal deposits of Utah and the establishment of a large steel plant at San Diego. An extensive report of the coal and iron resources of the Colorado river basin has been made by R. E. Clapp and the properties will be selected by Julian Kennedy of Pittsburgh. Details have not as yet been made public, but it is believed that a great impetus is about to be given to the coal and iron industry of Utah.

CANADA

British Columbia

Plans have been perfected by the Hedley Gold Mining Co. for a power development on the Similkameen river. The scheme comprises a concrete dam on the river a little below the mouth of Twenty-mile, with a head-gate on the north bank of the river leading into a flume which will extend down the river for 1800 ft. to a bridge and viaduct which will carry the flume across to the other side of the river. For this flume about a million and a half feet of lumber will be required and the cement used in the dam and at the power-house will likely total about 3000 bbl. Electricity will be generated at 6600 volts and will supply a 1500-hp. unit. While no scheme for enlargement of the mill has yet been decided on, it is generally believed that work for increasing the capacity of the mill by at least 50% will be commenced soon.

Ontario

(Special Correspondence.)—Nothing of particular importance has been developed in the Swastika district during the past few weeks and conditions are less encouraging. The Swastika mine has been reopened, but it is not believed this will lead to anything except further loss of money to those who are financing the property. The Burnside mine in Kirkland Lake has been closed and it is stated that lack of funds is responsible for the cessation of work. C. A. Foster has gone to London with the object, it is believed, of disposing of the Tough-Oakes property. No information is as yet available, however, regarding this.

Swastika, November 5.

The report of the Buffalo Mines, Ltd., for the month of September shows the following:

Mill ran, hours	605½
Ore milled, tons	5,744
Average assay per ton before milling, ounces	20.83
Silver recovered, ounces	99,043.00
Silver paid for during month, ounces	207,054.00

The ore treated during August and September came from old stock-piles. Dividends No. 53 of 5% and No. 54 of 15% were paid on October 1. The total dividends which have been paid amount to $2,437,000.

MEXICO

Sonora

Sinking is progressing well at the Calumet & Sonora mine, northwest of Cananea. The dry mill is treating old concentrate, and the wet mill is closed at present. La Cobriza Mining Co. is to resume work at its mine and smelter west of Noria. The Moctezuma Copper Co. will develop its Churunibabi mine, near Nacozari, until recently leased by Norton Hand. The Santa Rosa, east of Cabullona, has been leased to J. E. Englent and H. F. Brown.

NICARAGUA

During September, 1790 tons of ore yielding $12,000 was treated at the Oroya Leonesa mine. The west drift, 105 ft. below No. 1 adit was extended 39 ft., averaging $10.20 in gold and 63c. per ton in silver.

Personal

Professional men are invited to send news of their engagements and travels. Such news is interesting to friends.

B. L. Thane is down from Juneau.

Rene E. Hazard is now at Angers, France.

James Parks was in San Francisco this week.

Erroll MacBoyle was in San Francisco over Sunday.

W. H. Radford has gone to Oregon to examine property.

W. J. Patterson has returned from a trip through Nevada.

Desaix B. Myers will be at Nevada City until November 21.

N. H. Ruby came up from Durango by way of Mazatlan last week.

Warren D. Smith has returned to Manila from a trip through China.

George A. Packard has left Butte for Boston, where he will be for some weeks.

F. Danvers Power is in San Francisco on his way from the Malay States to London.

Howard M. Black, of Grass Valley, is examining mines near Crested Butte, Colorado.

Huntington Adams has gone to New York City, where his address is 115 East 80th street.

James Irving examined the 'Star of the West' mine in Inyo county, California, last week.

Arthur Winslow is in the hospital recovering from the effects of an operation. He is doing nicely.

Frank H. Probert passed through San Francisco this week, going from Plumas county to Los Angeles.

G. D. Kislingbury has come up to Los Angeles from Rosario, the inability to get supplies having forced the closing of the Minas del Tajo.

George H. Garrey, chief geologist for the American Smelting & Refining Co., is considering opening an office for consulting work in San Francisco.

The United States Civil Service Commission announces a competitive examination for positions as oil and gas inspector for the Bureau of Mines. Salary $1800 to $2500.

M. L. Jandorf, who has been studying the limestones of York county for the Pennsylvania Geological Survey, has taken the position of process foreman for the Standard Chemical Co. at Canonsburg, Pennsylvania.

The Metal Markets

LOCAL METAL PRICES

San Francisco, November 13.

Antimony	10–10½c	Quicksilver (flask)	$39
Electrolytic copper	17½–17¾c	Tin	44–45½c
Pig lead	4.00–4.05c	Spelter	7–7½c

Zinc dust, 100 kg. zinc lined cases, 7½ to 8c. per pound.

EASTERN METAL MARKETS.

(By wire from New York.)

NEW YORK, November 13.—The copper market is weak and a general decline is to be noted in copper stocks. Lead and spelter are dull and but few sales have been reported. The London copper market is slightly firmer, with spot quoted at £58 and futures at £67 10s. Antimony is dull, with Cookson's quotation at 7.60c. Tin is firm, with spot at 39.37½ to 39.62½. China is at present on the selling side of the silver market. India has made its purchases for the time being and financial difficulties at Bombay have caused a further easing of the market.

SILVER

Below are given the average New York quotations, in cents per ounce, of fine silver.

Date.		Average week ending	
Nov.	6	Oct. 1	61.68
"	7	" 8	61.27
"	8	" 15	61.12
"	9 Sunday	" 22	61.14
"	10	" 29	59.98
"	11	Nov. 5	59.52
"	12	" 12	59.62
	59.87		
	59.75		
	59.50		
	59.50		
	59.87		
	59.25		

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	56.25	63.01	July	60.67	58.70
Feb.	59.06	61.25	Aug.	61.32	59.32
Mch.	58.37	57.87	Sept.	62.95	60.53
Apr.	59.20	59.26	Oct.	63.16	60.88
May	60.88	60.21	Nov.	62.73	....
June	61.29	59.03	Dec.	63.38	....

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.		Average week ending	
Nov.	6	Oct. 1	4.61
"	7	" 8	4.33
"	8	" 15	4.40
"	9 Sunday	" 22	4.35
"	10	" 29	4.35
"	11	Nov. 5	4.20
"	12	" 12	4.19
	4.19		
	4.19		
	4.19		
	4.19		
	4.19		
	4.19		

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	4.43	4.28	July	4.71	4.35
Feb.	4.03	4.33	Aug.	4.54	4.60
Mch.	4.07	4.32	Sept.	5.00	4.70
Apr.	4.20	4.36	Oct.	5.08	4.37
May	4.20	4.34	Nov.	4.91	....
June	4.40	4.33	Dec.	4.20	....

COPPER

Quotations on copper as published in this column represent average wholesale transactions on the New York market and refer to electrolytic copper. Lake copper commands normally from 1-5 to 1-4c. per lb. more. Prices are in cents per pound.

Date.		Average week ending	
Nov.	6	Oct. 1	16.29
"	7	" 8	16.27
"	8	" 15	16.11
"	9 Sunday	" 22	16.38
"	10	" 29	16.55
"	11	Nov. 5	16.25
"	12	" 12	15.54
	15.75		
	15.65		
	15.60		
	15.60		
	15.40		
	15.25		

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	14.09	16.54	July	17.19	14.21
Feb.	14.08	14.93	Aug.	17.49	15.42
Mch.	14.68	14.72	Sept.	17.56	16.23
Apr.	15.74	15.22	Oct.	17.32	16.31
May	16.03	15.42	Nov.	17.31	....
June	17.23	14.71	Dec.	17.37	....

The copper market weakened last week, and with the publication of the Copper Producers' figures, on November 7, showing an increase of 2,700,000 lb. in stocks, the market remained dull. 'Second-hand' copper was available at 16¾c., but little business was being done. The visible supply in England, France, and afloat on November 1 was given as 21,380 tons, a decrease of 534 tons, in two weeks, while the German stocks were given at 4476 tons, a decline of 366 tons since October 15. The London market has been steadily weakening, showing a decline of £6 10s. per ton in the past two weeks.

The German consumption of foreign copper for the first seven months of the year, according to L. Vogelstein & Co., was as follows:

	Tons.
Imports of copper	153,154
Exports of copper	6,584
Consumption of copper	146,570

This may be compared with a consumption of 136,411 tons for the same period in 1912. Of the above quantity, 133,425 tons was imported from the United States.

ZINC

Zinc is quoted as spelter, standard Western brands St. Louis delivery, in cents per pound.

Date.		Average week ending	
Nov.	6	Oct. 1	5.39
"	7	" 8	5.24
"	8	" 15	5.28
"	9 Sunday	" 22	5.10
"	10	" 29	5.25
"	11	Nov. 5	5.13
"	12	" 12	5.09
	5.09		
	5.09		
	5.09		
	5.09		
	5.09		
	5.09		

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	6.42	6.88	July	7.12	6.11
Feb.	6.50	6.13	Aug.	6.96	5.51
Mch.	6.57	5.91	Sept.	7.45	5.55
Apr.	6.63	5.52	Oct.	7.36	5.22
May	6.68	5.23	Nov.	7.23	....
June	6.88	5.00	Dec.	7.09	....

Straits shipments in October were about the same as in September, and the visible supply on November 1 was 11,857 tons, a decrease of about 1000 tons as compared with last year. As a result, the market was firmer. Contracts for tin plate for 1914 are all being made on the basis of $3.40 per base box, which corresponds to a reduction in price of $2 per ton.

QUICKSILVER

The primary market for quicksilver is San Francisco, California, being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending			Week ending	
Oct.	15	39.00	Oct. 29	40.00
"	22	39.00	Nov. 5	39.00
			" 12	39.00

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	43.75	39.37	July	43.00	41.00
Feb.	46.00	41.00	Aug.	42.50	40.50
Mch.	46.00	40.20	Sept.	42.12	39.70
Apr.	42.25	41.00	Oct.	41.50	39.37
May	41.75	40.25	Nov.	41.50	....
June	41.30	41.00	Dec.	39.75	....

TIN

New York prices control in the American market for tin, since the metal is almost entirely imported. San Francisco quotations average about 5c. per lb. higher. Below are given average monthly New York quotations, in cents per pound:

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	42.53	50.45	July	44.25	40.70
Feb.	42.96	49.07	Aug.	45.80	41.75
Mch.	42.58	46.95	Sept.	48.64	42.45
Apr.	43.92	49.00	Oct.	50.01	40.61
May	46.05	49.10	Nov.	49.92	....
June	45.76	45.10	Dec.	49.80	....

Copper

According to L. Vogelstein & Co., copper has shown great firmness during the recent dull period, owing in large part to the strong statistical position of the metal. It seems impossible that during a period when complaints as to the volume of business have been so universal, the consumption of copper, both here and abroad, should have exceeded that of any previous year. Such excess consumption to the end of September amounted to almost 100,000,000 lb. as compared with last year, while the production increased approximately only half that amount. Hence last year's 26,000,000 lb. decrease of domestic stocks January to September, has this year jumped to a decrease of 76,000,000 lb. The results over a period of years make the following remarkable showing—foreign and domestic stocks included:

	Pounds.
On hand September 30, 1911	311,392,456
1912	154,614,387
1913	81,568,454

The Stock Markets

SAN FRANCISCO STOCKS AND BONDS

(San Francisco Stock and Bond Exchange.)

BONDS

November 13.

Listed.	Bid	Ask	Unlisted.	Bid	Ask
Associated Oil 5s	$ 97½	99½	General Petroleum 6s	$—	55
E. I. du Pont 4½s	—	87	Natomas Dev. 6s	99	—
Natomas Con. 6s	—	[illegible]	Pac. Port. Cement 6s	99½	—
Unlisted.			Standard Cement 4s	90	—
Asa. Oil 5s	78½	—	Santa Cruz Cement 6s	82½	—

STOCKS

Listed.	Bid	Ask	Unlisted.	Bid	Ask
Amalgamated Oil	77	—	Mascot Copper	—	2½
Associated Oil	38	38½	Noble Electric Steel	2½	—
Giant	86½	[illegible]	Natomas Consol	5	—
Pac. Cst Borax, com	—	100	Pacific Port. Cement	63	75
Pacific Crude Oil	—	35c	Riverside Cement	45	—
Sterling O. & D.	85c	—	Santa Cruz Cement	44	47½
Union Oil	55	—			

NEVADA STOCKS

(By courtesy of San Francisco Stock Exchange.)

San Francisco, November 13.

Atlanta	$ .10	Mizpah Extension	$ .30
Belcher	.32	Montana-Tonopah	1.02
Belmont	7.00	Nevada Hills	.47
Big Four	.15	North Star	.41
Cash Boy	.07	Ophir	.23
Florence	.23	Pittsburg Silver Peak	.35
Goldfield Con.	1.42	Round Mountain	.38
Goldfield Oro	.08	Sierra Nevada	.09
Halifax	1.30	Tonopah Extension	1.52
Jim Butler	.66	Tonopah Merger	.66
Jumbo Extension	.09	Tonopah of Nevada	4.60
MacNamara	.09	Union	.14
Mexican	1.35	West End	1.25
Midway	.38	Yellow Jacket	.29

COPPER SHARES—BOSTON

(By courtesy of J. C. Wilson, Mills Building.)

November 13.

	Bid	Ask		Bid	Ask
Allouez	$ 33½	34	Mohawk	$ 40½	41
Ariz. Commercial	4½	4¾	Nevada Con.	14¾	14¾
Butte & Superior	30	30½	North Butte	22¾	23½
Calumet & Arizona	62¾	63	Old Dominion	47	48
Calumet & Hecla	401	404	Osceola	73½	75
Copper Range	36½	37	Quincy	55	56
Daly West	2¼	2½	Shannon	6¾	6¾
East Butte	10½	10¾	Superior & Boston	2½	2¾
Franklin	3	3½	Tamarack	26½	28
Granby	68¾	68¾	U. S. Smelting, com.	36½	37
Greene Cananea	31	31¾	Utah Con.	.8	8½
Isle-Royale	17¾	17½	Winona	1¾	2
Mass Copper	2¾	3	Wolverine	41	42

NEW YORK CURB QUOTATIONS

(By courtesy of E. F. Hutton & Co. Kohl Building.)

November 13.

	Bid.	Ask.		Bid	Ask
Braden Copper	6½	6¾	McKinley-Dar.	1⅛	1⅜
Braden 6s	135	145	Mines Co. Am.	2	2¼
B. C. Copper	2½	2⅝	Nipissing	7⅞	8
Davis-Daly	1½	1⅝	Ohio Copper	¼	½
Dolores	2	4	San Toy	18	22
El Rayo	1	2	Sioux Con.	1	2
Ely Con.	2	5	So. Utah	¼	⅜
First Nat.	2⅞	3⅛	S. O. Calif.	191	193
Greene Can.	6	7	Tri Bullion	⅛	¼
Giroux	1⅛	1½	Tuolumne	¾	1
Iron Blossom	1.05	1.15	United Copper	1	2
Kerr Lake	4⅜	4½	Weetlaufer	10	13
La Rose	1¾	1⅞	Yukon Gold	2	2¼
Mason Valley	4	4¼			

NEW YORK STOCK EXCHANGE

(By courtesy of J. C. Wilson, Mills Building.)

November 13.

	Bid	Ask		Bid	Ask
Alaska G. M.	$ 20½	20¾	Miami	21½	22
Amalgamated	70⅛	70½	Nat. Lead	42¼	44
Anaconda	34	34½	Quicksilver, com.	2	2½
A. S. & R.	61½	61¾	Ray Con.	18⅛	18½
Calif. Pet.	16¾	18	Tenn. Copper	28¼	28¾
Chino	38¼	38¾	U. S. Steel, pfd.	105	105¼
Guggenheim Ex.	44¼	44¾	U. S. Steel, com.	55¼	55¾
Mexican Pet	45¼	45¾	Utah Copper	49¼	49½

LONDON QUOTATIONS

(By cable, through the courtesy of Catlin & Powell Co., New York.)

November 13.

	£	s.	d.		£	s.	d.
Alaska Mexican	1	15	0	Kern River Oilfields	0	6	3
Alaska Treadwell	[illegible]	2	6	Mexico Mines	5	5	0
Alaska United	3	15	0	Messina	1	7	6
Arizona	1	15	0	Oroville	0	6	3
California Amalg.	0	1	[illegible]	Pacific Oilfields	0	2	6
California Oilfields	6	0	0	Rio Tinto	72	5	0
Camp Bird	0	13	9	Santa Gertrudis	0	17	6
El Oro	0	13	9	Stratton's	0	2	6
Esperanza	0	16	9	Tanganyika	2	16	9
Granville	0	11	3	Tomboy	1	6	3

AUSTRALASIAN

November 13.

	£	s.	d.		£	s.	d.
British Broken Hill	[illegible]	17	6	Mount Boppy	0	16	9
Broken Hill Prop.	1	15	0	Mount Elliott	4	[illegible]	9
Golden Horse-Shoe	2	7	6	Mount Lyell	1	5	0
Great Boulder Prop.	0	12	6	Mount Morgan	3	10	0
Ivanhoe	2	16	9	Waihi	2	15	0
Kalgurli	1	11	3	Waihi Grand Junc.	1	5	0

Copper Producers' Association Report

The Copper Producers' Association statement, November 7, shows an increase in production and stocks on hand. The details are as follows:

	Pounds.
Stock of marketable copper of all kinds on hand at all points in the United States, October 1, 1913	29,793,094
Production of marketable copper in the United States from all domestic and foreign sources during October	139,070,481
Deliveries for consumption, October	68,173,720
Deliveries for export, October	68,123,478
Stock of marketable copper of all kinds on hand and at all points in the U. S., November 1	32,566,382

Recent changes in surplus have been as follows, in pounds:

	Increase.	Decrease.
September 1912	16,364,213	.....
October	13,679,380	.....
November	9,419,095	.....
December	19,148,523	.....
January 1913	17,885,770	.....
February	.....	896,134
March	.....	18,032,928
April	.....	28,720,162
May	.....	8,074,883
June	.....	14,569,619
July	690,339	.....
August	.....	15,280,908
September	.....	8,531,043
October	2,773,288	.....

The Aluminum Industry

The report recently issued by the Aluminum Industrie Gesellschaft, which owns the large works at Neuhausen, Switzerland, shows net profits for the year of $717,000, against $448,800 in 1911, and dividends were 20%, against 14% in 1911. The very low prices of aluminum which prevailed for some time resulted in many new uses being found for aluminum, which favorably influenced the development of the industry and enabled the whole Swiss production to go into consumption. As to the aluminum industry in the United States, it may be said that the market during the latter part of 1912 was brisk; later the demand has exceeded the supply. The Aluminum Company of America has been making serious efforts for some time past to increase its production, but has been confronted with difficulties in securing an adequate source of supply of electric power. It has, however, secured certain riparian rights in North Carolina and Tennessee. The development of this water-power is contemplated. Until its own power development is completed, the Company will use power supplied by the Tennessee Power Co. from its development on the Ocoee river, near Chattanooga; this new aluminum plant will, it is planned, be in operation by the latter part of 1913.

Monthly Copper Production

AHMEEK COPPER MINING CO., Kearsarge, Michigan. $1,250,000 in $25 shares. 24,796 shares owned by Calumet & Hecla; 1800-ton mill at Hubbell, concentrate smelted by Calumet & Hecla smelter.

Month.	Pounds.	Month.	Pounds.
April	1,503,535	June	1,281,980
May	1,061,995	July	1,020,500

ALLOUEZ MINING CO., Allouez, Michigan. $2,500,000 in $25 shares; controlled by the Calumet & Hecla, which owns 43,000 shares and $250,000 in notes of the Company; ore is milled by the Lake Milling, Smelting & Refining Co., in which the Allouez owns a half interest.

Month.	Pounds.	Month.	Pounds.
April	603,210	June	556,675
May	475,535	July	398,565

ANACONDA COPPER MINING CO., Butte, Montana. $108,312,500 in $25 shares; controlled through Amalgamated Copper Co. by Thos. F. Cole, J. D. Ryan, and Standard Oil interests; 10,000-ton concentrator and smelter at Anaconda; 5000-ton concentrator and smelter at Great Falls, Mont.; also 70-ton electrolytic refining plant at Great Falls. Production figures include copper from all companies which ship custom ore to Anaconda smelters.

Month.	Pounds.	Month.	Pounds.
April	23,800,000	August	22,500,000
May	25,600,000	September	22,600,000
June	21,500,000	October	18,400,000
July	21,181,000		

ARIZONA COPPER CO., LTD., Morenci, Arizona. £379,974 in 5s. shares; controlled by Edinburgh investors; mill at Morenci is being enlarged to 3000-ton capacity and a new 1200-ton smelter near Clifton has just been started.

Month.	Pounds.	Month.	Pounds.
April	3,100,000	August	1,800,000
May	3,200,000	September	1,800,000
June	3,000,000	October	3,550,000
July	2,600,000		

COMPANIE du BOLEO, Santa Rosalia, Baja California, Mexico. Fr. 12,000,000 in Fr. 100 shares; owned by Rothschild, Paris, interests and the Banque Mirabaud; 4000-ton smelter; matte and black copper shipped to Europe.

Month.	Pounds.	Month.	Pounds.
January	2,658,880	April	2,811,200
February	2,535,680	May	2,424,800
March	2,204,720	June	1,984,640

BRADEN COPPER CO., La Junta, Chile. $2,332,030 in $10 shares and $4,000,000 in 6% convertible bonds; entire stock held by Braden Copper Mines Co.; $12,000,000 in $5 shares; $5,000,000 in convertible bonds; controlled by Guggenheim interests; two mills at La Junta; 3000-ton capacity smelter at Raucagua.

Month.	Pounds.	Month.	Pounds.
April	1,148,000	August	1,572,000
May	1,481,000	September	1,322,000
June	1,808,000	October	2,600,000
July	1,046,000		

BRITISH COLUMBIA COPPER CO., LTD., Greenwood, B. C. $2,958,545 in $5 shares; controlled by Newman Erb; 600-ton sampling plant and 2500-ton smelter.

Month.	Pounds.	Month.	Pounds.
June	634,238	September	626,761
July	618,379	October	688,000
August	700,000		

CALUMET & ARIZONA MINING CO., Warren, Arizona. $6,285,710 in $10 shares; has absorbed the Superior & Pittsburg Copper Co. by stock exchange; controlled by Hoatson and other Lake Superior interests; 3000-ton smelter at Douglas.

Month.	Pounds.	Month.	Pounds.
April	4,500,000	July	3,800,000
May	4,300,000	August	4,500,000
June	3,000,000		

CALUMET & HECLA MINING CO., Calumet, Michigan. $2,500,000 in $25 shares; controls the Ahmeek, Allouez, Centennial, Isle Royale, La Salle, Osceola, Tamarack, and Superior copper mining companies as well as a number that are non-productive; controlled by Agassiz and Shaw interests; 2 mills on Lake Linden, capacity 15,000 tons; smelter Hubbell, Mich.; electrolytic refinery and smelter at Buffalo, N. Y.; figures include output of subsidiaries.

Month.	Pounds.	Month.	Pounds.
April	10,582,870	June	9,743,300
May	10,765,400	July	7,642,163

CANANEA CONSOLIDATED COPPER CO. S. A., Cananea, Sonora, Mexico. Capital ₱20,000 in shares of ₱100; entire stock owned by Greene Consolidated Copper Co.; $10,000,000 in $10 shares; 945,320 shares are held by Greene-Cananea Copper Co.; $50,000,000 in $100 shares, which is controlled by Thos. F. Cole and J. D. Ryan; 2 mills and smelter at Cananea, 3000-ton capacity.

Month.	Pounds.	Month.	Pounds.
April	3,581,000	August	3,146,000
May	3,272,000	September	3,148,000
June	2,908,000	October	3,160,000
July	3,328,000		

CENTENNIAL COPPER MINING CO., Calumet, Michigan. $3,250,000 in $25 shares; 44,250 shares are held by Calumet & Hecla Mining Co.; ore milled by Lake Milling, Smelting & Refining Company.

Month.	Pounds.	Month.	Pounds.
April	243,295	June	193,295
May	153,010	July	195,455

CERRO de PASCO MINING CO., Cerro de Pasco, Peru. $10,000,000; entire stock held by Cerro de Pasco Copper Co.; $60,000,000 in $1 shares which is owned by Cerro de Pasco Investment Co., which is controlled by J. B. Haggin, and Morgan estate; 3000-ton smelter at La Fundicion; monthly production figures not given out; output in 1912 was 45,000,000 lb. copper.

CHINO COPPER CO., Santa Rita, New Mexico. $3,500,000 in $5 shares; 121,200 shares are held by Guggenheim Exploration Co.; controlled by Sherwood Aldrich and C. M. MacNeill; 5000-ton mill at Hurley, N. M.; concentrate smelted at El Paso.

Month.	Pounds.	Month.	Pounds.
April	4,046,800	July	4,831,200
May	4,003,700	August	6,050,867
June	3,904,300	September	4,435,873

CONSOLIDATED COPPER MINES CO., Ely, Nev. $8,000,000 in $5 shares; $3,000,000 in convertible bonds; is a recent merger of the Giroux, Butte & Ely, Chainman, and Coppermines companies, controlled by Thos. F. Cole, Wm. B. Thompson, Charles F. Rand, and Jas. Phillips, Jr.; reduction plant not yet built; production so far derived solely from Giroux; ore treated at Nevada Con. smelter.

Month.	Pounds.	Month.	Pounds.
April	816,935	August	541,189
May	968,368	September	204,307
June	616,742	October	160,911
July	607,779		

COPPER QUEEN CONSOLIDATED MINING CO., Bisbee, Arizona. $2,000,000 in $10 shares; owns 100,000 shares of Greene-Cananea; almost all its stock is held by Phelps, Dodge & Co., Inc.; $44,995,000 in $100 shares; 4000-ton smelting plant at Douglas, Ariz.; output of Copper Queen mine:

Month.	Pounds.	Month.	Pounds.
April	7,079,600	August	7,590,994
May	7,160,021	September	7,775,560
June	6,292,480	October	7,653,153
July	7,439,864		

COPPER RANGE CONSOLIDATED MINING CO., Painedale, Michigan. $38,433,500 in $100 shares; owns 99,659 shares of Baltic M. Co., 99,699 shares Copper Range M. Co., 99,335 shares of Tri-mountain M. Co., half interest in Champion Copper Co., 16,392 shares of Copper Range R. R. Co., and $870,000 in Copper Range R. R. bonds; controlled by Wm. A. Paine; production is derived from the Baltic, Champion, and Trimountain companies, each of which mills its ore; concentrate is smelted by Michigan Smelting Co., Houghton, which is owned by mining companies.

Month.	Pounds.	Month.	Pounds.
April	3,072,000	June	3,267,600
May	3,400,000	July (est.)	2,500,000

DETROIT COPPER MINING CO., Morenci, Ariz. $1,000,000 in $25 shares; owned by Phelps, Dodge & Co.; 1300-ton mill and 350-ton smelter.

Month.	Pounds.	Month.	Pounds.
April	1,856,517	August	2,187,223
May	2,001,633	September	2,102,818
June	1,750,601	October	1,861,178
July	1,549,224		

EAST BUTTE COPPER MINING CO., Butte, Mont. $3,000,000 in $10 shares; owns 83% of the stock and all bonds of the Pittsmont Copper Co., which holds 90% of the stock and all bonds of Pittsburgh & Montana Copper Co.; controlled by W. A. Paine; 350-ton mill and 1000-ton custom smelter.

Month.	Pounds.	Month.	Pounds.
April	1,435,033	July	1,060,257
May	1,268,595	August	1,162,006
June	1,020,613	September	1,233,018

FRANKLIN MINING CO., Demmon, Mich. $4,166,650 in $25 shares; controlled by R. M. Edwards and the U. S. S. R. & M. Co.; 1000-ton mill.

Month.	Pounds.	Month.	Pounds.
April	164,640	June	143,000
May	149,960	July	106,000

GRANBY CONSOLIDATED MINING, SMELTING & POWER CO., LTD., Phoenix and Hidden Creek, British Columbia. $14,849,565 in $100 shares; controlled by General Chemical Co. interests; 4400-ton smelter at Grand Forks and 2000-ton smelter at Anyox.

Month.	Pounds.	Month.	Pounds.
April	1,806,452	July	1,654,000
May	1,828,000	August	1,827,300
June	1,789,000	September	1,824,560

ISLE ROYALE COPPER CO., Houghton, Mich. $3,750,000 in $25 shares; owns a $50,000 interest in the Lake Superior Smelting Co., owned by Calumet & Hecla; 2200-ton mill on Portage Lake.

Month.	Pounds	Month.	Pounds.
April	563,983	June	496,134
May	528,809	July	343,750

MASON VALLEY MINES CO., Yerington, Nev. $770,000 in $5 shares; $1,000,000 in 6% convertible bonds; controlled by W. B. Thompson; 1000-ton smelter at Thompson, Nev., also smelts ore of Nevada-Douglas Copper Co. and custom ore; smelter production:

Month.	Pounds.	Month.	Pounds.
April	1,274,000	August	966,000
May	1,226,000	September	918,000
June	1,132,000	October	1,052,000
July	990,000		

MIAMI COPPER CO., Miami, Ariz. $3,319,690 in $5 shares; $1,433,000 in 6% convertible bonds; controlled by General Development Co. (Lewisohn interests); 3000-ton mill at Miami; concentrate smelted at Cananea.

Month.	Pounds.	Month.	Pounds.
April	2,312,000	August	3,097,500
May	1,948,000	September	2,688,600
June	2,612,650	October	2,862,050
July	2,890,000		

MOCTEZUMA COPPER CO., Nacozari, Sonora, Mexico. $2,000,000; entire stock owned by Phelps, Dodge & Co.; 2000-ton mill; concentrate smelted by Copper Queen.

Month.	Pounds.	Month.	Pounds.
April	2,753,240	August	3,542,047
May	2,695,881	September	3,024,121
June	3,438,792	October	3,178,136
July	2,693,006		

MOHAWK MINING CO., Mohawk, Mich. $2,500,000 in $25 shares; controlled by Stanton interests; 3000-ton mill, Traverse Bay; concentrate smelted by Michigan Smelting Co.

Month.	Pounds.	Month.	Pounds.
April	962,994	June	820,522
May	932,979	July	600,000

NEVADA CONSOLIDATED COPPER CO., Ely, Nevada. $10,000,000 in $5 shares; has absorbed the Cumberland-Ely Copper Co.; controlled by American Smelter Securities Co. through the Utah Copper Co., which owns half of the Nevada Con. stock; the Nevada company owns the Steptoe Valley Mining & Smelting Co., $10,000,000; 16,000-ton mill and 1500-ton smelter at McGill, Nevada.

Month.	Pounds.	Month.	Pounds.
April	5,650,600	July	5,403,919
May	5,933,275	August	5,989,973
June	6,344,863	September	4,441,671

NEVADA DOUGLAS COPPER CO., Mason, Nev. $4,054,800 in $5 shares, $276,900 in 6% convertible bonds; also $158,200 6% refunding bonds; controlled by A. J. Orem; ore smelted at Mason Valley smelter.

Month.	Pounds.	Month.	Pounds.
April	552,146	July	399,451
May	495,441	August	354,760
June	392,288	September	426,070

OHIO COPPER CO., Bingham, Utah. $12,292,700 in $10 shares, $1,326,000 in 6% convertible bonds; 3500-ton mill at Lark, Utah; concentrate smelted at Garfield.

Month.	Pounds.	Month.	Pounds.
April	687,000	July	601,700
May	645,400	August	689,400
June	579,400	September	685,900

OLD DOMINION COPPER MINING & SMELTING CO., Globe, Ariz. $4,050,000 in $25 shares; 155,245 shares are owned by the Old Dominion Co., which is owned by Phelps, Dodge & Co.; 300-ton mill, 2400-ton smelter. Production figures include custom ore smelted.

Month.	Pounds.	Month.	Pounds.
April	3,040,000	August	2,524,000
May	2,749,000	September	2,679,000
June	2,511,000	October	2,037,000
July	2,526,000		

OSCEOLA CONSOLIDATED MINING CO., Osceola, Mich. $2,403,750 in $25 shares; owned by Calumet & Hecla; 2 mills, 4000-ton capacity, at Torch Lake.

Month.	Pounds.	Month.	Pounds.
April	1,667,340	June	1,424,640
May	1,759,815	July	1,217,255

PHELPS, DODGE & CO., Inc. $44,995,000 in $100 shares; controlled by C. H. Dodge, James Douglas, and others; owns the Copper Queen, Moctezuma, Detroit, and Burro Mountain Copper companies, Stag Canon Fuel Co.; indirectly controls Old Dominion, United Globe, and Commercial Copper Mining Co.; members of the firm control the El Paso & Southwestern railway, and have large interests in the Rock Island and Great Northern railways. Production figures include all properties under its control and copper derived from custom ore, the latter ranging from 750,000 to 1,000,000 lb. per month.

Month.	Pounds.	Month.	Pounds.
April	12,819,923	August	13,971,674
May	12,999,119	September	13,561,742
June	12,667,328	October	13,332,943
July	12,611,837		

QUINCY MINING CO., Hancock, Mich. $2,750,000 in $25 shares; controlled by W. R. Todd; 4500-ton mill at Mason; 340-ton smelter at Ripley.

Month.	Pounds.	Month.	Pounds.
April	1,748,460	June	1,611,840
May	1,704,300	July (est.)	1,250,000

RAY CONSOLIDATED COPPER CO,, Ray, Ariz. $11,975,740 in $10 shares; controlled by Sherwood Aldrich and C. M. MacNeill; 8000-ton mill at Hayden, Ariz.; concentrate smelted in A. S. & R. smelter adjoining.

Month.	Pounds.	Month.	Pounds.
April	4,514,565	July	4,097,177
May	4,520,000	August	4,401,000
June	4,392,612	September	4,470,551

SHANNON COPPER CO., Metcalf, Ariz. $3,000,000 in $10 shares; controlled by N. L. Amster; 500-ton mill and 1000-ton smelter at Clifton.

Month.	Pounds.	Month.	Pounds.
April	1,238,000	August	1,248,000
May	1,080,000	September	1,232,000
June	924,000	October	1,216,000
July	880,000		

SHATTUCK ARIZONA COPPER CO., Bisbee, Ariz. $3,500,000 in $10 shares; controlled by Duluth investors; ore smelted at Calumet & Arizona smelter.

Month.	Pounds.	Month.	Pounds.
April	1,158,326	July	1,019,388
May	1,026,170	August	1,001,624
June	1,059,625	September	1,163,237

SOUTH UTAH MINES & SMELTERS, Newhouse, Utah. $4,300,000 in $5 shares, $1,300,000 in 6% convertible bonds; controlled by Samuel Newhouse; 1000-ton mill; concentrate smelted at Tooele, Utah.

Month.	Pounds.	Month.	Pounds.
April	132,267	July	195,254
May	201,405	August	230,410
June	142,817	September	249,323

SUPERIOR COPPER CO., Calumet, Mich. $2,500,000 in $25 shares; owned by Calumet & Hecla.

Month.	Pounds.	Month.	Pounds.
April	291,525	June	382,080
May	389,975	July	307,260

TAMARACK MINING CO., Calumet, Mich. $1,500,000 in $25 shares; owned by Calumet & Hecla; 2 mills, 3500-ton capacity, at Torch Lake.

Month.	Pounds.	Month.	Pounds.
April	630,190	June	598,770
May	655,885	July	476,725

TENNESSEE COPPER CO., Copperhill, Tenn. $5,000,000 in $25 shares; $1,500,000 in 6% convertible bonds; controlled by Jas. Phillips, Jr., and Lewisohn interests.

Month.	Pounds.	Month.	Pounds.
April	1,718,188	July	1,295,804
May	1,037,115	August	1,143,019
June	1,379,220	September	1,309,985

UNITED STATES SMELTING, REFINING & MINING CO. $44,871,150 in $50 shares; copper production chiefly derived from its subsidiaries. The Mammoth Copper Mining Co., Kennett, California.

Month.	Pounds.
September	1,750,000

UNITED VERDE COPPER CO., Jerome, Ariz. $3,000,000 in $10 shares; owned by W. A. Clark; 1000 to 1200-ton smelter at Clarkdale; monthly figures not given out, estimated at about 3,000,000 pounds.

UTAH CONSOLIDATED MINES CO., Bingham, Utah. $1,500,000 in $5 shares; owns the Highland Boy Gold Mining Co. and 5000 shares of International Smelting & Refining Co. stock; ore smelted at Tooele.

UTAH COPPER CO., Bingham, Utah. $15,625,990 in $10 shares; owns half of Nevada Consolidated; controlled by A. S. & R. Co., Sherwood Aldrich, C. M. MacNeill, and W. B. Thompson; 2 mills, 20,000-ton capacity, at Garfield; concentrate smelted at Garfield plant of A. S. & R. Company.

Month.	Pounds.	Month.	Pounds.
April	9,834,894	July	9,849,043
May	10,312,605	August	10,900,000
June	11,637,949	September	11,992,780

WOLVERINE COPPER MINING CO., Kearsarge, Mich. $1,500,000 in $25 shares; owns $80,000 interest in Michigan Smelting Co.; controlled by J. R. Stanton; mill on Traverse bay treated 388,500 tons during last fiscal year.

Month.	Pounds.	Month.	Pounds.
April	641,885	June	627,087
May	663,430	July	426,000

Concentrates

Most of these are in reply to questions received by mail. Our readers are invited to ask questions and give information dealing with the practice of mining, milling, and smelting.

WHITE PRECIPITATE often found in zinc-boxes is generally a mixture of zinc oxide and zinc ferrocyanide, and its formation has no connection with the use of lime in the treatment of the ore, for which it is often mistaken.

FERROCHROME is now made in an electric furnace at Trollhättan, Sweden, from ores brought from Africa and New Caledonia. It is estimated that the output in 1913 will be 1200 metric tons. While the process is as yet secret, it is said that 1700 kw. is required per ton of metal.

INDEX numbers are used to show the variation in prices as a whole. They are made upon various bases. For example, the *Annalist* index number reflects the average price of 25 food commodities selected and arranged to represent a theoretical family's food budget. The yearly averages have been: 1890, 109.2; 1896, 80.1; 1910, 137.1; 1911, 131.1; 1912, 143.2. The index number for the week ended November 1 was 141.6.

CHEMICAL differences between wrought iron and soft steel are slight. The iron contains little, if any, maganese, only such as may remain in the pig iron, whereas in steel manufacture manganese is added for purifying. The carbon content is slightly less in wrought iron. The main difference is structural, the wrought iron containing layers of slag which divide the iron and give it a fibrous structure at the same time that they retard oxidation.

COMPOSITE metal prices are used, as are index numbers, to reflect the general trend of prices. The theoretical pound of metal sold November 3, according to the *American Metal Market*, for 9.904. This is made up of 4 lb. of lead at St. Louis price; 2½ lb. of spelter, also at St. Louis price; 3 lb. of electrolytic copper at New York price; ½ lb. of tin, also at New York price; the whole divided by 10. Clearly the value of such a composite number is influenced by the proportions chosen as well as the quotations; if, however, the base be the same, sequence of change is brought out.

THE United States Bureau of Mines now has in the Matanuska coalfields of Alaska an expedition which has begun operations on the mining of 1000 tons of coal; this coal to be taken to tidewater and tested in Alaskan waters on the cruiser *Maryland*. One year ago the Bureau mined 800 tons of coal in the Behring River field for the same purpose. It is expected that these tests, which are being made in behalf of the Navy, will give a definite idea of the value of Alaskan coals and that their commercial development will follow soon after.

PROSPECTORS in Nevada may obtain useful information from the Mackay School of Mines, along many lines. For example, Circular No. 2, printed for their benefit, includes notes on the value and market for minerals, and the methods of sale of ores. There is a table of production with average unit prices; the 'Current Prices of Ores and Minerals' published regularly in the *Mining and Scientific Press*; the average price of minerals in carload lots in New York in 1910 as given in 'The Mineral Industry'; standard bases for purchase of lead and zinc ore; and names of buyers of ores and minerals.

IN smelting cyanide precipitate, the regulation of temperature has much to do with the efficiency of operations. If the temperature is allowed to rise too high during the fusion stage there is violent ebullition, and the capacity of the crucible is considerably reduced. The temperature variation required in an ordinary fire assay may be used as a guide, and as soon as the whole mass is in a state of quiet fusion the temperature should be regulated so that no undue ebullition occurs. Fresh fluxed precipitate can then be added from time to time until the full load has been reached, and after the mass has quieted down the temperature can again be raised in order to insure a thoroughly fluid pour. Oil fuel offers the best facilities for temperature control.

KIESELGUR is one name for fuller's earth, which usually is a diatomaceous earth, made up of the minute silicious skeletons of diatoms. It is also known as Tripolite, and by various trade names. Aside from its proper uses as a bleaching agent and as an absorbent for unstable materials, as when used in making dynamite, it is frequently employed as an adulterant and for 'loading' cloth and other materials. The compact varieties are cut into filters and it is also crushed for use as a polishing material and for making heat-protecting packing for pipes. Large quantities are used in the chemical industries such as the making of water glass, paper, pigments, safety matches, and *papier maché*. It occurs in many parts of the world, and deposits have recently been reported in Chile where they may be of importance in the local manufacture of dynamite.

COPPER is determined by wet assay, and from this result smelters usually deduct 1.3%. The copper remaining is usually paid for at the New York quotation for electrolytic copper less 3c. Thus, if a copper ore showed by analysis 10% copper, 1.3% would be deducted, leaving 8.7%. At a quotation of 14c., the price per pound would be 11c. The 174 lb. of copper would return $19.14. From this the freight and treatment charges would be deducted. Certain penalties for insoluble residue and credits for iron are made similar to the above, or else a flat treatment charge is made. Deductions for sulphur, arsenic, and antimony are also often made. Gold and silver in a copper ore are paid for in copper ores, although in cases only 90% of the silver is paid for at the New York quotation. Special contracts are made with large and steady producers.

THE CHALCEDONY from the dike that Omer Maris is working a few miles east of Manhattan, Nevada, is proving to be a useful product. It is an exceedingly hard rock, which, when broken to size, is used as an abrasive in tube-mills, supplanting the beach pebbles which have heretofore been imported from Europe. The use of such rock in the southern Nevada mills amounts to about 200 tons per month, and it is expected that this demand may be supplied with the home product. The local mills now running are making use of it with satisfactory results. The Tonopah-Belmont Milling Co. will use one tube-mill to give a thorough trial of the rock's efficiency, keeping a record of the amount used per ton of ore milled. To all appearances, and as far as local tests have shown, the rock is similar to the imported kind and at least equal in wearing and grinding qualities. If longer tests sustain this impression, its use will no doubt become general in southern Nevada.

THE value of a mineral or an ore depends upon the difference between the amount realized from its sale and the sum total of the mining, transportation, marketing, and general costs. A mineral deposit, in order to have value, must not only show that the mineral can be profitably marketed, but that there is a sufficient quantity to cover the capital investment required for plant and development. A certain part of the apparent profit must be used in order to redeem the capital investment required to put a project into producing condition. Not only must the deposit insure the return of the capital, but it must also show a fair commercial profit in addition. Mineral deposits may be classed into three divisions—those which have a sufficient quantity of mineral, unit market value, and capital investment to insure a profitable enterprise; those which have sufficient quantity and value, but which lack sufficient capital to provide low enough working costs; and those which, while they may have sufficient quantity and the mineral may have value, under existing conditions cannot be profitably operated, and which do not justify the investment of sufficient capital to make the production costs low enough.

Book Reviews

THE MINING WORLD INDEX OF CURRENT LITERATURE, Vol. III. Edited by George E. Sisley. P. 158. Index. The Mining World Co., Chicago. For sale by the *Mining and Scientific Press*. Price $2.

This volume, which is the third of the series, covers the world's literature on mining, metallurgy, and the allied industries for the first six months of 1913. It has been the aim of this work to include all articles of importance which have been published during this period pertaining to the technology of mines and minerals, and within this list will be found an invoice of a large majority of the world's leading publications. The large mass of material has been classified and systematically indexed in such a manner that the information on any branch of the subjects treated can be readily found. As a complete bibliography and technical index the work is most commendable, and to the engineer who desires to have at hand an index of the current literature it serves a useful purpose. All of the articles indexed can be had through the Mining World Company.

RADIUM: ITS PRODUCTION AND USES. By Sydney Fawns. P. 60. Ill., index. *The Mining Journal*, London, E.C., England. For sale by the *Mining and Scientific Press*. Price $1.

It is estimated that there is only 30 to 35 gm. of pure radium bromide in use in the world, the annual consumption being from 10 to 15 gm., while the price keeps steady at about $77,500 per gram. Ores containing radium in commercial quantities at present are only mined in Austria, Cornwall, Colorado, and South Australia, while production of the compounds is from works at Joachimstal, Austria; Giff, France; London, England; and Sydney, New South Wales. There is a good demand for uranium ores containing pitchblende, from which the radium is extracted by a complicated process known as fractionization. This interesting little volume contains everything connected with radium: its history, appearance, and energy; radio-activity of the earth; description of rays and emanations; the electroscope by which ores are 'assayed' for radium content; uses of radium; occurrences of radium-bearing ores; reduction and extraction of the metal; a bibliography of other works on the subject; and an appendix containing notes on calculating radium from uranium ores, and details of such ores. The book contains a frontispiece of Mme. Curie, who is so well known as an investigator on the subject, with the late Pierre Curie, Becquerel, Rutherford, Joly, and Soddy. The work covers the subject in a most interesting and instructive manner and will be enjoyed by those interested in this rare element.

METALLURGICAL ANALYSIS. By Nathaniel Wright Lord and Dana J. Demorest. P. 334. Ill., 3rd ed. McGraw-Hill Book Co., New York, 1913. For sale by the *Mining and Scientific Press*. Price $2.50.

This is an excellent revision of an excellent book, and combines comprehensiveness with conciseness. Twenty years ago Nathaniel Lord, then professor of metallurgy and mineralogy in Ohio State University, published in book form the laboratory notes intended for his students in analytical chemistry as applied to metallurgy. In the present edition Mr. Demorest, who has succeeded to the chair of metallurgy, has rewritten the work throughout so that the latest practice may be included. New chapters have been added and the worker in the chemical laboratory of a metallurgical plant will be able to find practically everything required in ordinary practice within the covers of this small book. The title page alone throws an interesting side light on American metallurgy in the past quarter century. Nathaniel Lord was one of a half dozen men who taught both metallurgy and mineralogy in the early days of mining education in America, a curious conjunction, the influence of which has not yet entirely disappeared. He, however, combined with these the teaching of analytical chemistry, which is, after all, but a single subject, whether the analysis be of alloys for the manufacturer, ores for the smelter, rocks for the geologist, or soils for the agriculturist. The relation of analytical chemistry to metallurgy may be regarded as close, or as somewhat remote. As a matter of fact, analytical chemistry is as subservient to metallurgy as brick-making is to architecture, or as physiological chemistry is to medicine, and the coming relation of the two is now foreshadowed at Toronto University, where the students in metallurgy are relieved of analytical work, just as would be the case in the management of a plant. A man can know too much detail, and the chief clerk rarely makes an efficient general manager. The moral of this is that books such as this are more for the chemist who expects to work upon the materials of metallurgical practice than for the metallurgist *per se*.

ORE DEPOSITS. By S. F. Emmons. P. 954. Ill., index. Published by Amer. Inst. Min. Eng., New York, 1913. For sale by the *Mining and Scientific Press*. Price $5.

This so-called 'Emmons Memorial Volume' on ore deposits is less a memorial to him than a forceful example of how impossible it is to write comprehensively of ore deposits without bringing out the great part he played in the development of modern ideas on this subject, and recurring constantly to our heritage from him of ideas and ideals, which is Emmons' best memorial. A man who leaves so firm an impress on a whole science as Emmons did, needs no other memorial; though it may still be pleasant and profitable to erect one or more to him.

The book in question is a compilation of certain significant papers on ore genesis published in the *Transactions* of the Institute and selected for republication by Emmons before his death. It is preceded by an introduction that he prepared and which adds greatly to the value of the volume, as also by a charming sketch of his career written by his life-long friend, G. F. Becker. We wish all the young men of the profession could read both of these, as they depict not only what has been done in the last forty years in the study of ore genesis, but the admirable spirit in which the work has been prosecuted. As to the papers themselves that have been included in the volume, we can only say that the choice has been most happy. As a whole they are the significant papers of the period, due allowance being made for those already reprinted in the earlier or 'Posepny' volume. The student who masters them will have a comprehensive and fairly accurate conception of modern beliefs as to the genesis of ores, and will have obtained it by that best of methods, comparison; the study of diverse interpretations by different engineers. As Emmons quotes King, the true theory of genesis of deposits is only to be developed after "the varied types of deposits in all the important mining districts * * * have been studied." This work is still incomplete, but at least it is now possible to recognize with fair assurance some of the final types, and to this Emmons contributed mightily.

The formal papers here reprinted number 29 and range from 'The Genesis of Certain Ore Deposits' by S. F. Emmons in 1886, to 'The Agency of Manganese in the Superficial Alteration or Secondary Enrichment of the Gold Deposits in the United States' by W. H. Emmons in 1910. The first is general, designed to correct misapprehensions of certain critics of the classic Leadville report, and the last is a specific application of the newly formulated doctrine of secondary enrichment to a certain group of deposits. In a way, this progress from the general to the detailed is characteristic of the development of knowledge in the period indicated.

It would require too much space to review in sequence the numerous individual papers or even to list their authors. The studies here reprinted are already widely recognized as permanent contributions to the body of knowledge. They are now given convenient form and rendered readily accessible to many who do not have the whole file of *Transactions* at hand. They are admirably supplemented by the classified bibliography and digest of cognate literature and summary of papers in the *Transactions* but not included in this volume, prepared by J. D. Irving. The volume as a whole is one that each engineer will want in his own library and that students may well thumb.

H. F. B.

Sullivan Angle-Compound Air-Compressors

By Fred D. Holdsworth

The Sullivan Machinery Co. is now manufacturing what is believed to be the first angle-compound air-compressor offered in commercial sizes. A number have been installed at mines in Arizona, Utah, and elsewhere and are giving excellent satisfaction. Angle-compound engines have been used for many years under conditions demanding high speed, freedom from vibration and close economy, and some special air-compressors of very large capacity have been built on the same principle. The Sullivan 'angle-compound' may fairly claim, however, to be the only power-driven compressor of this design now being manufactured in ordinary commercial sizes.

The angle-compound air-compressor has its low pressure or intake cylinder in a horizontal plane, with the high pressure cylinder set vertically, on the end of the horizontal frame. Both pistons are actuated by a single crank, and both sets of valve gear by a single eccentric pin. The driving pulley or motor is mounted at one side, on an extension of the crank shaft. This design permits a very close balancing of reciprocating masses. The momentum of moving parts increases as the square of the rotative speed, and the matter of balancing is of larger economic importance for engines and compressors which are intended to run at comparatively high speed than has generally been recognized. The perfect balance of the angle-compound compressor saves for useful work power otherwise wasted in friction and vibration. The output per unit of floor space has also been increased, and this with an actual advance in accessibility of all parts. This saving of floor space is accompanied by a reduction of strains on the foundation, and this is of correspondingly small dimensions. No lining up, except leveling, need be done; no expensive or intricate problems in driving attachment need be solved, and the installation cost, often a serious item in other compressor types, is always a small matter in this machine.

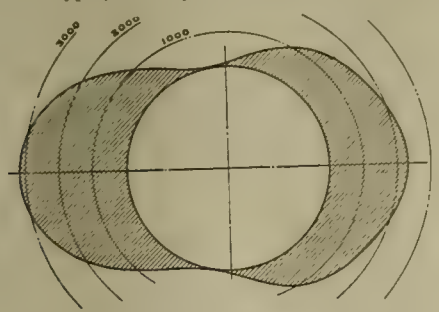


Fig. 1.

The reciprocating parts of a high speed steam-engine or compressor offer problems in balancing that are extremely difficult of satisfactory solution. Opposing balancing weights attached to the crank produce uniform opposing centrifugal forces radially around the shaft; while the inertia forces set up by the motion of the reciprocating parts change constantly in intensity throughout a revolution, in line with their motion. They are started from a point of rest at one end of the stroke, accelerated to maximum speed about mid-stroke, retarded from this point, and brought to rest at the end of the stroke. In accelerating the reciprocating parts, force has to be applied to them from the crank, tending to oppose its rotation, and they become charged, so to speak, with potential energy due to their velocity. After their maximum velocity has been reached at mid-stroke, and retardation begins to take place, the energy absorbed during the first half of the stroke is given up during the latter half, producing a force tending to assist the crank in its rotation.

In compressors of slow or moderate rotative speed, say 150 r.p.m., the disturbing effects of these intertia forces are so small that they are readily absorbed by the mass of the entire machine, but as the inertia varies as the square of the speed, it will be seen that if it is attempted to run such a compressor at a speed of 225 r.p.m. the disturbing effects have been increased in the ratio of $(\frac{225}{150})^2 = 2.25$. In other words, with a speed increase of 50%, the disturbing forces produced by the reciprocating parts have increased 225 per cent.

The inertia of the reciprocating parts reaches a maximum at the ends of the stroke, and is equal in value to the centrifugal force of a mass having the same weight as the combined weight of the piston, piston rod, cross-head, and connecting rod. Fig. 1. shows the effect of these forces, plotted radially about a neutral circle; and they are shown to be maximum at either end of the stroke. The difference in shape of the curve on either side is caused by the angularity of the connecting rod. As stated above, the effect at the ends of the stroke is equivalent to the centrifugal force of a revolving mass of the same weight as the reciprocating parts, and the horizontal vibrations may be entirely neutralized by attaching such an equivalent weight to the crank opposite the crank pin. If this be done, however, the result will be as indicated in Fig. 2. Here the opposing cen-

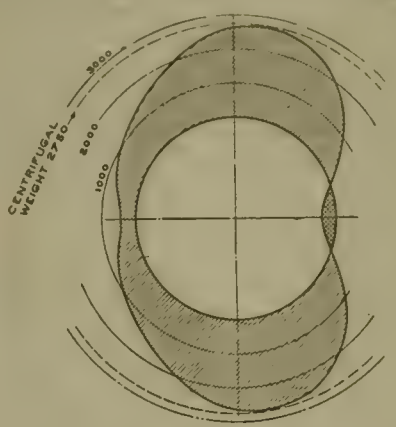


Fig. 2.

trifugal force of the revolving weight has practically neutralized the inertia forces, but has introduced a new set of vertical unbalanced forces, of equal intensity, tending to shake the shaft and engine up and down.

In horizontal single or duplex compressors, it will be seen that good balancing is an impossibility, and the best that can be accomplished is a compromise, effected by attaching a centrifugal counterweight, of less weight than that of the reciprocating parts, which will partly absorb their horizontal disturbing effects without introducing vertical unbalanced forces of injurious magnitude, leaving the bearings, frames, and foundations to absorb the remainder.

In the angle-compound compressor, the disturbing influences of the horizontal and the vertical members tend to offset or neutralize each other, the maximum unbalanced

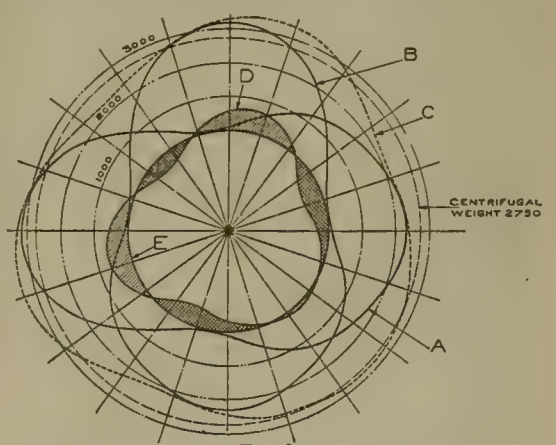


Fig. 3.

effects of the vertical parts being produced when those of the horizontal parts are at minimum value and vice versa. This result is illustrated in Fig. 3. Here two curves, dupli-

cates of Fig. 1, are shown at right angles to each other, curve A representing forces in the horizontal, and curve B those of the vertical machine. Curve C represents the sum of the two curves, and approximates, roughly, a circle, showing that the disturbance produced is more nearly uniform throughout the revolution. In Fig. 1 it will be noted that the disturbing forces fluctuate between 0 and 2300 to 3200 lb., while in the combined curve in Fig. 3 there is a difference, between a maximum of 3300 and a minimum of 2200 lb., of 1100 lb. only.

An opposing revolving weight, producing a centrifugal force, practically equivalent to the inertia forces of the reciprocating parts at the ends of the stroke, will produce the effect shown in curve D; indicating that the unbalanced forces have been reduced from approximately 3000 lb. in Fig. 1 and 2 to 500 to 700 lb. in Fig. 3.

The beneficial effects of such a marked reduction in forces tending to set up vibrations are manifold. One of the main obstacles to high rotative speed having been removed in this design, a smaller machine may be used for a given duty, provided it is designed with proper valves and valve areas for its rated speed, thereby involving savings in the original investment, space requirements and foundations.

The massive foundations necessary to absorb the unbalanced vibrations in other types are not required for the perfectly balanced angle-compound compressor, and it may be successfully operated in buildings where vibration is objectionable, or on unstable or filled ground, where vibration would have a tendency to cause unequal settlement and throw the compressor out of alignment.

The heavy counterweight permitted by this design practically absorbs within the shaft itself all of the heavy inertia loads which would otherwise have to be carried by the crank shaft bearings, and leaves these important elements of the compressor free to perform their proper function of carrying the load due to the air pressure on the pistons and to support the weight of the moving parts, thereby greatly reducing power losses due to friction, trouble with heated bearings, and similar annoyances.

In addition to the elimination of inertia loads from the bearings a further benefit is gained by a more uniform distribution of the working pressures around the circumference of the crank shaft boxes. In the horizontal type of machine, the wear due to the influence of piston load is all on the sides of the boxes, while with the angle-compound type the piston load produces wear in both horizontal and vertical directions, with the result that the boxes require less adjustment, the wear is distributed over a greater surface, and both the shaft and boxes retain a more nearly cylindrical shape throughout their life, resulting in unusual freedom from pounding.

In the ordinary duplex design, the stresses due to piston load are applied to the ends of a crank shaft supported in bearings several feet apart, and as the piston loads during cartain parts of the revolution act in opposite directions, a twisting effect or couple is set up in a horizontal plane which must be resisted by the machine frame, the foundations or both. Any lack of rigidity in these elements disturbs the alignment and produces a tendency toward heated bearings and increased friction. In foundations for duplex compressors, which are necessarily of large horizontal dimensions, if any settlement occurs, it is bound to be unequal; and the wide base or frame cannot be made stiff enough to resist the distorting forces of the settling foundation. The angle-compound compressor foundation is short and narrow, and if settlement occurs, the foundation, in tilting from a level position, will move as a solid block or unit, and no distortion of the frame will result. Furthermore, this frame is of great depth in comparison to its width, giving it a rigidity far in excess of that found in the broad and more flexible base supporting the duplex compressor.

The unique arrangement of the cylinders in the angle-compound compressor permits the placing of both connecting rods side by side on the same crank pin. This feature reduces the distance between the centre lines of the two cylinders from several feet, in the duplex, to the width of one connecting rod box in the angle-compound type, and practically eliminates the severe distorting forces, which have been referred to in the preceding paragraphs.

The crank shaft is supported in large bearings immediately on either side of the crank pin, so that the load imposed by both pistons is borne equally by these bearings, without any tendency to rock or spring the shaft or main frame.

A New Stretcher

The Kny-Scheerer Co. is manufacturing a special form of stretcher known as the Stokes, and designed to make it easy to carry injured men in awkward situations, as on shipboard and in mines. It was developed by C. F. Stokes, surgeon general of the United States Navy, and is used by the Navy, the Oliver Iron Mining Co., Inspiration Con. Copper Co., Copper Queen, Arizona Copper Co., Ltd., and other large concerns. The stretcher is so made that the injured man may be strapped in it and broken arms or legs held as in a splint. He can then be carried without further injury.

Commercial Paragraphs

The Sullivan Machinery Co., announces the resignation of Myron G. Doll, for several years local manager at Salt Lake City. H. E. Moon, heretofore associated with the Denver, Colorado, office of this Company, has been appointed local manager, as successor to Mr. Doll.

The Union Iron Works Co., of San Francisco, has lately completed a large and expensive power-plant which includes electrically operated air-compressors, motor-generator sets, electric booster system, switchboard, distributing panels, and all accessory equipment. The Company is now offering for sale all the machinery in the old power-plant consisting of boilers, engines, compressors, pumps, electric generating sets, fans, blowers, and the complete piping system.

John A. Roebling's Sons Co. recently made tests at its Trenton, New Jersey, works of the wire ropes to be used as towing lines at the great locks at Gatun and Miraflores. Forty wire ropes each 400 ft. long have so far been made by the Roeblings for this purpose. Each rope has six strands, with 37 wires in each strand, the strands being twisted around a hemp centre. The ropes are 1 in. diameter and have a 4-ft. loop at one end. The specifications for ropes called for a tensile strength of 37 tons each. To obtain this requires a tensile strength in the wire of 260,000 lb. per square inch. Pieces cut from ends of the ropes, when broken in the testing machine, showed the ropes to have strengths ranging from 12 to 15% in excess of that called for by the specifications. In towing boats through the locks four electric locomotives will be used for each vessel at each lock. Two of these locomotives will be connected by wire ropes to the bow and two to the stern.

The Baldwin Locomotive Works signalized the completion of their forty-thousandth locomotive recently by publishing a most attractive booklet in which something of the history of the Baldwin works is told. This is at the same time the history of the art in America since the Baldwin works have been building locomotives for 82 years. Indeed, the Standard Steel Works Co., a subsidiary, goes back to the famous Freedom Forge, founded in 1795. It comes as a bit of a shock to realize how far back in the past some of the manufacturing concerns in this young country, may be traced. The Baldwin concern began modestly enough in 1832. Things moved slowly then, and it was 30 years later that locomotive 1000 was completed. The five thousandth was turned out in 1880, the ten-thousandth in 1889, the twenty-thousandth in 1902, and the thirty-thousandth in 1907. It is evident from this record that the benefits of good work were accumulative, and it is pleasant to know that demand has so continued to increase that the original Philadelphia works were long since outgrown. At the Eddystone, Pennsylvania, the East Chicago, Indiana, plants, and the Standard Steel Works at Burnham, Pennsylvania, the Company has now works of which it may well be proud, while around the world its locomotives are disproving the old superstition that only European plants built honestly and to last.

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EDITORIAL

DECLINATION by Mrs. Pankhurst of a proposal of marriage by the holder of the United States record for fasting, removes the hope of an interesting international attempt to defeat the high cost of living by eugenics.

A REPORT from Nome states that many of the old time placer miners are of the opinion that the storm of a month ago washed enough gold on the beach to more than pay for the damage done by the elements. If such proves to be the case, storms may be looked upon as a blessing rather than a bane in the future.

THE session of Colorado editors at which both sides of the strike of the Colorado coal miners was presented, resulted in adopting a resolution that the strike should be declared off immediately and that the union should give up its demand for recognition by the operators as well as abandon claims for higher wages. We believe that the expression of this meeting voices the sentiment of the people of Colorado, and if so, success on the part of the strikers can hardly be anticipated.

THE attack on the President and the administration's Mexican policy by Mr. D. P. Barrows, acting president of the University of California, reads more like the outburst of a petty Mexican ranch owner who would precipitate intervention because of the theft of a steer by the revolutionists, than that of an authority on international affairs. It is a surprising variant from Mr. Barrow's usual excellent discussions of contemporary history. When a university president preaches jingoism, one is led to believe that there is some truth in the statement that the sphere of the average professor is a rut, which has been likened unto a coffin that is open at both ends.

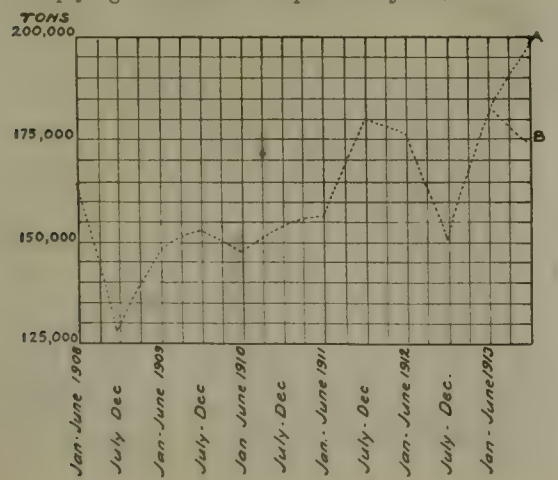
MINE taxation was one of the problems touched upon by Mr. D. W. Brunton in the well balanced presidential address that he delivered before the American Mining Congress at Philadelphia and which we print this week. Interest in the problem is widespread and is especially keen in Colorado, where, as Mr. Brunton pointed out, a most anomalous system has been evolved. The local members of the American Institute of Mining Engineers, as related in our Denver letter, made the matter the subject of discussion at a recent meeting and have appointed a strong committee to study the situation further. Incidentally, we note that the meeting was preceded by a dinner, an excellent means of establishing a friendly basis for debate. We present in

our news pages an account of the meeting and a picture of the men at dinner.

NEWSPAPER accounts of mines and mining are frequently trivial when they are not inaccurate, and the so-called financial journals usually refuse to consider mining seriously. An honorable exception is the New York Times *Annalist*, the weekly issue devoted to finance, commerce, and economics. This well written and well informed journal maintains a regular department devoted to mining. As its editor is Mr. C. S. Burton, long the New York correspondent of the *Mining and Scientific Press*, the information printed is timely, interesting, and unusually accurate. We congratulate the *Annalist* on recognizing mining as one of the fundamental industries of the country, without discussion of which no complete forecast of industry is possible.

SAN FRANCISCO engineers celebrated the opening of the new quarters of the Engineers' Club in Hotel Sutter last Saturday night by an entertainment in the course of which men from each branch of engineering gave practical exemplification of their skill. The miners made a good impression with a drilling contest, in which Messrs. Edmund Juessen, J. M. Parks, Clifford Dennis, and C. E. Grunsky, Jr., were contestants and over which Mr. E. H. Benjamin presided as referee. Mr. W. A. Williams drilled in a successful oil well despite the unfavorable opinion of such experts as Messrs. W. R. Hamilton, E. B. Kimball, and D. M. Folsom. The new club is proving a useful centre for extending acquaintance among men of the engineering professions and is bringing to light unsuspected talent in other directions.

INTERESTING reflections regarding copper exports are suggested by the graph below. The figures show conclusively that recent exports are abnormally large, but they also show that large fluctuations are normal. The inference from the October figures is that they have begun to decrease again. The line has been projected to January 1, 1914. If the exports for the last half year amount to double those for July to October, it would run to the point A. If, however, the October shipments be taken as the true guide for the last quarter, the point B would be the correct one, that point having been found by multiplying the October shipments by six.



MACHINERY is not the only element in successful mill work, and a manager must be prepared to spend time and thought on his men as well as his machines. It is an old saying that 'there is a lot of human nature about folks,' and one that it is well always to keep in mind. Mr. Gelasio Caetani, in an address before the students at Harvard, which we print this week, points out some of the many ways in which the human factor must be taken into account if one would become a successful millman.

Doubtful Leadership of Labor

In a recent speech at Seattle, Mr. W. B. Wilson, Secretary of Labor, is credited with having made statements that will go far to destroy the feeling of confidence in him and the new department that was gaining ground. Mr. Wilson is a long time trade unionist and was at one time secretary of the United Mine Workers of America. As one of the men who supported Mr. John Mitchell in building up that organization, he came prominently before the public. He and his associates proved the place and value of collective bargaining in modern industry, never more so than when by carrying through a reduction in wages, they showed that the scheme really could be made to work both ways. In view of the chaotic condition of our anti-trust laws, the bituminous industry has been for years fiercely and disastrously competitive, and it is an open secret that the United Mine Workers has been the most important agency for leveling conditions and enforcing a measure of equality in this competition. Labor union officials are expected to be radical, but among them, Mr. Wilson has been a conservative and he has also been constructive. His career as a congressman, while not distinguished, has been clean and creditable, and his appointment to the Cabinet was considered appropriate and fitting.

It is a disappointment to find such a man forced by the exigencies of position to defend so discredited an organization as the Western Federation of Miners. Its history is an open secret through the West, and, despite loud protestations of reform, the fact remains that Mr. Charles H. Moyer is still president; and this is the Moyer of Leadville, Cripple Creek, Telluride, Goldfield, and Idaho fame. No one doubts but that the mine managers of the Lake Superior country would willingly make any reasonable concessions to their men, but no experienced Western mine manager can do otherwise than sympathize with them in their refusal to treat with the Western Federation of Miners. We are among those who believe in labor unions and in collective bargaining, but we do not believe that workingmen have anything to gain by fighting the battles of such men as Mr. Moyer.

It was doubtless a severe disappointment to the officers of the new Department of Labor that official mediation in the strike was refused. As sincere believers in trades unionism, they naturally feel that the operators should recognize the particular union that makes a show of strength in the district. It is also true that the alternative of destroying the Western Federation may be the upbuilding of the mis-named 'Industrial Workers of the World.' We

would hope, however, that another alternative would be the coming forward of a conservatively managed union; one knowing more about mining costs and less about dynamite. In the meantime, Mr. Wilson will do well to look less to the immediate cause of irritation and more to fundamental causes. World-wide conditions cannot be changed in a day, and political 'bunk' is no sufficient substitute for sound knowledge.

Education That Educates

The question, 'What constitutes an education?' brings answers as varied as there are viewpoints. In the Middle Ages, familiarity with Latin and Greek was enough to put the then limited store of knowledge at the service of anyone with the time and inclination to do a little reading. Today no ordinary lifetime would suffice for a man to familiarize himself with the important treatises published in English in the past hundred years alone. A metallurgist, for example, finds it increasingly difficult to even keep moderately well informed of progress in that knowledge of inorganic chemistry on which his art is based. So we have come to a present-day standard of practical education in which an accurate comprehension of the basic principles which underlie all knowledge, and a complete mastery of the details of some one branch, is regarded as the working ideal. It is unfortunately true that a large part, perhaps a majority, in our population possess neither of these, since faulty methods of primary education have not conduced to the former, and a natural desire to keep abreast of the times tends to substitute for the latter a smattering of many things. Extending the doctrine of Malthus from the material to the intellectual world, it may be said that there is impending an equilibrium between the world's fund of knowledge and the capacity of the human brain to make any useful application of it. As a result, everyone is content to remain in contact with many things he does not understand. Thus, to choose a familiar example, automatic weighing devices attached to conveyor belts form a common feature of industrial plants, yet it is rare to find anyone on the staff of the plant who has a competent knowledge of how they are constructed, or how they do their work. Everybody uses the telephone, but few understand it, beyond that an electric current, magnets, and vibrating diaphragms give the desired result. Absurd as the statement may at first seem, it is certainly open to question whether the general public has a clearer detailed understanding of the world in which it moves than was the case in the Middle Ages. The great advance in general understanding has perhaps been more than compensated by the tremendous increase of complex objects of knowledge. The pursuit of knowledge thus appears a hopeless race for the generality of mankind, and the present condition of affairs, in which a comparative few seek the ultimate boundaries of research, while the many make the best use possible of what others furnish, seems likely to become a permanent relationship.

Looking at the matter from this viewpoint, it is clear that educational methods are and have been fundamentally wrong, being founded on erroneous conceptions of the mental psychology of the child and perpetuated in schemes which are not adapted to secure the end desired. What is requisite is to give each child primary training which will lead up to either a mastery of the knowledge of others, or the ability to advance the bounds of knowledge; trusting to the child, when he reaches the proper age, to automatically determine which of these two paths to follow. On the range it is the custom to let a colt run wild until it is old enough and strong enough to work under the saddle. It is then roped, 'broken', and put to work. Something similar has been the practice in our schools, where the exact manipulations of laboratory work in physics and chemistry are suddenly introduced with the high school course at an age at which the child has had ample opportunity for his natural aptitude for such work to atrophy and disappear. Thanks to Madame Maria Montessori, the most obvious fact that the highest serviceability of the human senses can only be secured by beginning their training at the earliest possible moment has now gained universal acceptance, and it is not too much to hope that educational methods, from the primary school to the university, will soon be recast along more rational lines.

Out of this faulty conception of education arises never-ending controversy over the relation between general education and vocational training. In a recent report Mr. Nicholas Murray Butler, president of Columbia University, said that vocational training, carried to its logical result, would mean a stratified and static social order which would put an end to individual initiative and to individual opportunity. On the other hand, Mr. T. W. Robinson, first vice-president of the Illinois Steel Company, has recently made an eloquent plea for vocational training, which he declares is not a passing social expedient, but a method which results in greater industrial efficiency and increased economic truth, morality, and civic duty. The two men are regarding the obverse and reverse of the same shield. The child is now thrust into vocational training without the fundamental requisites of general training because we have been too inept to convey them to him in his early years, relying upon the horse-breaking method of conveying them by painful application of the 'three R's.' The possession of an education is indicated by mental horse-power, not by ability to quote Greek or Sanscrit. Given a proper training in fundamentals, the average student will obtain more real education from vocational training than from the study of abstract knowledge. The competent mechanic knows how to use tools, where they are kept in his shop, and how to make new ones if necessary. Similarly, the educated man knows how to think accurately and logically, and what records of the study of others are available, while competent to study individual problems as the need arises. The Mining and Metallurgical Society has a committee at work studying the practical training of engineers. We believe that it will be found that more failures are due to lack of grounding in principles than similar lack of familiarity with practice.

The Human Side of Milling

By Gelasio Caetani

Not many years ago, when I graduated, one question that vividly interested me was to know what the experience of others had been during the first years after leaving college. What impressed me very much was to see the great influence that unimportant circumstances may have on our future and how a small incident may at times change entirely the direction of our career.

I began by graduating as a civil engineer and architect in Italy and find myself now specializing in ore dressing. I understand that F. L. Bosqui, the well known metallurgical engineer, graduated as a physician, all of which goes to prove that one may train himself for one profession and then actually follow a very different one; the course of our studies does not absolutely determine the course of our lives.

College Education

Some people, especially those that have not had the opportuniy of going through college, believe that the main object of a college education is to memorize a long and obstruse series of facts that one would never have taken care to study unless somebody had obliged us to do so. As a matter of fact, we memorize a great deal during school years and remember very little; all we really do is to make an inventory of human knowledge, so that we may know what there is of human knowledge, where to find it, and how to use it in the moment of need. The real studying begins after leaving college, and it is right to say that the school is more for the purpose of learning how to study than for that of studying what there is to be learned.

The most valuable asset that is gained at college is the scientific training; it is the art of looking at things in a clear-minded way and of using common sense in the solution of both technical and moral questions. A man with a good technical training is well equipped for whatsoever technical profession; the man who in life has been a successful mine manager would have been equally successful had circumstances in life made of him the manager of a cotton spinning mill or of a paper factory.

The knowledge of technical facts peculiar to any one industry is quickly acquired by any man equipped with a good technical training, and it is for this reason that, in my opinion, a course of civil engineering will equip a man for the mining profession just as well as a course in a school of mines. I have taken a degree in both courses and have always had the impression that my civil engineering studies have been of greater support to me than my studies in mining. The reason of it probably is that mining in general is one of the broadest applications of civil engineering; the problems that arise in the mining industry do not generally call for calculus and higher graphical statics, but at the same time a mining engineer will be called to make use of more branches of modern technology than is the case in any other industrial enterprise.

With all this, technical training counts little when compared with will and character, as it is upon this that any success in life depends. Every year the mining schools of the country turn out from two to three hundred mining engineers fresh from the mint. These engineers all get a start at the same moment and are more or less all on the same footing, inasmuch as regards technical training. Of these two or three hundred men, a number drop off along the road, the greater number will settle here and there in minor positions and only a few will reach the top. What differentiates them one from each other is not the technical training, but the will, the mind, and the character. These qualities establish our relations with our fellow-beings, and it is just on this account that they are of paramount importance. There is nothing one could do if left completely alone; every move, every action, any success that may be achieved in life is necessarily and primarily connected and dependent upon our fellow-beings. All our future is dependent on the coöperation of other people with ourselves, and it is therefore true that the knowledge of human nature, the acquaintance of other men, and the art of dealing with other men, will be the determining factor of our success or failure in life. This art is not learned at school, but is acquired slowly by experience, while shifting from one camp to another, and the more one wanders the more one sees of things and of human nature.

When I graduated, I made up my mind that I would not attempt to make any headway during the first few years; I had decided that I would try to get as wide and as varied experience as I could and that I would not hold on to any one job for over six months, even if by clinging to it there was a good chance of advancement. I never made a secret of this, and therefore never aimed for a position that would be given only to a man who intended to stick to the job for an indefinite period of time.

Early Experience

So I wandered over the country, gaining varied and interesting experience both of things and of human nature, and never felt any compunction in letting go a $5 job to take up a $2.25 job when the limit of time I had prefixed for myself had run out. These were my 'Lehrlingsjahre,' and in the three or four years that they lasted I learned more than I ever learned at school, because I learned, without realizing that I was studying, and remembered things without attempting to memorize them.

The advice I would give is to do the same thing, though others may point out to you that the best policy is to get in with some company where the possibilities for the future are good and to stick there like glue. This system may be a good one to follow when the principal aim in life is to settle as soon as possible into comfortable quarters; my personal opinion is that a young man should not attempt to realize too soon on his own capitalization, but, as you would say, keep on investing all operating

profits in development work and capital improvements.

This roving spirit in a college graduate is a hindrance in obtaining positions that involve responsibility of some kind. You cannot blame a mill foreman if he objects to hire as jig-man a graduate who, after wasting a lot of good mineral in studying the idiosyncrasies of a Harz jig, will suddenly quit the job to join the office staff or to leave for some distant camp. It is an old saying in the Coeur d'Alene district that every new jig man will waste more in a month than he is paid in a year. On this account those that have in them the 'Wanderlust' must give up the idea of making headway during the first years of practical experience.

Prejudice Against College Graduates

The old time prejudice of the 'old hands' that college graduates, or 'college guys,' as they are called, are no good, generally in the way, and always ridiculous, is gradually wearing out. In most reduction plants college graduates are holding the more responsible positions, and the great majority of college men that I have known working as mill hands were to be credited with good and intelligent work. The most damaging characteristic of the green graduate is his consciousness of science. The desire for manifesting to others the stores of knowledge acquired, is in reality only an attempt to convince one's self of one's own merit, because to the other party such vain-glorious display generally causes a feeling of irritation and diffidence. The man of real knowledge does not feel the need of impressing this fact on others. He will realize, instead, how much there is still to be learned and will listen with attention to whoever may have something interesting to say. I mention this because a common defect of many green graduates (and I have been one of them, too) is that when asking for information they are afraid to expose their own ignorance; they try to shield themselves by assuming the airs of a man well acquainted with the subject and acknowledge what they are told with understanding grunts, instead of frankly acknowledging their ignorance and showing their willingness to learn. My experience has been that such frankness, coupled with a sincere desire to learn, is the most reliable introduction a man can have at any plant, and when you enter a mill in brand-new overalls this policy will quickly acquire you a mentor and probably a friend.

As a rule, millmen are of kinder and gentler disposition than underground miners, and I have never found any difficulty in becoming good friends with the 'boys.' The blacksmith generally, and the carpenter every now and then, are the cranky elements of mill crews; this is a kind of tradition.

As a whole, a mill crew is more clannish than the other labor elements in a plant. It is also a more conservative element, and labor agitators do not find as much response in the mill as they do in the mine.

The most usual way for a college graduate to enter a mill is either as laborer or on some experimental work. In the first case he will seldom find any difficulty in getting along with the millmen as long as he minds his own business and does his full share of work. The second case is entirely different, and the green college graduate who is appointed to carry on an extensive series of mill tests will often get into trouble if he does not use judgment and tact. Experimental work generally interferes more or less with the routine mill work; it is generally given precedence over the operation of any individual machine in the mill, though it must never be allowed to interfere with the general operation of the plant.

When experiments are being carried on it is necessary to install temporary launders that generally leak; some machines are robbed of their feed, the floor space is taken up with sampling boxes and iron buckets, and, more often than not, the waterhoses in the neighborhood of the testing plant are monopolized by the 'experts.' With all this, the millmen will generally be found to give a helping hand and often some good advice; in return, the man who runs the tests must strive to take upon himself all the burden of the extra work caused by the experimenting. There is probably nothing that irritates a millman more than to find an outsider making a big mess around some part of the mill and then walking off without putting back everything as he found it. Go to a millman and ask him for a wrench and he will give it to you most graciously; forget to bring the wrench back so that he must hustle it back for himself and he will cuss you to perdition. A carpenter may not mind very much if you attempt to ripsaw a twenty-penny nail with his crosscut saw, but he will cuss at you if he finds it rusted next day because you forgot to wipe and oil it. It is the old Christian maxim of treating others as you wish to be treated yourself, and as long as you follow this rule you will fare well.

Eventually, as you advance in your work, you will be given charge of a plant. When this takes place, a man feels an irresistible desire to enforce immediately all the reforms that have been brewing in his mind for some time past and to make all those changes in the mill and to the flowsheet that he has so diligently studied before having authority to carry them out.

Reforms and Changes

It is a fundamental mistake for a man who is taking charge of a plant to begin by enforcing reforms and changes. Humanity is instinctively adverse to anything new, whether it be a new superintendent or a new jig, and you cannot make a success out of anything, especially in a mill, if you have not with you the sympathy and the good will of your men. I am willing to assert that any common sensed machine can be made to work satisfactorily if there is some friend to look after it, and the most perfect of our standard machines can be made a complete wreck if entrusted entirely to unfriendly hands. As an example, you can take the Frue vanner, the most standardized of all concentrating tables; this machine is so full of mean little tricks and weaknesses that if it was invented and placed on the market today, it would be thrown out in every plant where the spirit was not sufficiently friendly to take care of its weaknesses for the sake of its efficiency.

So it will be with any reform or any new process

that the new superintendent may try to introduce. To operate a plant successfully you must have with you the good will and the friendliness of your men.

When the new superintendent is put in charge, there is for a time a general tension of feelings. The men are asking themselves "What's next?" Those with a poor conscience look for some wholesale 'firing'; the friends of the former boss seldom sympathize with the new one, and if the former boss was 'fired,' you can be sure that a certain number of his followers will quit. When this is the case, it is good counsel not to make any special move, but to let things hum along in the customary old way while getting a firm grip on the whole situation. Especially, if new in the place, it is unwise to modify any existing order of things without having thoroughly investigated the "why" of such ways. If something is done in a certain way at one plant, it is most probable that there is some very good reason for doing it so. Jigging of unsized material may be theoretically wrong and have been proved to be wrong in one camp, whereas in another camp it may be entirely justified and probably preferable. Once, however, that the new superintendent has taken a solid hold of the situation and its problems, he must not hesitate in carrying into effect whatever policy he thinks is right.

Essentials of Success

To gain and hold the esteem of the men who are under you, you must convince them of two things: first, that you know the business at least as well as they do, and second, that you are going to give them a square deal. The thorough practical knowledge of the work is chiefly expected from the foremen and bosses who are directly in charge of the workmen. The men higher up, that is, the manager or the president of the company, have seldom a thorough practical knowledge of every department of the plant, and this is not expected of them. These men have generally risen to their positions from some of the departments and hold their position more for their business ability and for their knowledge in dealing with men than for their thorough knowledge of the technical details of every department. What is expected of them is to impart the right spirit to every department of the plant and to pick out for heads of these departments men that will carry out the work in the right spirit and with technical ability.

It is to these men that the manager will impart his orders, and they in turn will pass the orders to the bosses, who will see that the orders are carried out. It is a fundamental mistake not to respect the organization of a plant as, not only will orders given over the head of the bosses cause confusion and conflicts, but this will also arouse the ill-feeling of the men in charge, because high-handed methods minimize their authority in the eyes of their men.

Authority is a dear thing to men of all ranks; a precious privilege to be jealously guarded, not so much for the material advantages it confers, as for the feeling of class distinction that, at least in the opinion of the man enjoying it, is constantly associated with authority itself. But whatever be the humorous aspect of the human side of all this, a well defined authority is absolutely essential in an organization of whatsoever kind, and therefore must always be respected, even if it be only that of a 'straw-boss.'

The orders given to any subaltern must be clear and decisive, even if they are wrong. The men want clear orders, for a definite object and from a definite source; what the effect of the order will be generally concerns them but little. When an order is clear and decisive it is an indication that the boss knows his own business, and this is his most powerful asset in commanding the respect and good-will of his men.

From this it naturally follows that revoking an order is confusing and demoralizing. It is well to think out a question thoroughly before giving orders. If later you find that a serious mistake was made, revoke your order openly and decisively, but if the order has already been carried out in part and if no serious consequence has resulted, it generally pays to let things stand. It always irritates a man, and disgusts him, to be told to tear down something that he has just been erecting with painstaking diligence.

More difficult than to enforce new orders is the breaking up of pleasant and inveterate habits. Once a habit has been sanctioned by not being repressed, it ends by being considered as an inalienable right, and the abrogation of the privilege appears to the men an unjustified violation of their prerogatives. A characteristic instance comes to my mind. In one camp, the mills used to be operated on a twelve-hour shift basis. It had become customary that, as the shift drew to its end, the millmen would start washing themselves and changing clothes so as to be ready to leave as soon as the other shift appeared. This shift would then quietly proceed to change clothes and, in due course of time, place hands to the work. All this meant that, at the end of every shift, there was a period of about 35 minutes during which the concentrating machines were left to strive for themselves; when the eight-hour law was enforced in that state, the loss of time to the companies due to this habit amounted to over seven per cent. To break this habit by force meant spotting and nagging, an odious and generally unsuccessful way of dealing with men. A simple remedy was found in the erection of a change house outside the mill. Orders were given that no clothes were to be left hanging in the mill and that no man should leave his machine until relieved by the next shift. The men appreciated the new change house and took kindly to the new rules.

Smoking

Whether smoking is or is not an objectionable habit is a question on which management and crew have often opposite views. Two arguments are brought against smoking; one is the general idea of discipline and the loss of time caused by the repeated lighting of a refractory pipe; the other is the danger of fire.

Against the first argument I will say that even the most unremitting worker will every now and then straighten up to stretch his back, and that it seems unfair to deprive a man of the satisfaction

of a smoke when he has wiped the grease off his hands after accomplishing a stiff job. As to the discipline, I do not believe that it is much benefited by the enforcement of a rule which is generally considered vexatious and therefore frequently transgressed even by the most reliable men in the mill. A 'super' noticing one of his best men having a smoke on the sly must either fire the man for a truly menial offense or allow discipline to slack by not enforcing the rules. Where Mexican labor is employed, the rule has some reason of being, as a Mexican is liable to give precedence above all other things to the rolling of his cigarette, when the psychological moment to do so has arrived.

The Danger of Fire

As to the danger of fire, I will say that the only danger lies in the possibility of some one throwing away a lighted match. To build a fire with wood shavings and a burning cigarette is a very difficult undertaking, as you can convince yourselves by trying it.

The sources of fire in a mill can be better explained to you by an insurance agent than by me. However, in two instances have I seen a fire start under conditions that were the results of defective arrangements of the mill.

In one case a wet 'jumper' had been placed on a radiator to dry; some matches in one of the pockets came in contact with the steam coils and, when the clothes had become dry, the matches ignited and the whole thing burst out into flames. I have given this example to emphasize the necessity of providing change-rooms for the men as a measure which, besides being a protection against fires, offers also many other advantages.

Another source of fire is the inveterate use of the miners' candlestick in and around the plant. It is natural that a workman must be able to see to do his work, and therefore, if the designer of the mill or the superintendent does not provide good and practical ways of illuminating every part of the mill and machinery, the millman will have recourse to the primitive but always effective candlestick. Eventually the candlestick will be jabbed into a post and forgotten, until the 'snuff' burns its way out of the socket and falls to the ground.

In a fire of any kind, it is the immediate action of a few that counts more than the action of many later on. Generally there are only a few men, even in a large plant, and these men must be drilled so that their efforts will be applied to the best advantage. It is well, therefore, to entrust certain specific duties to the men employed on certain jobs. As example: the table-man is to give the general alarm, the jig-man to open the water supplies and cut off the water wheels; others to play out the hose, and so forth. If these actions are not preconcerted it will be found that invariably the same idea of what is most important to do will loom in several minds at the same instant, and several men will be running for the alarm whistle, whereas one man is entirely sufficient to perform this duty.

All this may sound very commonplace and self-evident, but I know that there is not one plant in ten where such precautions are planned and the men drilled into fire brigades. After the fire is over, everybody complains about the great confusion that took place.

More difficult than the abrogation of a few bad habits is the reforming of an organization that for some time has been running down and losing the right spirit that leads to high standards. A reform of this kind may take considerable time, as bad habits are more easily acquired than lost. Once, however, that a certain standard has been established, it is not hard to maintain it; all that is necessary is to keep up the right spirit between the men and it is remarkable how appearances and items of comparatively small importance may be of great consequence in keeping up this spirit.

The factors affecting the spirit of a mill crew may be moral or material ones. The first ones can be summarized in the words, 'interest in the work.' They are the friendliness existing between the management and the crew, the spirit of emulation between one shift, or one crew, and the other, and the interest taken by the management in the work. If a mill-crew feels that its good work is not noticed and appreciated by the management it becomes discouraged and ends by not caring whether the work is done well or not as long as the mill is kept running and the job holds out.

The Value of Posting Assay Returns

To keep up the interest of the men it is necessary to keep them posted of the daily assay returns, as without these the men are absolutely unable to gauge their own work. There are some mining companies which still maintain the time honored prejudice that there is much wisdom in secrecy. If the mill losses are heavy there is no use of hiding the fact, as any outsider really interested to find out this point, will succeed in doing so by direct or indirect means, and the losses cannot be concealed from the men who operate the plant, as they are better aware than anybody else of what is right and what is wrong in the plant. More so, secrecy is in general responsible for an unfavorable public opinion, and is the source of many exaggerated statements and much unjustified gossip. The companies which have adopted the policy of posting daily all mill assay returns in broad daylight have never, to my knowledge, had occasion to repent of having done so. On the other hand, I have often listened to the complaints of millmen who, owing to the system of secrecy in force, were absolutely unable to gauge their work and improve it. There is nobody to whom an assay means more than to the man who was operating the machinery at the time the sample was being taken; he knows the conditions existing at that time and the meaning of the assay returns. The daily returns give him means to judge the quality of his work from the appearance of the ore on the machinery and to establish relations between cause and effect that would escape even the eye of the superintendent.

Besides this, there are many other factors, some of apparently little importance, others only indirectly connected with the operation of the plant, that materially affect the spirit of the men and the efficiency of operations. The question of light is one of vital importance; whether natural or artificial, a good

illumination is instrumental in imparting a spirit of activity, buoyancy, and contentment that can be understood more easily by thinking of the feeling of depression one has when obliged to work in a gloomy place. In addition to this, good illumination not only helps and even is necessary in the performance of good work, but it brings also in evidence all failures and defects; the men will be more painstaking just because their negligence will be more apparent.

Cleanliness of the Mill

So also the general cleanliness of the mill is a most powerful factor in keeping up the spirits of the men and in insuring the healthy life of the machinery. You can be sure that in a plant where the floors are clean, where the windows have been washed, where small repairs are not made with patches, oakum, and electric light wires, it will also be true that the machinery will be in good shape and in good adjustment, and that the metallurgical efficiency will be high. Where a plant is expected to be kept spick and span the designer and the management must do their share in arranging the plant so that everything can be kept clean. If the management makes serious efforts in this direction by repairing against the sources of uncleanliness, it can exact from the men a strict observance of the rules, but where the cause of the trouble lies in some congenital defect of the plant it is impossible to expect the men to devote a good part of their efforts to cleaning.

Some of the modern ore-dressing plants have been carried to such a degree of refinement, you could almost say of comfort, that they have been subjected to criticism. In these plants some details may have been carried too far, but in a general way I believe that the capital invested in refinements will bear return interest in reducing the cost of operation and increasing the metallurgical efficiency. To understand the far-reaching importance of these refinements it is best to consider the effect of reversed conditions.

In most old plants, and even in some new ones, you will find some machinery which has become the 'Cinderella' of the plant. Generally it is a piece of machinery that has been squeezed in some forsaken hole as a make-shift, very often to repair some error committed elsewhere or to bear the burden of insufficient foresight. Whenever this happens, it is almost hopeless to prevent the machine from degenerating to the last stage to which iron and steel can fall, and all that is asked from the machine is that it should be gracious enough to keep on running so that other parts of the plant may operate undisturbed. In such cases the irritation caused by perennial troubles, destroys all feeling of friendliness, and, instead of care, the machine receives little else but oil and cuss-words. To repair such a state of affairs it is useless to reproach the men; the odious conditions have spoiled their spirit, and the only remedy is a radical change.

These conditions lead us to another item—I should say to *the* item—where the human element must be remembered, and this is the designing of a plant. Our friend, T. A. Rickard, in his numerous papers on technical writing reiterates, "Remember the reader." In the same way the engineer who designs an ore-dressing plant should repeat to himself, "Remember the millman." The general principles governing the design of a plant, I will take up some other time. What I wish to emphasize now is that an engineer in deciding about the general arrangement of the mill, the spacing of the machinery, the distribution of the floors, the division of buildings, and so forth, must constantly keep in mind the fact that the plant is going to be operated by human beings. These human beings are going to be the prime movers of that great living, pulsating organism that is a modern ore-dressing plant; they are the governors that control and balance one part with the other. These human beings are the most important pieces of machinery in the whole plant.

This all-important human side of the mill design cannot be studied at school; it is only by practical experience, chiefly by the repeated method of committing errors, that we learn this difficult art of what men will do under given circumstances. To analyze this question thoroughly would lead us too far; a few examples will illustrate the principles.

First of all, a human being is only capable of a certain amount of physical effort and mental strain; if overtaxed beyond this limit, a man will instinctively lighten the load by shirking work and neglecting things; if not kept sufficiently busy a man feels unhappy and becomes lazy. The mill, therefore, must be so arranged as to allow of an equitable distribution of labor. All operations ought to be made as easy as possible because the greater the ease the more care can a man bestow on his work and the greater the volume of work that can be entrusted to him. As an instance: where a table floor is arranged in such a way that the operator can see at a glance the operation of many machines, one man can operate a greater number of tables than when the tables are distributed irregularly and on different floors. The men must not be distracted from their work and therefore it is essential that none of the secondary or subsidiary machinery of the plant should ever become the source of trouble.

Arrangement of Equipment

Launders, feeders, pipes, transmission machinery, and so forth do not perform selective work of any kind; they are supposed to operate without requiring intelligent attention, and if any of these mill-parts give trouble the men are distracted from their more important duties, that of watching the machines where the money is earned. A good illustration of this are launders which, owing to insufficient grade, are affected by chronic congestion. A launder of this kind will periodically call the men away from their work and thoroughly disgust them by necessitating frantic efforts that are absolutely uncalled for and which could have been avoided by more foresight and care.

Not only ought operations to be made easy, but everything ought to be arranged in such a way that any work may be performed without personal discomfort. As example, if insufficient space is left under some machine or if the space is wet, dark, and dirty, you can be sure that the men will let things go pretty well to the bad, before making up their minds to crawl into that ugly hole for making necessary adjustments and repairs.

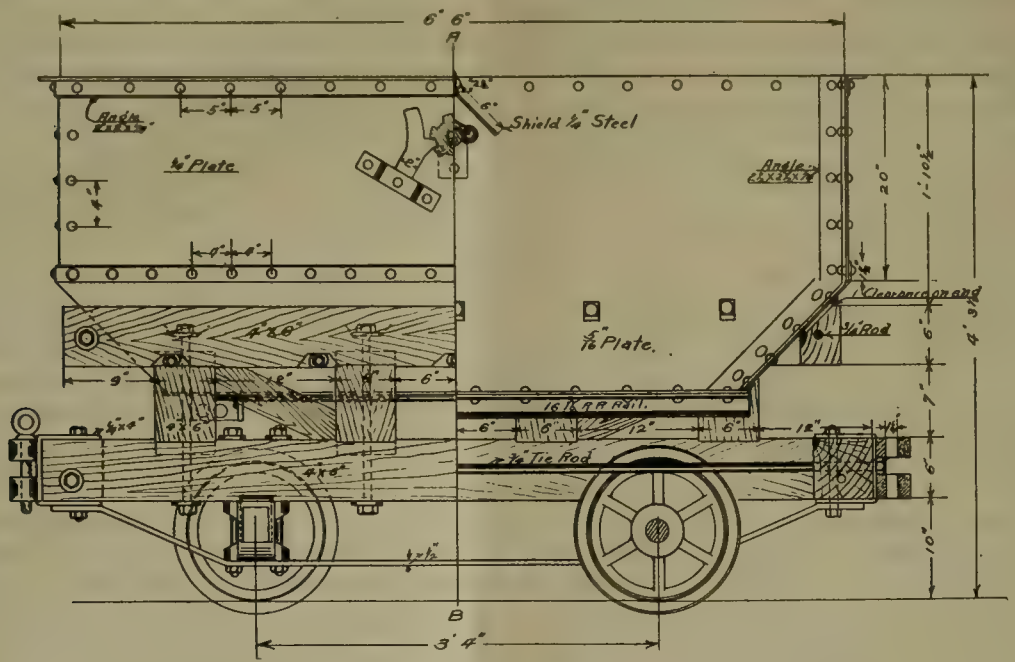
In a similar way the provision of good facilities for adjusting the concentrating tables, will increase the economic efficiency of the mill; where the exact division of concentrate from middling, and middling from tailing can be attained by simply shifting with one finger a galvanized iron splitter, these small adjustments will be done more frequently and more carefully than if the operator has to crawl below the machine to tilt the table.

In one mill I had occasion to study, the building was poorly designed and constructed for a cold climate; in addition to this the table floor was heated by one solitary radiator which was in proximity to none of the machines and during the cold winter nights the millmen would huddle together around the only warm place in the plant, almost completely deserting their machines. The removal of this friendly radiator to a more central position greatly increased the mill efficiency during the cold season.

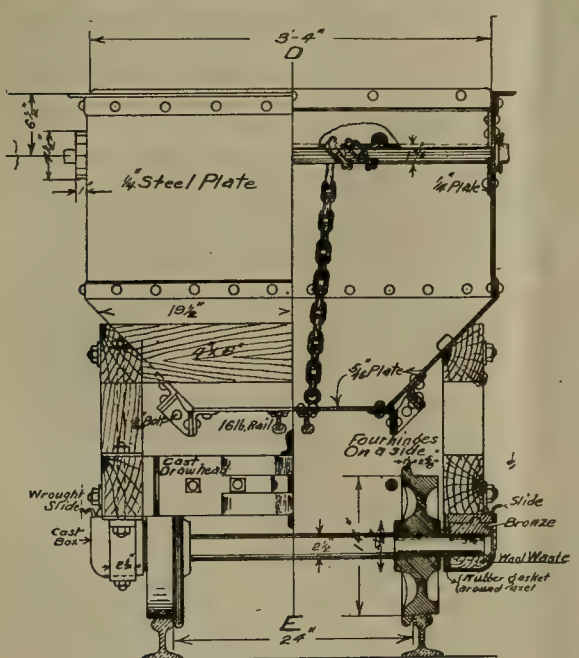
The various aspects of the human side of the milling that I have mentioned may give an idea of how more could be said about this subject; to cover the ground more extensively would be straying too far from the traditional curriculum of ore-dressing.

Many of the statements made may appear commonplace, but it is astonishing to see how many of these commonplace principles are either ignored or disregarded in practical life.

The human element is the prime mover of everything. More so, it is the fundamental basis of success or failure in life. The men that have succeeded are the men who have known how to handle men, and it is my conviction that a man's success in life depends far more upon his knowledge of human nature than upon his fund of human knowledge.



SIDE ELEVATION. SECTION D-E.



END ELEVATION. SECTION A-B.

The Coeur d'Alene Mine-Car

By Ulysses B. Hough

Above are presented scale drawings of a centre-dump steel mine-car used in the Coeur d'Alene lead mines of Idaho. The mines of this district are opened by means of adits extending three to six miles into the mountains, and electric locomotives are used for haulage. Ordinary mine-cars are not adapted for this service, being too light, of too small capacity, and requiring too much time for unloading. The car illustrated weighs 2200 lb., has a capacity of 49 cu. ft., and costs $105 to $225, depending upon the exact method of construction. The body is made of ¼-in. steel plate put together with ½-in. rivets. All bolts are of ¾-in. diameter. The figures show side and end elevation with cross and longitudinal sections.

The Rand Banket—Part VI

By C. B. Horwood

The particular banket series chosen by the mineralizers as maximum channels of circulation, in which deposition of their gold and pyrite has occurred, and the reason for such selection, has been discussed. The extension of the gold contents both along the direction of the strike of these beds of conglomerate and in depth has also been considered. The distribution of the gold as between the various members of the series has been described; also the fluctuations in the amount of the gold contents between the two leaders, which represent the profitable seams of the two subdivisions of the series.

It will now be well to review the question of the much-discussed and sometimes disputed presence of 'shoots', and of local enrichment due to dikes. Afterward, mention will be made of some of the local indications of relatively rich ore in these lodes.

The Occurrence of Shoots

Weed believes that the satisfactory explanation of the occurrence of ore-shoots is one of the most difficult problems in the study of ore deposits.[245] Posepny showed that fissures do not provide, throughout their entire length, spaces of uniform width, and that only those portions remaining open permit active circulation of solutions and regular deposition from them; hence, at obstructed parts there would be either no circulation or only a sluggish one, thus explaining how on the same vein-plane rich deposits alternate with poor or barren zones. He stated that "from the genetic standpoint, the richer portions are interesting as sometimes occupying more or less regular belts in the vein-plane, called 'channels,' 'shoots,' 'chimneys,' etc. These names evidently designate the main channels through which the mineral solutions passed; and the occurrence of such forms in most kinds of deposits tends to prove that, notwithstanding other differences, they were all formed in a similar way."[246] From the facts already enumerated and from what follows it will be sufficiently clear that the gold deposits of the Rand form no exception; to them also the same reasoning can be applied.

As already emphasized when dealing with the extension of ore along the direction of the strike and with the fluctuations in yield between the two leaders (which represent the principal gold-carriers of the two sub-series of banket), fairly regular alternations between rich and poor ground occur along the strike, and these extend in depth. The extensions in depth are generally not at right angles to the line of strike; they have more or less pitch; that is, the rich or poor ground, as the case may be, has a trend that forms an angle with the line of strike.[247] This angle is almost invariably greater than the one made with the direction of the dip of the banket; that is, in nearly every case the direction of the longer axis of the orebody is downward, rather than parallel to the line of strike of the banket. The definition of a 'shoot' is an orebody that forms a sort of continuous column.[248] Experience has shown that these columns die out eventually in depth. Gregory[249] has tried to maintain that, in the Rand conglomerate, the gold exists in patches and not in shoots, as is proper in a placer deposit, whereas if the gold were introduced by filtration it should be present in shoots. His attempt is far from convincing, nor has he defined his terms. Marriott,[250] who maintains that the gold does not occur in shoots, has stated that "the consistently richer portions lie in a series of irregularly shaped areas of which the units can be observed as measuring roughly up to five thousand feet by two thousand five hundred feet on their major and minor axes."

The context indicates that he admits that the major axes make the lesser angle with the direction of the dip of the banket. The attempt to distinguish between 'patches' and 'shoots' seems somewhat labored. Whichever they are termed (although, according to the amount of pitch, they may course more or less diagonally across the banket beds), their general direction is downward, and therefore they come under the definition of 'shoots.' Richard Beck,[251] in discussing Gregory's paper, said that the argument based on the difference between shoots and patches seemed to him to prove very little, as in true quartz veins, as well as in placers, there are areas that are either elongated in one dimension and are termed shoots or channels, or of irregular shape and termed patches. J. Malcolm Maclaren[252] pointed out that in actual mining practice no distinct line of separation could be drawn between patches and shoots. He rightly said that "if the presence of patches rather than shoots were admitted as a sufficient criterion of the alluvial deposition of gold, then many of the world's richest gold mines, for example, Waihi and Mount Morgan, must be grouped under the heading of alluvial deposits. Certainly, so far as might be judged from the literature of the subject, there appeared to be more evidence in favor of shoots on the Rand than in either of the mines mentioned." De Launay[253] stated that the theory that the gold was formed after the bankets would afford a good explanation for "the variations in the grade of the ore, as it is observed in following the line of the outcrop from one claim to

[245] W. H. Weed (1903), *loc. cit.*, p. 553.

[246] Posepny, *loc. cit.*, p. 14.

[247] "The inclination of a shoot in the direction of the strike is called its pitch." 'A Text-Book of Ore and Stone Mining,' by C. Le Neve Foster (1894), p. 11.

[248] C. Le Neve Foster, *loc. cit.*, p. 11.

[249] "The Origin of the Gold in the Rand Banket,' by J. W. Gregory, *Trans.* Inst. Min. and Met., Vol. XVII (1907-1908), pp. 21-23.

[250] "The Problem of Gold in Depth,' by H. F. Marriott, *South African Min. Jour.* (21st Ann. No., Sept. 1912), p. 69.

[251] Discussion on Gregory's paper, 'The Origin of the Gold in the Rand Banket,' *loc cit.*, p. 61.

[252] Discussion on Gregory's paper, *loc. cit.*, p. 50.

[253] 'Observations on the Rand Conglomerate,' by L. De Launay. *Eng. & Min. Jour.*, April 4, 1903, p. 521.

another, and likewise the relative uniformity of zones, rich or poor in sinking on the dip, while the placer hypothesis would appear to require a uniformity along a line parallel to a primitive coast and a progressive decrease in richness as distance is gained transversely to the shore line." The general direction of the pitch is not always the same; it varies in individual cases. For example, there is a distinct shoot of relatively high-grade ore, which might be termed the York-Luipaard's Vlei shoot, which was formerly worked in the York mine. It trends from northwest to southeast into the Luipaard's Vlei mine and has a pitch of about 40 degrees.[254]

The Shoot on the Near West Rand

Another well known example of a shoot of good ore occurs on the near West Rand. This has a pitch to the southwest and runs from an outcrop mine into a neighboring deep-level. Some of the best examples occur in the Nigel district. The successful operation of the Nigel mine depends on the presence of shoots of good-grade ore.[255] These are admitted to be 'shoots' even by the most ardent disbeliever in the presence of shoots on the Witwatersrand proper. The Nigel Reef series is held, with good reason, to be the same as the Main Reef;[256] if this be so, then the existence of shoots must be admitted for the Witwatersrand also. On the Central Rand, the rich ground of the Pioneer and Robinson outcrop mines extended in depth into the Bonanza and Robinson Central Deep mines and passed again in depth into the Robinson Deep; this surely partakes of the ordinary nature of a shoot? Gregory[257] admitted that J. Hays Hammond referred to "unquestionable evidences of ore-shoots in the Nigel and Rietfontein mines"; and that Hatch and Chalmers maintained that "there are instances of distinct shoots in the New Rietfontein, the central portion of the Simmer & Jack, and in the Meyer, Leeb, and Orion properties." Gregory pointed out that the bankets in the New Rietfontein mine and at the Meyer and Orion mines are not those of the Main Reef series. Although those at the former belong to the Du Preez series and those at the two latter mines to the Black Reef formation,[258] yet in every case they are conglomerate beds. It has already been shown in this paper that the mineralization in the first of these cases was doubtless contemporaneous with that of the Main Reef series; and later it will be shown that the gold in the Black Reef conglomerates was also, in all likelihood, introduced at the same time.[259] Therefore this discussion applies in these instances with equal force. E. J. Way[260] has stated that in the Kleinfontein mine there are five distinct shoots, which vary in width from level to level; that the company's system of development was based on their presence; and that it was known from level to level, as depth was gained, approximately to within a few feet, where they would be encountered. The writer's experience, as a mine manager on the Rand, is that in almost every mine there are shoots, that is, more or less vertical stretches, of ore of relatively higher grade than the average for the mine; their presence influencing both the development and stoping policy. In consequence of the physical nature of the beds (which have been appropriated by the mineralizing solutions in preference to ordinary fissures), including their great extent along the strike, the more or less vertical columnar orebodies of higher grade are often much larger than is usually the case in normal fissure-veins. When the ground between such zones on the one 'reef', or layer of banket, is poor or unprofitable, the yield of that portion (lying opposite to it) of the other parallel seam frequently compensates for this; consequently, less attention is attracted to the fact that richer and poorer columnar masses exist than would be the case were these mines not twin mines but merely dependent on one lode alone.

The Influence of Dikes

Gregory,[261] in discussing the connection of gold ore with the dikes, admitted that "if a connection between the dikes and the ore values had been established for the Rand as a whole, the fact would have given powerful support to the infiltration theory." He then quotes J. Kuntz as having maintained that the banket was the richest in the proximity of dikes. He admitted that, in places, the dikes have influenced the enrichment; he described an example in the case of the Worcester dike and stated that a similar case occurs in the Ferreira mine. He also quoted a case of enrichment between the arms of two dikes in the Meyer & Charlton mine.[262] Further, he admitted cases in which faults appeared

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[254]'Mines of Africa' (1913), by R. R. Mabson (published by *The Statist*, London), p. 375.

[255]R. Curnaw, manager of the Nigel mine, in his report for the year 1912 made constant reference to these shoots. The chairman of the company did so, in greater detail, at the annual meeting in May (1913).

[256]F. H. Hatch (1904), *op. cit.*

[257]J. W. Gregory, *loc. cit.*, pp. 21 and 22. See also the discussion on Gregory's paper by F. H. Hatch, *loc. cit.*, p. 46.

[258]G. Denny in his book, 'The Klerksdorp Goldfields,' pp. 141, 175-176, and 184, speaks of shoots in the Black Reef banket in the Klerksdorp district.

[259]L. De Launay, ten years ago, pointed out that if the gold was formed since the conglomerates, then also the advent of the pyrite must have been subsequent to the deposition of the banket beds, so that we have to deal with a lode formation of hydrothermal and deep origin of a special type. The Rand ore deposits being a simple but particular case of the type of deposit represented by the various formations, of South Africa, which carry gold-bearing pyrite. They have been produced under pressure and in depth by mineralizing waters from an eruptive magma; and, during the intrusion of the ancient granite, or during the period marked by the Black Reef, or even much later, a far-reaching emanation of sulphide waters must have affected different geological formations, throughout South Africa. He pointed out then that there were those, on the Rand, who admit a relationship between the gold and the basic dikes. Since De Launay wrote this, it is now known that the Witwatersrand beds are younger than the ancient granite, on which, and the Swaziland series, they were laid down; and, therefore it is not to this ancient granite that one must look for the source of these emanations.

[260]Discussion on J. W. Gregory's paper on 'The Origin of the Gold in the Rand Banket,' *loc. cit.*, p. 47. Mr. Way was formerly general manager of the Kleinfontein group of mines.

[261]J. W. Gregory, *loc. cit.*, p. 24.

[262]Described to him by M. Ford, who was then manager of this mine. J. W. Gregory, *loc. cit.*, p. 24.

to be connected with the deposition of gold, and gave an example. In face of all this, he then attempted to minimize the importance of such cases and said that similar differences could be seen in places as near together, and not separated by a fault, as those sometimes recorded in the assays on the two sides of a dike or fault. He maintained that "the sudden differences in value of the reef on two sides of a dike or fault may be due to movements long after the deposition of the gold. Many of the dikes have been introduced along fault-planes, and the faults have shifted the country, bringing patches of barren reef against patches of rich reef." If the displacement produced by the main faults and dikes that have influenced the distribution of rich ore were in a lateral direction, this reasoning of Gregory's might have some weight.

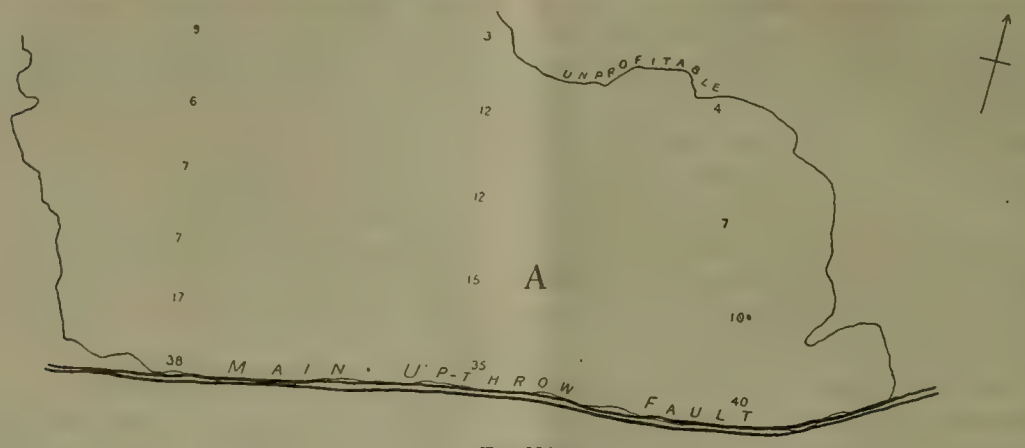

FIG. 28A.

The Main Structural Faults

The main structural faults are parallel to the strike of the beds and have been produced by pressure exerted at right angles to this strike; and the longitudinal dikes intruded as a result of the fracturing and faulting are also parallel to the strike of the banket beds. Reversed faulting[263] has ensued, producing vertical displacement of the beds, with, generally speaking, little or no lateral displacement. So Gregory's argument does not hold. Moreover, there is often distinct enrichment of the banket on both sides of a dike. Numerous instances of this are known; for example, those associated with the Ferreira-Crown Deep dike. A. D. Bacon, formerly general manager of the Langlaagte Estate and Langlaagte Block B. mines, told the writer that there was distinct enrichment on both sides of the Ferreira-Crown Deep dike in these mines, and that it continued for two levels on the south side of the dike. An enrichment due to the Crown Reef dike has already been described in the first part of this paper in connection with the occurrence of pyrite 'pebbles' in the Crown Reef mine. R. B. Young[264] states that "banket and quartzite at their contact with dikes are sometimes crowded with well formed crystals of pyrite." He illustrates his remark by a micro-photograph showing chloritized banket from the Main Reef Leader near its contact with a basic dike in the Robinson Deep gold mine; and the close association between the pyrite and gold in the banket has already been discussed in this paper. Denny,[265] writing of the Buffelsdoorn 'reef', near Klerksdorp, stated that the gold in this banket was confined within a recognized distance of a dike, maintaining throughout a well defined parallelism, and beyond this limit there was no profitable ore. Truscott,[266] commenting on this, points out that the presence of the gold is thus evidently due to the dike, which he says is either a portion of the diabase underlying the Black Reef formation,[267] or is a separate intrusion lying closely under that diabase. An example, in the Worcester mine, at Johannesburg, to which Gregory refers, had been described by J. Hays Hammond.[268] He speaks of the dike as being in the upper levels immediately above the Main Reef Leader and there the hanging wall portion was very much richer than the foot-wall portion of the banket, and maintained this character until, in the lower levels, the dike, having cut across the banket, formed its foot-wall, when the gold contents were found on the foot-wall side of the reef. Truscott[269] also refers to this case. Hammond[270] also mentioned an interesting occurrence in the Ferreira mine, at Johannesburg, of a dike containing a considerable amount of visible gold. This dike was below the South Reef and separated from it by several inches of vein-quartz, which was auriferous. Associated with the banket beds, sometimes following, sometimes crossing the formation, or intercalated with the banket, were numerous quartz veins, which usually carried little gold, but in places were very rich. Many of the quartz pebbles were cracked, but had been re-cemented by secondary silica. Films of gold were frequently found along these cracks. Truscott[271] also described this occurrence. The distinctly

[263] This reversed faulting has produced an up-throw, or upward displacement, of the beds on the southern side of the east and west, or longitudinal dikes. The vertical amount of displacement is often as much as 250 ft. By such faulting the tonnage of ore per claim-area is increased.

[264] R. B. Young (1909), *loc. cit.*, p. 89.

[265] George Denny, *op. cit.*, p. 89.

[266] Truscott, *op. cit.*, p. 58.

[267] That is to say, the Ventersdorp diabase.

[268] Truscott, *op. cit.*, p. 127.

[269] Truscott, *op. cit.*, pp. 110 and 111.

[270] Truscott, *op. cit.*, p. 127.

[271] Truscott, *loc. cit.*, pp. 111 and 112.

favorable influence exerted by the big longitudinal dike, known as the West Reef dike, on the ore in some of the Randfontein mines was pointed out by the writer in the second part of this paper. This case is somewhat similar to that in the Worcester mine, on the Central Rand, inasmuch as the upper portion of the West Reef is richer where immediately overlain by this dike. Where the dike is absent the foot-wall portion is the richer. The accompanying Fig. 28A, 28B, and 28C represent the plans of three stopes in the central section of the New Rietfontein Estate mines. The western one, seen in Fig. 28A, is on the 8th level and is 630 ft. vertically below the surface; the central one (Fig. 28B) is on the 7th level, at a vertical depth of 550 ft., and is 900 ft. east of the one in Fig. 28A; and the eastern stope (Fig. 28C) is on the 6th level, at a vertical depth of 470 ft. and 500 ft. east of that in Fig. 28B. These stopes are terminated on the south by what has been termed in these mines the 'main up-throw fault.' The figures on these plans represent the approximate assay-values in pennyweights per ton (as taken from the stope-sheets) of the various portions of these workings. In every case the sections through the stopes are as shown, diagrammatically, below:

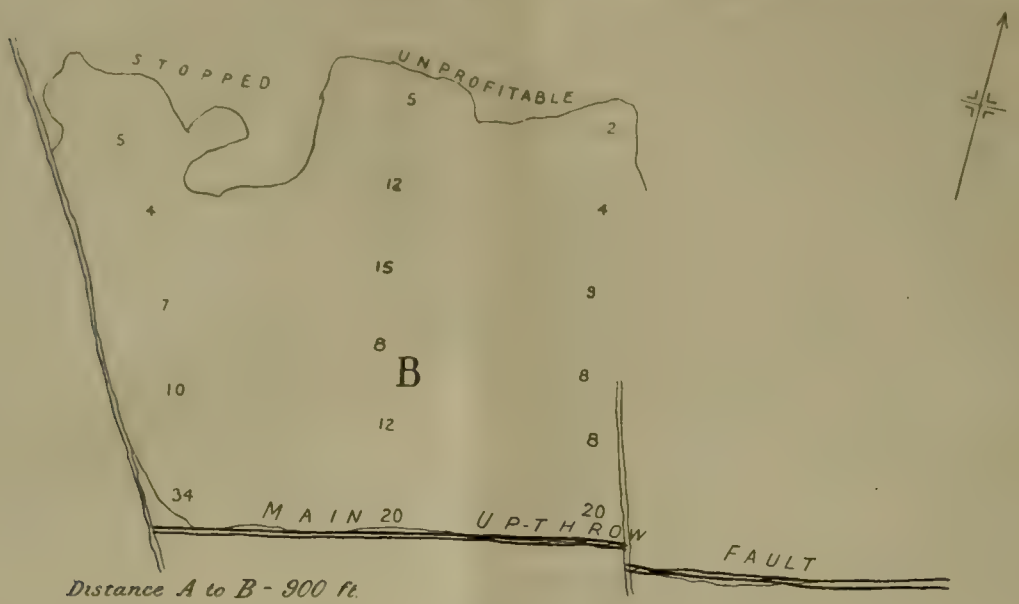

FIG. 28B.

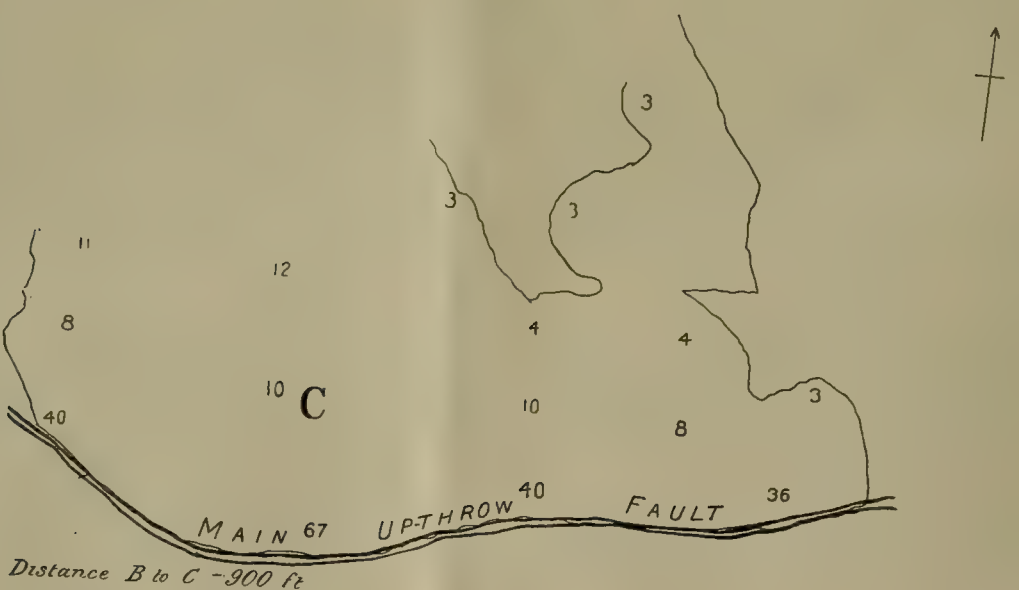

FIG. 28C.

SECTION THROUGH STOPE.

That portion of the lode that is illustrated in the above sketch by a shading invariably has an assay-

value of from 20 to 60 dwt., irrespective of the yield in the northern, upper, portions of the stopes. This fault can be clearly traced for a distance of about 5000 ft., and in every stope its effect was similar to that in the three just described.[272]

Transverse Dikes

The numerous transverse dikes observed in the mines of the Rand are of later date than the longitudinal or strike dikes, as is evident from the fact that the latter are often faulted by the former. As already mentioned in a footnote in the third part of this paper, these transverse dikes mark the position of radial fissures, which constitute one of the features obtaining around centres of igneous intrusions, and which are really contraction-cracks due to the cooling of the igneous mass. When such fissures extend in depth to the molten magma they are filled, and dikes result. Consequently these transverse dikes are, in all probability, of only slightly later date than the longitudinal ones, which are also due to the contraction of the igneous mass. In some cases, with which the writer is acquainted, they have produced distinct enrichment of the neighboring banket; but the longitudinal dikes have, speaking generally, certainly exerted a far greater influence in this respect; and although they have not invariably affected the richness of the ore, yet it seems reasonable in mining to expect that the gold contents may be affected by these dikes; and the experience of the writer has been that they usually are affected either on one or both sides of the dikes. A connection between these longitudinal dikes and the gold contents has now been sufficiently established for the whole Rand.[273] Where there is no reason to believe that the gold was originally deposited elsewhere and has since been dissolved and re-precipitated, a thin film of gold is sometimes found on the surface of these longitudinal dikes,[274] clearly indicating that the deposition of the gold occurred after their intrusion.

Local Indications of Good Ore

Gregory[275] rightly asserted that mining engineers on the Rand claim to have noted a connection between the richness of the banket layers and their physical characters, and that they can often distinguish at sight between rich and poor ore. Locally, managers and mine foremen, if the ore comes from their own mine, can tell by its appearance whether it is rich or poor. Few, however, have sufficiently analyzed the reasons why they are able to do so, to be able lucidly to explain the characteristics indicating good ore. Gregory argues that these features are those connected with the original deposition of the conglomerate and consequently support the hypothesis of a detrital, or placer, origin of the gold. It will, however, be seen from what follows that only the first mentioned of the many characteristics, to be described, is connected with the original deposition of the banket; the remainder are due to causes that have operated since the conglomerates were formed, and probably late in their history.

(*a*) *Large Pebbles.*—Gregory, after quoting the following from Becker,[276] "It is well recognized on the Rand that, other things being equal, the coarser pebble carries the greatest quantity of gold," goes on to say: "Prister[277] reports that it is the opinion prevailing among mine managers that conglomerates with big pebbles are a good indication of gold, an opinion which is often confirmed." Gregory then states that this was the late Wager Bradford's[278] experience in the Langlaagte Deep mine; and also Fred Hellman's[279] in the East Rand Proprietary mines. He then states that "taking the mines along the Rand, the occurrence of big pebbles is generally regarded as favorable to the existence of good ore values," with which statement the present writer entirely agrees; but he does not agree with Gregory that in this case it is an argument in favor of the placer theory.

That the conglomerate beds were more easily permeated by the mineralizers than the sandstones has already been shown; and, in the same way, other things being equal, the larger the pebbles of the conglomerate the easier the channel presented to ascending, deep-seated, mineralizing solutions. This directly explains the frequent association, in the banket, of large pebbles with rich ore. The Main Reef Leader often contains large pebbles, up to 4 and sometimes as much as 6 or 7 in. long, and one can then rely upon its good grade. It is an excellent example of the occurrence of large pebbles in conjunction with rich ore.

(*b*) *Much Pyrite.*—Other things being equal, the presence of more than a usual amount of iron pyrite in the banket is usually, though not invariably, an indication of good ore. This is only what one would expect, since the gold of the banket is to a large degree mechanically bound up in the pyrite.

(*c*) *Pyrite 'Pebbles.'*—In the first portion of this paper, it was demonstrated that these 'pebbles' are in every case metasomatic products, formed after the deposition of the banket by metasomatic agencies similar in all essentials to those familiar to us in the case of normal fissure-veins. The invariable association of the so-called 'pebbles' of pyrite with good ore was considered of such importance, in relation to its bearing on the origin and period of the gold deposition, that it was separately dis-

[272] The above details and diagrams, in connection with this fault in the Rietfontein mines were given to the writer in 1911 by F. Graham Bell, who was then general manager of these mines.

[273] In the case of a goldfield like the Rand, where the mines are being actively worked and so many interests are involved, there are obvious reasons why all the examples with which one is acquainted cannot, at the present time, be quoted.

[274] The writer has found good examples of such occurrences; and in some the films of gold exhibit four slickenside surfaces, demonstrating that some movement has occurred after its deposition.

[275] Gregory, *op. cit.*, p. 17.

[276] 'The Witwatersrand Banket,' by G. F. Becker. 18th Ann. Rep. U. S. Geol. Surv., part V (1897), p. 168.

[277] 'Notes on the Origin and Formation of the Witwatersrand Auriferous Deposits,' by A. Prister. *Trans.* Geol. Soc. So. Af., Vol. IV (1899), p. 27.

[278] Wager Bradford was, at the time of Gregory's visit to the Rand, manager of the Langlaagte Deep mine.

[279] Fred Hellman was general manager of the East Rand Proprietary mines.

cussed in Part IV of this paper. It might be well to call to mind that it was then shown that the gold and pyrite were introduced into the banket after the intrusion of the dikes. Further, it was indicated that the intimate association of the gold and pyrite and the fact that the pyrite replacements are a sure indication of gold, suggest that both were deposited from the same solutions, in which possibly they may have been present as a eutectic mixture; and, if so, the difficulty of imagining the high temperatures otherwise necessary to vaporize the minerals and metallic elements of veins would at once disappear.

(*d*) *Carbon.*—The presence of carbon in the ore is an almost certain indication that it is of good grade. The first detailed account of its mode of occurrence in the banket is that by R. B. Young,[280] who described it as being found in small, black, opaque nodular grains, having a somewhat warty dull surface, and ranging in diameter from one millimetre downward, sometimes blending together into a compact mass of anthracite appearance. He mentions that at the Rietfontein mines it occurs not only in nodular grains, but also in veinlets, up to two millimetres thick, with a columnar structure, the columns being perpendicular to the walls; and, between the columns, thin films of sericite are generally present.

Distribution of Carbon

He states that in his specimens the carbon lies along, or close to, a parting, generally a bedding-plane, but in some cases a crack oblique to the bedding, and that the carbon is frequently wholly or partly embedded in secondary quartz. After calling attention to the association of gold with carbon, he remarks: "There are features in the distribution of carbon in the bankets and associated quartzites which suggest that it may not have been an original constituent of the rocks in which it is found, but was introduced at a later date. This, however, requires a fuller investigation than I have been able to give it." He then adds: "The association of graphite with gold in some of the Australian goldfields is well known. In the Croydon goldfield, in Queensland, the auriferous quartz veins are found in a much disturbed and altered zone of granite containing graphite." George G. Holmes[281] informed the present writer that in the Buffelsdoorn mine, near Klerksdorp, the carbon occurs in small granules a foot or so above the foot-wall of the gold-bearing quartzite, and scattered over a distance of some feet, and that when carbon is present the quartzite generally contains good gold values whether pebbles are present or not; for instance, there are places where assays give 1 to 1½ oz. of gold over about 6 ft. and where no pebbles occur, but small granules of carbon are scattered through the rock. The carbon also occurs in small veinlets up to ⅛ and ¼ in. wide. There, experience has proved that carbon is a sure indication of the presence of gold. Carbon can be detected in the ore that is mined in probably most of the mines along the Rand; but only in a few is it sufficiently in evidence to be a characteristic feature. These are the Rietfontein mines, on the East Rand, and the Randfontein mines on the far West Rand. Carbon occurs also in noticeable quantity at the Buffelsdoorn mine, and in the Black Reef banket at the Machavie mine, between Klerksdorp and Potchefstroom. Gold can be found not only as a film on the particles of carbon, but it has also been observed, by the writer, actually imbedded in the carbon; he has also seen in Rietfontein and Randfontein specimens the columnar structure (which Young noticed in the carbon) in both gold and carbon, the former being enclosed within the latter. In examining under the microscope thin sections of banket showing carbon from the Carbon Leader and Buckshot Reef from Rietfontein, from the Randfontein Leader, and from Buffelsdoorn, the writer found that the most noticeable features are the intimate association and intergrowth of the carbon with gold, the latter not only frequently lying round the carbon grains, but also occurring as particles entirely surrounded by carbon, while the carbon grains often contain minute specks of gold scattered through them; the frequent and close association of the carbon and pyrite, which is particularly noticeable in the Buckshot Reef; and the frequent association of sericite with free gold and carbon. These facts, together with the presence of carbon in small irregular spheroids (frequently, owing to the way it is imbedded in the matrix, resembling circular flat flakes) scattered through the matrix of the banket, but more abundant along its immediate foot-wall; and, further, its almost invariable presence in close association with 'buckshot' pyrite, when the latter is present, cannot well be explained by any theory of organic origin. When subjected to destructive distillation, the writer found that the carbon yields traces of oil, indicating the presence of hydrogen in other form than in combination with oxygen as water. The writer's investigations showed that, in some cases, when heated in a closed tube, it swells up like sprouting graphite, and vapors are evolved that have a characteristic smell, and these, on cooling, condense as oil on the upper portion of the tube. In both cases the presence of hydrocarbons is suggested. Having made a careful study of the occurrence of carbon in the banket in those mines of the Rand where it is most typically developed, the writer, some few years ago, embodied the results of his investigations in a paper;[282] while it was going to press, R. B. Young[283] called attention to the relation of the carbon to the quartz in the matrix of the banket as suggesting that the carbon had, in some instances, replaced quartz; he had observed carbon in the pebbles in banket specimens from the Meyer & Charlton mine and from the Bon Accord mine; although it was generally in the neighborhood of cracks, it did not occur as a filling of these, so he (Prof. Young) con-

[280] R. B. Young (1909), *loc. cit.*, p. 86.

[281] George G. Holmes was at the time (1910), manager of the Buffelsdoorn mine. This is a banket mine about 70 miles southwest of Randfontein.

[282] 'The Mode of Occurrence and Genesis of the Carbon in the Rand Bankets,' by C. B. Horwood. *Trans.* Geol. Soc. So. Af., Vol. XIII (1910), pp. 65-86.

[283] 'The Replacement of Quartz by Carbon in the Rand Banket,' by R. B. Young, *Trans.* Geol. Soc. So. Af., Vol. XIII (1910).

cluded that it had replaced portions of the quartz of the pebbles. The present writer referred to this in a footnote in his paper and pointed out that similar conditions were exhibited by some of his own specimens and that in slides from Buffelsdoorn specimens and from the Carbon Leader from the Rietfontein mines the rounded grains of carbon appear sometimes to be intergrown with the quartz granules of the matrix, the latter being in some cases invaded by the carbon; and that in one of his hand specimens of the Leader from the North Randfontein mine an irregular grain of carbon, varying from one-sixteenth to one-eighth of an inch in thickness, with a thin leaf-like layer of gold around its edge, can be seen distinctly embayed into the edge of an oval-shaped light-gray quartz pebble of regular outline. Carbon can also be found in the body of a pebble where no cracks are to be seen, as the writer has observed in the Rietfontein Buckshot Reef and in the Randfontein Leader. This points to a portion of the quartz of the pebbles having been metasomatically replaced by carbon, even as it has been already shown that the quartz pebbles have, in some cases, been so replaced by pyrite; and it strongly suggests the agency of active magmatic vapors. In this paper (in 1910) the present writer traced the genesis of the carbon to the agency of the neighboring diabase dikes, which by numerous analyses he found contained carbon in appreciable amount.[284] From one dike, about 5½ ft. thick, he had samples taken from the centre 12 inches in the main cross-cuts, in the mine, from the 2nd down to the 15th level (both inclusive); that is, at distances apart of about 160 ft. over a total inclined length of 2080 ft., and between the vertical depths of 190 and 2090 ft. The result was that, except in two cases where only traces were present, carbon was found in quantities varying from 0.02 to 0.22%. He concluded his investigations on the genesis of the carbon with the following remarks:[285] "Its occurrence is closely associated with that of the pyrite and gold and indicates a close relationship between its presence and that of neighboring igneous rocks, which have, in the foregoing pages, been shown to contain carbon. It is difficult to account for the way the carbon occurs in tiny spheroids scattered through the matrix in Rand bankets other than that it was deposited from gaseous or very mobile liquid hydrocarbons, in a similar manner to that of the carbon mineral at the Mary mine as described by Kemp,[286] before the final cementation and induration of the bankets by the deposition of secondary silica; and, taken in conjunction with the known facts of its occurrence in other parts of the world, it is perfectly reasonable to attribute its origin to magmatic vapors or solutions derived from the neighboring basic igneous intrusions before their final solidification."

Source of the Carbon

One critic, in discussing[287] the writer's paper on the carbon in the bankets, admitted that he (the writer) had demonstrated that carbon occurs in the dikes; and further admitted that it must have been precipitated from some substance capable of finding its way along most minute cracks, but he (the critic) argued that it was not proved that the dikes were the source of the carbon, because, as he suggested, the carbon may have been introduced into both dikes and reefs from some other source.[288] Those who have made a careful study of ore deposits are agreed that the igneous rocks are the ultimate source of the metals; and, in studying any particular ore deposit, unless there is excellent reason for believing otherwise, if the same minerals are found in neighboring igneous rocks they are satisfied to ascribe the source of the minerals in the deposit to these rocks. The researches of numerous investigators (such as Armand, Gautier, Edouard Suess, Brun, Chamberlain, Weinschenk, Osann, and Kemp) have proved beyond question the abundant presence of deep-seated carbon and hydrocarbons in the earth's interior, therefore the same reasoning applies in the case of this carbonaceous matter as in the case of the metallic minerals of an ore deposit. In his paper the present writer pointed out that Kemp traced the origin of the graphite, or some closely related carbon-mineral, at the Mary mine to the agency of some gaseous or very mobile liquid hydrocarbon which had penetrated into minute cavities and had been subsequently changed to graphite; also that Walter McDermott,[289] in writing of the Silver Islet vein, in Lake Superior, described the occurrence of silver-bearing veins associated with a diorite dike, the latter being in places strongly impregnated with graphite. The silver mostly occurred native, but also as sulphide of silver. Stress was laid on the evident connection between the deposit of the silver and the region of graphite impregnation of the wall-rock, the silver occurring where these veins traversed those portions of the dike which were impregnated with graphite. Outside the veins the graphite rock itself frequently carried silver. The diorite and the veins in it were unproductive where the igneous rock was free from graphite. Cirkel[290] and Eugene Coste[291] have also called attention to this occurrence and to the association of graphite in mineral veins or rocks with

[284] In Greenland, graphite occurs in basalt porphyrite associated with native iron. See 'The Geology of Ore Deposits,' by H. H. Thomas and D. A. MacAlister. Ed. Arnold, London (1909), pp. 35 and 36.

[285] C. B. Horwood, *op. cit.*

[286] See 'The Deposits of Copper Ores of Duckstown, Tenn.' by J. F. Kemp. *Trans.* Amer. Inst. Min. Eng., Vol. XXXI, p. 261. Kemp mentions the presence of graphite, or some closely related carbon mineral, in occasional specimens of the ores from the Mary mine, and states that it appears "to specially favor the crushed masses and was probably of late introduction. It not only forms fine leaf-like aggregates, but, in thin sections, may be detected by the microscope as minute spheroids in the midst of other minerals such as calcite and chalcopyrite. It must have been introduced as some gaseous very mobile liquid hydrocarbon which has penetrated into minute cavities and filled larger cracks and has been subsequently changed to graphite."

[287] When owing to his absence from South Africa, he was not well able to reply.

[288] R. B. Young, *Proc.* Geol. Soc. So. Af., Dec. 12, 1910.

[289] *Trans.* Inst. Min and Met., Vol. XVIII (1909).

[290] 'Graphite, its Properties, Occurrence, Refining and Uses,' by Fritz Cirkel, Mon. Can. Department of Mines, Ottawa (1907), p. 19.

[291] 'Petroleum and Coals,' *Quart. Bull.*, Can. Min. Inst., No. 6 (1909), p. 151.

precious metals, the former remarking that graphite seems to be connected in some way with the occurrence of silver.[292] Weinschenk,[293] as the result of his investigations, concluded that carbonaceous matter and graphite is sometimes of plutonic origin and is formed in somewhat the same manner as cassiterite; deep-seated vapors probably containing carbon monoxide and its compounds of the cyanogen group and iron carbonyls, in the presence of water and carbon dioxide, ascended with the eruptive rocks along lines of fracture, and having become dissociated, set free the carbon to crystallize as graphite. In one locality he has proved this origin for graphite occurring in veins near the borders of a gneissic mass. Possibly a similar origin may be ascribed to the Cumberland graphite, which occurs in the basic dikes of Borrowdale.

As already mentioned in Part V of this paper, Kemp has remarked that the presence of even a small dike in any region is proof of the existence of a relatively large reservoir of igneous rock at some point beneath the surface, at unknown, but not great depth.[294] A dike may thus be considered a channel by means of which there was at one time free communication with the underlying molten magma, which latter may be looked upon as an abundant reservoir, or source, of the metals and of hydrocarbons and other compounds containing carbon.[295] Thus, in tracing the origin of the carbon to the longitudinal basic dikes occurring in the mines of the Rand, the results of the writer's investigations are well supported by the researches of other investigators who have worked along similar lines in other parts of the world.

(To Be Continued.)

The consumption of chrome ore is approximately 125,000 tons per year. Like many other slightly used commodities, the greater output of recent years has stimulated markets, so that the industrial uses of the metal have multiplied in a ratio sufficient to absorb the larger production. Prior to 1906 the trade disposed of some 60,000 tons of ore per year. The control was in the hands of a French group which controlled and regulated the source of the main supplies, which belonged to the Tiebaghi Company, and carried on operations in New Caledonia. The largest contributor to the world's output today is Rhodesia. It is a somewhat singular fact that the ore beds now being worked in that country were found in the Selukwe district in Matabeleland, and lie in a group of hills which have for many years been worked for gold, the output therefrom being nearly 10% of the entire Rhodesia yield.

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[292]It is interesting that silver occurs in Rand bullion to the extent of about 125 parts per 1000.

[293]*Zeit. für Prak. Geol.*, Jan. 1903.

[294]'The Rôle of the Igneous Rocks in the Formation of Veins,' by J. F. Kemp (1902), *loc. cit.*

[295]Thus the reasoning of the before mentioned critic may be likened to that of a person who seeing ice in a basin, thinks the ice in the frozen pipe and tap above it has been introduced into them from the same source as that whence the ice in the basin was derived; or, of a man who seeing coals in a truck at Newcastle concludes that the coal in the neighboring mines owes its origin to the same source as the coal in the truck.

Dredging by Hand in Siberia

By John Power Hutchins

In several parts of Siberia dredging by hand is now being done to recover gold or platinum from the beds of streams. The following is a description of the conditions under which such work is performed.

Conditions

The gravel must not lie in the bed of a stream having a maximum current of more than about 5 miles per hour; a faster current fills the excavation made by the scoop, and washes material out of the scoop while it is being hoisted. The maximum depth from the surface of the water to bedrock must not be more than 10 ft. If more, the length of scoop-handle is awkward, and the time consumed in hoisting reduces the capacity seriously. The gravel must be free, fine, and easily excavated; otherwise the scoop will not dig it. This method is applied extensively where there is an annual surface concentration on the bed of rivers. It is likely that it could be applied successfully in the Sacramento river, near Redding, California, where there is such concentration.

The Dredge

The dredge consists of a raft made of two sets each of 3 logs of about 10 to 12 in. diameter, and about 40 to 42 ft. long, bound together at both ends at distances of 3 and 7 ft. from them respectively. The binders are cross-logs securely mortised into the longitudinal logs. The over-all width is about 7 ft. A well about 2 ft. wide and about 30 to 32 ft. long is arranged beginning about 3 ft. from one end and extending to within about 7 ft. of the other end. The raft is anchored securely on 4 wooden spuds from 7 to 9 in. square, at each corner of the raft. These spuds are driven hard into the bottom of the stream with a heavy wooden maul and heavy wooden wedges are driven between the spuds and their holes to make everything stable.

A windlass, securely braced, is erected at the upstream end of the craft, and about 7 ft. from the end. This 7 ft. of the upper end is used as a platform upon which to dump gravel, as it is excavated and hoisted from the bottom. The windlass has 4 in. by 6 in. standards, 3½ ft. apart, and mortised into the logs of the raft. The drum, which is 3 ft. above the water, is 2½ ft. long, 8 in. diameter, and has a crank at each end with the iron handles long enough for two men to work at each.

There is a manila rope of ¾ in. diameter, fastened to a bridle, which is in turn fastened to each side of the scoop. The scoop is about 1½ ft. wide, 2 ft. long from back to point, which is shaped like that of an ordinary hand-shovel, and 1½ ft. logs on the sides. It is about 5 in. deep, and is made of ⅛ in. steel reinforced with a 3⅛ in. by 2 in. iron strap along each side. A wooden handle 14 ft. long, 4 in. by 6 in., is fastened to the scoop, near the upper end of the handle there are 1½ in. holes, 2 ft. between centres, through any one of which a round wooden stick can be fastened to use as a handle.

The method of operation is as follows: one man grasps the round wooden handle, which has

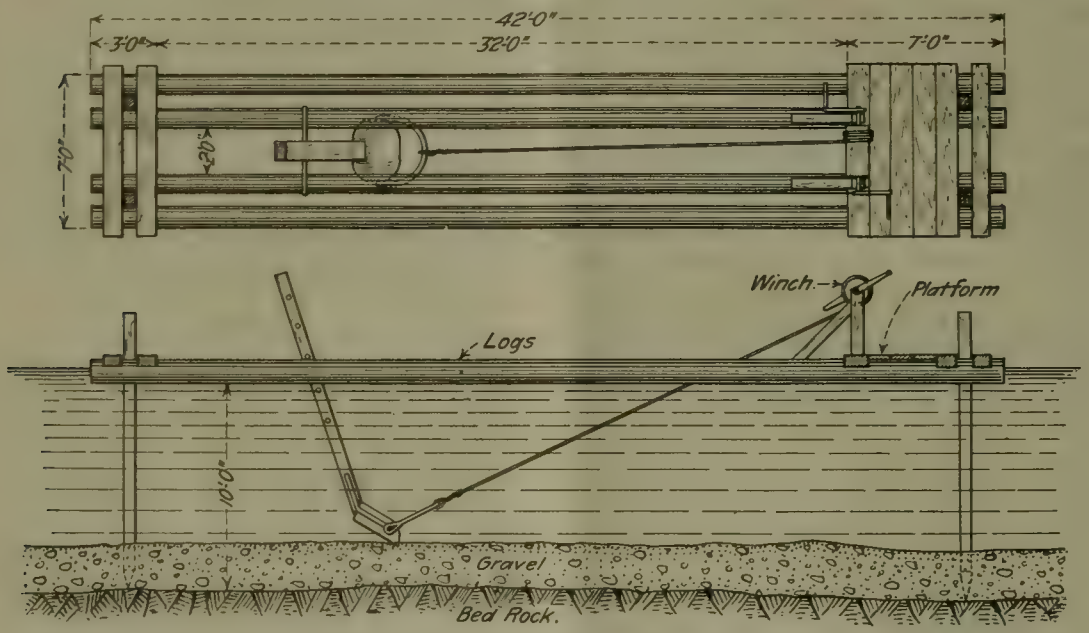
been fastened through the scoop-handle at a convenient distance, and walks back down-stream on one side of the well as one or more men reel out the rope at the windlass. When he has reached the end of the well and the scoop-handle is almost vertical, he puts his weight on the scoop by bearing on the cross-handle, and the men on the windlass slowly wind-in the rope, dragging the scoop along the bottom toward the windlass. When the scoop is thought to be full it is hoisted to the surface, swung over the platform, and dumped sideways, as the scoop-man twists the scoop-handle to the right by the wooden handle that is fastened through it. This completes a cycle of digging operations that may take two or

Crew

Thus a crew of 8 men is needed, 5 for digging, and 3 for washing, when the ground is hard; although sometimes, in easy ground, one man on the windlass, one on the scoop-handle, one on the pump, and one shoveling into the *Amerikanka* and screening, or four in all, will suffice. Women often do the pumping and washing in such hand-dredging operations in the Ural mountains.

Capacity and Cost

The capacity of an 8-man plant in loose gravel of medium size, working at a depth of about 8 ft., is from 2½ to 5 cu. yd. per 12-hour day. Counting



PLAN AND ELEVATION OF THE HAND DREDGE.

more minutes, depending upon the difficulty of excavating and the depth.

Four men usually work on the windlass, though often in hard ground two more, who ordinarily work the washing-plant, may also help. It is hard work, and the scoop is often only moved by four or more men jerking on the windlass handles together. When the gravel is hard, a hook is substituted for the bucket to loosen the gravel previously to digging.

The washing plant consists of an *Amerikanka* mounted on another log-raft about 20 by 6 ft. and also anchored with spuds, alongside the first raft. The *Amerikanka* is supposed to have derived its origin from America, but its resemblance to American gold-saving devices is a little remote. It is more like a long-tom than anything else. It is usually about 6 ft. long, about 1 ft. wide, 6 in. deep, and it has a fall of 2 ft. in 6 ft. There is a screen-plate at the upper end, and riffles made of twigs bound together with string are laid on the bottom. No quicksilver is used. A home-made wooden pump with a 4 in. barrel furnishes water.

The gravel is shoveled from the platform upon the screen by one man, another pumps water upon it, and a third rakes it back and forth over the screen, and shovels off the oversize when cleaned.

wages at 40c. per day, as in the Urals, this gives a cost of 64c. to $1.28 per cu. yd.; or in East Siberia, where wages are about 50c. per day, 80c. to $1.60 per cubic yard.

Missouri leads all the other states in the production of zinc and lead, according to figures compiled by the United States Geological Survey, in coöperation with the Missouri State Geological Survey. The total value of the mineral products of the state in 1912 was $58,332,550, an increase of $6,399,644 over 1911. The quantity of sphalerite concentrate increased from 217,812 short tons, valued at $8,680,550, in 1911, to 244,986 tons, valued at $12,346,922, in 1912, and the quantity of zinc carbonate and silicate concentrate increased from 20,119 tons, valued at $477,420, in 1911, to 22,172 tons, valued at $641,881, in 1912. The recoverable zinc content of the ores produced in Missouri in 1912 amounted to 136,551 short tons of metals, valued at $18,884,038, against 122,515 short tons, valued at $13,966,710, in 1911. The output of lead concentrate decreased from 258,240 tons, valued at $12,469,260, in 1911, to 256,838 tons, valued at $11,948,358, in 1912. The recoverable lead content of Missouri ores in 1912 was 177,069 tons.

Mining Problems and the Mining Congress

By D. W. Brunton

*The difficulties under which coal mining operations are carried on and the restrictions by which that industry is hampered have been so graphically described during discussions at our meetings elsewhere that it would be a waste of time for me to repeat them. Adverse as these conditions may seem, they are no worse than those under which precious and semi-precious metal mining is carried on in the West. In order that those of you who are not personally familiar with precious metal mining may understand the difficulties under which we operate, allow me to sketch briefly the discovery and history of a Western mine.

Location of the Claim

As soon as a prospector who has been tramping over the hills, perhaps for many weary years, discovers the outcrop of an orebody, he makes a location as prescribed by law, and by the time he receives the first assay returns on the ore he has exposed not only the ground adjacent to his location, but his claim itself will be covered two or three layers deep by conflicting locations, running in every possible direction.

He then proceeds to perform the $500 worth of work required by the government before United States patent can be obtained. When the work is completed, patent surveys made, and the advertising period ended, he finds himself face to face with a number of adverse claims, the fierceness with which these conflicting claims are fought being dependent, not so much upon the supposed rights of the people who are opposing him, as on the value of the mineral in his claim. The mine is not yet producing, he has no money to fight these adverse suits, and he must either compromise by conveying a portion of his discovery to the men who are attempting to rob him or give up an interest in his claim to some one with ready money who will finance his legal battles.

When this fight is over, if the surface openings still continue to carry ore in depth, he begins shipping, and before he has time to reap the reward of his labors, or accumulate a respectable surplus, he finds himself confronted with one or more 'apex' lawsuits. It is a most unusual thing for a mine to find its way into the producing stage without having to fight one or more 'apex' lawsuits, and all because our legislatures in 1872 gave us the most archaic law that was ever placed on the statute books. No other nation possesses such an antiquated, absurd, and irrational mining law, which, no matter what it was intended to do, has only resulted in a continued expense and annoyance to mine owners and big fees to lawyers and experts. If the possibilities of litigation ended with the first few years of exploration, the case would not be so serious, but some of the most bitterly fought and expensive lawsuits have arisen between claims which have been in operation for many years. At the present time two of the greatest mines in Cripple Creek, which have worked together in peace and harmony for over fourteen years, are fighting a two and one-half million dollar battle, all because of the discovery in one of the workings of a spur or branch of the main orebody. One of the most disastrous effects of this continuous litigation is to frighten capitalists away from mining investments, because observing Eastern investors have learned that the discovery of a new mine carrying rich ore is almost certain to be the beginning of the most expensive and interminable litigation.

Some years ago the United States government appointed a committee to examine and report on the advisability of revising our present mining laws. Some of the ablest men in the industry were placed upon this board and, while their report was pigeonholed and never made public, I understand it was unequivocally in favor of a complete revision. The Mining and Metallurgical Society, the American Institute of Mining Engineers, and the American Mining Congress each have had committees composed of representative mining men from all portions of the United States investigating the desirability of a change in our mining laws, and the reports of the committees appointed by all of these societies have been unanimously in favor of an entirely new code, as piecemeal revision seems not only undesirable, but under present conditions, almost out of the question. The American Mining Congress is joining hands with the American Institute of Mining Engineers and the Mining and Metallurgical Society, and together we hope to arouse public opinion to the necessity of making a complete revision of our present mining law. Neither revision nor repeal will, however, be an easy task, as the apex side-line features of our mining law have proved a veritable mint for lawyers and experts.

Smelting the Ores

Let us follow our typical mine a little further. If the composition of its ores is such that they can be treated by themselves at or near the mine the owner may congratulate himself, but, unfortunately, the great majority of our precious or semi-precious metal mines carry ores which contain several metals, usually associated with sulphur in such a form that they can be most successfully treated by smelting. This is an operation which experience has shown requires a wide mixture of ore to avoid the necessity of using dead fluxes; consequently, the ores have to be shipped and sold to a smelting company, situated, usually, at some convenient railroad centre. Years ago there was ample competition among the numerous smelting companies, and the miner could be sure of obtaining all that his ore was worth under existing conditions. Today most of the plants have passed into the hands of a few great corporations, which practically amount to a gigantic monopoly, which not only tells the miner flat-footed what they will pay for his ores, but in some instances, just how much they will permit him to produce. It would

*Abstract of Presidential Address, delivered before the American Mining Congress at Philadelphia, October 20.

seem that all these things are about as great a burden as an industry could bear, but our typical miner has still more troubles.

The Forest Service is doing splendid work in the preservation of our forests, but the organization is still young and somewhat imperfect; many of the superintendents and rangers are not only untrained, but are overzealous and officious, and as a consequence rules and restrictions, made with the best intentions in the world, are often misinterpreted and the mine owner sometimes finds it difficult to obtain timber for mine supports and fuel, permission to build roads, or to lay pipe lines, without carrying on an interminable correspondence and waiting until reels of red tape have been unwound. In addition to this the Government has now stepped in and withdrawn coal lands and water-power sites from entry. The operations of hoisting, pumping, air-compressing, and ventilating all require large amounts of power. Picture to yourself the feelings of a mine owner with an undeveloped coalfield or an unused water-power near his property and yet, to all intents and purposes, as far away as if situated in the mountains of the moon.

The Tax Burden

The drawbacks already enumerated, which seem to be sufficient to discourage any industry, are bad enough, but the end is not yet. The soil in the valleys of our Western mountains is extremely rich, the mines furnish a near at hand and high priced market for all the products of the range, field, and garden, consequently tillable land anywhere near the mines is rapidly taken up by settlers, and, so generally successful are their operations, in a few years the agricultural population is sure to outnumber the miners, a condition which already obtaines in nearly every mining state in the West. Just as soon as a farming community gains numerical strength sufficient to make itself felt in legislative halls, its first act is to place the principal burden of taxation upon the mines. There is scarcely an exception to this anywhere in the West. For instance: In Colorado the mines are now assessed at their entire cash value plus one-half of the annual gross output, plus the total net output, while the agricultural and fruit lands of the state are, in many cases, only assessed at one-third to one-fifth of their actual market value. In Arizona a law has recently been passed under which the mines are assessed at their full cash value plus one-eighth of their annual gross output, plus four times their net output. Nothing could be more ruinous or unfair to the mining industry, yet, it is difficult to see how it is possible for the mine operators to prevent or repeal such iniquitous legislation with a minority vote.

Nor are they content with this. In many places the farmers have not only attempted but succeeded in throttling the very industry which called them into existence and made them prosperous. In Montana, Utah, and California the agriculturists have actually succeeded, by means of legal injunctions, in closing up or obtaining unheard-of damages from these smelters on account of alleged damages to crops, which any impartial observer knows are often entirely mythical. In fact 'smoke farming' has become a recognized business, and lands in many localities near a smelter are now worth much more than they could have been sold for before 'smoke suits' were instituted. The Amalgamated Copper Co. has already paid out more money for damages, alleged and real, to the lands of farmers around Anaconda than the entire valley could be sold for if the smelter were not in existence. This, in spite of the fact that the Company maintains near the smelter an experimental farm which raises the largest crops and the finest cattle in the state. In California the farmers have made placer mining difficult, and in many places impossible. These things may seem incredible, but they are absolute facts, as everyone conversant with present conditions in the West is fully aware.

The necessary risks and difficulties attendant upon mining operations are a sufficient load for any industry to carry, but there are many things other than those already mentioned which the Mining Congress hopes to be able to change. For instance, an experienced miner, for the love of change or from being dissatisfied with his condition in one state, moves to another where a different code of signals is employer. He is, of course, careful to study the new code, but some day before the use of the new signals has become entirely mechanical he absentmindedly gives a wrong signal and the unlooked-for result is often disastrous. Again, a miner who has been working in a mine with an electrical equipment for power and lighting of 220 volts, changes to another property, perhaps in the same district. Two hundred and twenty volts, as we all know, is comparatively harmless, but in the new mine where our miner goes to work, the potential on the underground line is 440, or perhaps even 2200, and, without realizing the difference, he is as careless in handling or working about the high potential line as he formerly was with the low, and the results are unexpected and perhaps fatal. This illustrates emphatically the necessity for a uniform system of electrical equipment throughout the entire country, and committees from the Mining Congress and engineering societies have already drafted rules and regulations for uniform and safe underground equipment which should become a law in every mining state.

Mine Accidents

In any mine, no matter how stringent rules may be adopted for the protection of the miners and the prevention of accidents, careless workmen will sometimes drill into missed shots, postpone timbering weak ground, ride on loaded cars, or walk into open winzes or shafts. Accidents from these sources occur with altogether too much frequency and, while they are something which the operator has taken every precaution to avoid, they are and must remain a burden on the industry. At the present time in most states when an accident of this kind occurs, the contingent fee attorney is immediately on hand and a prolonged period of bitter litigation ensues, and when a verdict is finally reached the crippled workman or his family gets practically nothing; court costs and lawyers' fees having absorbed nearly, if not all, of the award. To obviate this, a number of states have recently passed what are known as Em-

ployers' Liability or Workmen's Compensation laws, and so far as I am able to learn, in every state in which such laws have been passed the results have been extremely gratifying. The cost to the employer has been no greater than before, while the sufferers get from two to ten times as much as they did under the antiquated laws in force in most states, and, what is even of more importance, they obtain the compensation immediately, instead of at the end of an exhaustive and embittered struggle. For this reason the American Mining Congress urges the passage of laws of this kind in every mining state, because it is certain the result will be a direct benefit to both employers and workmen, besides tending to bring about a much better feeling between these two representative classes.

A Law to Regulate Pumping

When our typical mine finally reaches a stage where deep explorations are necessary, water is generally encountered, sometimes in sufficient quantities to make pumping a most serious item of expense. So long as pumps only drain the property in which they are situated, all goes well, but it often happens that, owing to the presence of numerous cracks and fissures, or the permeability of the rock itself, it is impossible to drain one mine without lowering the water-level in the mines immediately adjacent. This throws a most unjust burden on the pioneer company, for which at present it has no recourse, and it has either to stand the expense of draining all the surrounding territory or cut down its rate of development to the average of the mines about it. We need a drainage district law which will compel every one operating mines within a given district to bear their proper share of the expense of pumping.

As soon as the earliest developed mines in a new district begin shipping any considerable amount of valuable ore, a parasitic population descends like a cloud on the camp. Prominent among this class is the mine promoter, the better class among whom carry on a perfectly legitimate and useful work, as they raise capital with which to develop new mines or promising prospects; but obtaining a bond or purchasing a promising new mine or prospect costs real money, consequently the impecunious and irresponsible brokers usually pick up worthless claims which can be had for little or nothing, and then proceed to boom them by means of flamboyant prospectuses and magazine and newspaper advertising all over the United States. In the district it is easy to distinguish the difference between a valuable property and a worthless one, but a thousand or two miles away it is exceedingly difficult to discern the difference between their prospectuses. In fact, as a general rule, the wild-cat promotion is groomed until it presents a more attractive appearance on paper than the genuine article, and as a consequence the country is annually flooded with millions of dollars' worth of absolutely useless mining stock, the effect of which is to absolutely discredit mining operations of all kinds in the minds of the unfortunate purchasers. The Mining Congress has for years urged the passage of laws which would make wild-cat promotions impossible, legislation which should be of the greatest benefit both to Eastern investors and to the mining industry. Kansas and California have already passed laws of this kind, and we hope that the other mining states will soon follow in their footsteps.

The greatest service the Mining Congress has so far been able to perform for the benefit of the mining industry has been the assistance it was able to give in the creation of the Bureau of Mines, which we hope and confidently expect will do as much, and even more, for the mining industry as the Department of Agriculture has been able to do for the farmer. It took years of patient endeavor to arouse sufficient interest in the matter and to build up public opinion to a point where our national Congress appreciated the necessity of giving such an aid to mining, and, although the Bureau of Mines was not organized until 1910, the magnificent results which it has already accomplished have more than convinced every one of its value. The experiments and work which it has carried on at the Pittsburgh testing station on explosives and explosions have marked a new epoch in scientific investigations on the causes of explosions and the properties of explosives, the practical results of which have been a steady annual decrease in the number of coal-mining accidents. Even here, however, there is still much to be accomplished, as there is no reason why mining accidents, both serious and fatal, should be two and a half times as great in the United States as in Great Britain.

Work of the Bureau of Mines

Until this year the work of the Bureau of Mines has been almost entirely confined to coal-mining in the East, but the last Congress gave an appropriation of $100,000 for Western metal mining. This appropriation only sufficed for the opening of chemical and microscopical laboratories, which have been established in Denver and are already carrying on a most valuable and useful work in the investigation of the properties of the rarer metals and in petrographic and microscopic studies of our low-grade complex ores. Investigations are also being conducted at the present time on concentration methods and the adaptability of the various methods now in use to the different ores found throughout the Rocky Mountain region. The Mining Congress hopes soon to see a large testing station, something on the lines of the one now in use at Pittsburgh, established somewhere in the West, where experimental work on a larger scale than is possible in a laboratory could be conducted. The able and enterprising Director of the Bureau of Mines is extremely anxious to make this installation, and the Mining Congress expects that every one connected with the industry will do what he can to assist the Bureau in obtaining a sufficient appropriation for this work.

The total appropriation this year for the Bureau of Mines was only $662,000, a very considerable part of which was spent in testing coal purchased for the Navy, the Panama canal, and other necessary government work. Compared with the appropriations made for the Department of Agriculture, this sum is hardly worth considering, and, when we stop

to realize that the products of the mines are equally as essential to the wealth and welfare of the nation as those of the farms, it is evident that larger appropriations for the support of the Bureau of Mines are not only desirable, but absolutely necessary. A power-plant, no matter how perfect its design or excellent its workmanship, is absolutely useless without an adequate supply of fuel, and unless the Bureau of Mines is given ample funds for the work ahead of it, the results attained will fall far short of our expectations and necessities.

The speeches and debates that you have already listened to give some idea of the requirements of the coal-mining industry, while the examples I have just cited in the history of a typical precious-metal mine give some, although not all, of the defects in our present system for which some legal remedy is required. We all know that mines can neither be called into existence nor made profitable by legislation, but we do expect that laws will be framed and passed which will afford equal opportunity to all and just protection to every one who risks either life or capital in the industry. The motto of the Mining Congress is safety and efficiency, by which we mean not only security to the investors and owners, but health and safety to our employees as well. The American Mining Congress is the only organization covering the entire United States whose sole business it is to look after the legal and commercial interests of the coal and metal mining industries, and the work which it entails necessitates a continually increasing expenditure of time and energy. There is nothing so effective in carrying out legislative reforms as a thoroughly aroused and insistent public opinion, a condition which in this case can only be reached by a continuous and well conducted educational campaign. To conduct this effectively we require more funds and a greatly increased membership, and we hope that every person directly or indirectly interested in mining will see that it is to his best interest to become a member of the American Mining Congress. This would give us immediately a vast increase in both funds and influence, without which no great improvement in present conditions can be expected.

The results of experiments conducted in connection with the treatment of tin and zinc ores in an electric furnace in England and France have been satisfactory enough to open up many possibilities for electric smelting. In France the tests were carried out on a new process, and a project is on foot to establish it in conjunction with a hydro-electric scheme, which it is hoped will restore the zinc mines in the vicinity of the Pyrenees to their former activity. The tests on the reduction of tin ore in the electric furnace were extensive, and were conducted by the Gröndal-Kjellin Co. of London in Cornwall. The results were favorable, pure ores yielding metal of 98% purity, while Bolivian ores containing 49.5% of tin and about 15% of iron yielded metal of 92 to 97% purity, which could be further refined to 99.75% or more by blowing air through the molten mass. The energy consumed amounted to 1700 kw-hr. per ton on the average. By working with two furnaces, one to treat the rich slag and the other to produce the metal, the company hopes to reduce this consumption to 1400 kw-hr., giving an efficiency of 55%. There is a saving of 25% of labor.

The Calumet Dredge

The Calumet & Hecla M. Co. has recently built a dredge for reclaiming the tailing from Torch lake, and for the following details of construction we are indebted to James MacNaughton, general manager.

The dredge is designed to excavate to a maximum depth of 100 ft. below water line. The hull is of steel, 72 ft. wide by 110 ft. long, and weighs approximately 450 tons. The machinery, exclusive of motors, weighs approximately 300 tons. The material to be dredged consists of stamp sand all finer than ¼ in., in two piles of approximately 20,000,000 tons each in Torch lake, the centres of piles being approximately 2000 ft. apart.

The dredge is to be equipped with two 20-in. centrifugal pumps so arranged that material discharged by No. 1 pump passes through a trommel to a sump connected with the suction of No. 2 pump, which delivers it through a maximum of 2400 ft. pipe. Suction piping is so arranged that either pump can be run alone for pumping material ashore by cutting out the trommel. The material rejected by the trommel is delivered to a scow alongside of the dredge by a chute. To hold the dredge to its work six swing lines and one stern line are provided.

The dredge pumps are 20 inches in diameter, with 54-in. runners. The pump casings are not lined. Flexible couplings connect pumps to 2300-volt induction motors, one pump having a 600-hp. and the other a 1000-hp. motor.

The ladder for supporting the outboard suction pipe consists of latticed steel girders, pivoted to the hull and braced sideways with wire rope. The pipe is lap welded, 21 in. outside diameter, and connected to pumps by cast steel swivel joints. The lower end of outboard suction pipe terminates in a suction head, provided with annular water chamber and nozzles for loosening material. No cutter head is used. The lower end of the suction pipe also has means for admitting water from above in case of the clogging of the suction mouth by its being buried in the sand. The suction ladder is hoisted by wire ropes operated from an electric winch.

The No. 1 pump will discharge into a hopper feeding a trommel 7 ft. in diameter by 45 ft. long provided with screens of manganese steel with 1-in. openings. The oversize consists of accumulated rubbish, which is discharged into a scow, the undersize discharging into a sump in the hull from which it is picked up by No. 2 pump and delivered to a fixed point on shore.

The dredge is provided with all the necessary auxiliaries, including winches, compressor, jet pump, bilge and priming pumps, steam boiler for heating purposes, crane, etc. The hull and dredging machinery were furnished by the Bucyrus Co., with the General Electric Co. furnishing electric equipment. Electricity is generated in the stamp-mill powerhouse, and wires are carried to the dredge on discharge pipe pontoons.

Cooperation and Formation Names

Mining engineers and geologists who have been confused by the rapid invention of geologic formation names, will approve of an effort that is being made in the Mississippi valley states to coöperate in future studies of the Mississippian formations. A significant field conference was held, as already noted, October 10-12 in Missouri for the purpose of planning joint studies by the several states and the United States Geological Survey. The states represented were as follows: Arkansas, Purdue; Illinois, DeWolf; Indiana, Barrett, Beede; Iowa, Kay; Missouri, Buehler, Hughes; Ohio, Prosser; Oklahoma, Ohern, Snider; Tennessee, Purdue. The U. S. Geological Survey was represented by David White, chief geologist, and W. H. Herron, geographer in charge of the central section.

The discussion showed clearly the evils of work in adjoining states without due consideration of that already done or in progress in adjacent territory. Since considerable new work is now being done on the Mississippian formation, it is highly important that the new stratigraphic units and formation names which may be proposed shall be carefully considered in the light of past usage and general rather than local needs. A directing committee, consisting of H. A. Buehler of Missouri, G. F. Kay of Iowa, and A. H. Purdue of Tennessee, was authorized to confer with the chief geologist of the U. S. Geological Survey and to begin active direction of coöperative work. It is probable that field work will continue to be done by the several states, although the U. S. Geological Survey will contribute to this phase of the work and will probably assume the responsibility for publishing the monographs as they are made ready from time to time.

In connection with the conference the party examined an interesting section in St. Genevieve county, Missouri, in which all of the formations from the Cambrian to the top of the Mississippian are exposed within easy reach. The conference continued for three days, and was not only exceptionally enjoyable, but promises to pave the way for interstate coöperation in all future problems which have general significance.

Mineral Production of Michigan

Michigan is sixth among the states of the Union in the value of its mineral production, according to the figures compiled by E. W. Parker, of the United States Geological Survey, in coöperation with the Michigan State Survey, it ranked second, and in the production of copper it was third. Among the less important branches of the mining industry it ranks first in the production of salt, bromine, calcium chloride, graphite, and sand-lime brick, second in the production of grindstones, and fourth in the production of gypsum. In 1910, the total value of the production considered, the mining of iron ore was the leading industry in Michigan, but in 1911 and 1912 the value of the recoverable metallic content of the copper ores produced in Michigan exceeded the value of the iron ore mined. In 1912 the production of iron ore amounted to 12,797,468 long tons, valued at $29,003,163, and the copper production to 218,138,408 lb., valued at $35,992,837. The total mine production of copper in the United States in 1912 was 1,249,094,891 lb., of which Michigan contributed 218,138,408 lb., or 17 per cent.

The total production of copper in Michigan from earliest records has been about 5,200,000,000 lb., or about 30% of the total output of the United States.

Michigan stands well up among the states in the manufacture of cement, producing 3,494,621 bbl. in 1912. The salt production of the state (exclusive of rock salt) amounted to 10,271,715 bbl., valued at $2,743,389. The value of Michigan's clay products increased about 22%, from $2,083,932 in 1911 to $2,545,498 in 1912. The mining and calcining of gypsum is also an industry of considerable importance, and production increased from 347,296 short tons, valued at $573,926, in 1911, to 384,297 short tons, valued at $621,547, in 1912. The total value of the mineral products in Michigan in 1912 was $80,062,486, against $65,275,324 in 1911.

The Innoko-Iditarod Placers

During the summer of 1912 Henry M. Eakin, of the U. S. Geological Survey, visited the Ruby, Innoko, and Iditarod districts in Alaska, and a report on the gold placers in those districts has been issued by the Survey. The mining centre of the Ruby district is about 25 miles south of Yukon river at Ruby and comprises half a dozen creeks, all within an area of a few miles square. The first discovery of gold in this district was probably that made on Ruby creek in 1907, near the site of the present town. This discovery proved to be of no great importance, and it was not until 1910 that the discoveries on Long creek and its tributaries created widespread interest in the region. Exact data regarding the amount of gold produced in the district are not available, but the total in 1912 was probably between $150,000 and $175,000.

The Innoko-Iditarod region lies in west-central Alaska and embraces most of the upland area north of Kuskokwim river that is drained by Innoko and Iditarod rivers. In all, 24 claims, located on five creeks, were worked in the Innoko district in 1912, by a total force of about 140 men. The total value of the placer gold produced during the year in the district was probably in excess of $250,000. Twenty-nine claims, located on eight different creeks, were worked in the Iditarod district in 1912. Thirty-six plants were engaged in the work, and about 975 men were employed. The value of the total gold production of the district, including Moore creek, for the year was probably about $2,750,000.

Coal is mined in New Zealand by the government at two collieries, which produced a total of 247,200 tons in 1912. This is partly used by all the state departments and the balance is sold to the public. After deducting depreciation at the mines and coal depots, there was a loss of $48,000 on the year's work.

Discussion

Readers of the MINING AND SCIENTIFIC PRESS are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment. Insertion of any contribution is determined by its probable interest to the readers of this journal.

Simple Smelting

The Editor:

Sir—The letter published in the *Mining and Scientific Press*, September 27, under the caption, 'Simple Smelting in Arizona,' reminds me of an incident that occurred in Nevada City, California, in 1851, an account of which is given in E. F. Bean's 'History of Nevada County,' published in 1867. I have not a copy of the history at present, but the article below will be found to be largely word for word with the account of Mr. Bean's. One Dr. Rogers, becoming possessed by the idea that heat would free the gold from rock, proceeded to talk the idea into others. He finally raised the money from some of Nevada's wealthy citizens to make the experiment. He built a furnace in which to heat the rock, under which there was placed a large iron tank for the purpose of catching the precious metal as it fell from the furnace. The furnace was filled with alternate layers of gold-bearing rock and fuel. The fire was lighted at the bottom and as the mass lowered more rock and fuel was added at the top. The millionaires who were financing the project were on hand night and day in anticipation of a princely haul, the 'savant' who was testing his discovery on a large scale at a snug salary, rode up occasionally and gave his orders, which his employees obeyed. After tons upon tons of milk-white rock had passed into the furnace, when the vulgar crowd, who had no soul for science or pluck for advanced enterprise had departed, the first and only clean-up was made. A stout armed person made his way to the tank where the precious metal was supposed to collect.

He scraped the bottom and returned with a pan of cinders and ashes, the bubble had burst, and so had some of the millionaires. Dr. Rogers left the camp declaring that quartz mining was a humbug and he would leave it to its fate.

R. NOBLETT.

Nevada City, California, September 28.

The Extralateral Right

The Editor:

Sir—If, as is recommended by Messrs. Winchell, Goodale, and Requa in their report, the extralateral right law is repealed, as it ought to be, the present requirement that the side-lines of the claim shall be laid off at equal distances from the outcrop of the vein should also be repealed. The law should allow the prospector to locate the side-lines at unequal distances from the apex of the vein if he so chooses. In the case of inclined veins of low dip, obviously, if one side-line is placed just outside the apex, the vertical planes passing through the side-lines will enclose on the dip nearly twice as much of the vein as would be enclosed if the side-lines were at equal distances from the apex, and this would only be fair to the surface discoverer.

Years ago an old-time prospector, a veritable crusader in favor of the extralateral right, related to me the following incident. He said: I was in Nevada when prospectors and miners made the rule that every man should have the right to follow his vein down, no matter where it goes. This resulted in a great mass meeting. Most of the speakers wanted to have the claims bounded by vertical planes. At last an old prospector stood up and said: "Maybe you fellows want to cut yourselves off from the bottom of your vein, but as for me, I want to follow mine." The debate was decided in favor of the prospector.

Doubtless this brief speech sums up the only argument that ever has been made for the extralateral right. It will go a long way toward reconciling the friends of that right, if it is repealed, to permit the locator of a lode claim to place the side lines at unequal distances from the outcrop of his vein if he so prefers. This would give him a good mine if the vein is of value and suitably favors the surface discoverer.

G. H. STONE.

Colorado Springs, Colorado, October 18.

Government Prospecting

The Editor:

Sir—Having recently read the articles of Albert Burch and R. P. McLaughlin in regard to government prospecting, I would add that it appears very doubtful if government prospecting can be done successfully, as the cost would be excessive, judging by the bureaucratic methods and 'red tape' of government officials in other lines. The poor prospector would be worse off than under the present arbitrary rulings of the land office and the regulations of the Forestry Department as construed by some of the forestry agents.

Mr. McLaughlin's proposal that companies be induced to try it might work out advantageously; but judging from all past experiences, it will not be possible to interest them. All of our largest mining companies, and individual operators, spend thousands of dollars every year in the examination of developed and partly developed mines, but they cannot be induced to look at a prospect. Several of the large operating companies in recent years have examined 600 or more reports on mines each year, and their engineers have been sent to make examinations of those which were most attractive. In no case have they taken over more than one-half of one per cent of those presented. If ten per cent of the money thus expended was used in assisting or paying a few good men to prospect, I believe more would be accomplished.

Mr. McLaughlin's definition of the prospector, "an ordinary man with some knowledge of minerals and possessed with the spirit of adventure," probably applied to the average prospector of the past. I think at the present the chances of success are far more favorable to a better class man, especially one familiar with the rarer minerals and possessing some knowledge of the geology of ore deposits. The days of the prospector looking for certain classes and conditions of formation are past. The field of pros-

pecting for the rarer metals, blind veins, and dry placers is still large. Only the quartz veins exposed above the surface, generally speaking, have been found. I know of four tungsten veins accidentally discovered in this county during the past year.

Reno Sales, in his excellent article in a recent bulletin of the American Institute regarding the Butte ores, says that nearly all of the copper veins of Butte were blind veins and rarely showed more than a trace of copper at or near the surface. Some of the best deposits of copper at Cananea were only barren quartz veins at the surface.

If government assistance is desired, why not adopt the Australian plan? The government there, I understand, gives a bonus premium to anyone who discovers a producing mine. Districts where water and transportation are difficult and expensive, the Australian government does this work, pipes in the water, and makes good wagon-roads or railroads, as needed.

Everyone will recall old camps in the United States today that could and would be rejuvenated if they had better and cheaper transportation. This certainly is as legitimate a field for government work as to make roads for the agriculturist. In many instances it would benefit both the miners and the ranchers.

I would recommend that the present mining laws be changed or altered to conform more with present conditions, insisting that they be liberal to the prospector and the man who actually does the first development work.

Let there be a justifiable appeal from the decisions of the land office. Cancel one-half of the present forestry reserves, especially all in the arid belt, where there never was an excuse for a reserve. Confine the forestry service agents to fire protection of present forests and the reforestation of districts where trees can be made to grow. If this is done, I venture the prediction that there will soon be plenty of prospectors in the hills.

G. L. SHELDON.

Ely, Nevada, October 6.

Professional Ethics

The Editor:

Sir—Mr. Caetani's citation of a contingency which may occur in the career of a mining engineer, given in your issue of September 13, seems to me to resolve into a question of honesty to self and to clients 'A' and 'B'. Hair-splitting technicalities and ethical doubts should give way before common sense; and if this is done, the engineer will know what to do.

Professional ethics decree that he shall not give to 'B' the report made for 'A', because he was detained by client 'A' to examine the mine and submit the report. When client 'B' retains him for the purpose of examining the same mine and submitting a report, the engineer is not morally or professionally obligated to refuse the business just because he shortly before had reported upon the same mine for 'A'. Yet he would have to decline unless he used the information gained while in the service of 'A', which, ethically, he should not use. If 'A' refuses to give 'B' the report, or refuses to sell it, then, ethically, the engineer would have to make another examination and submit another report to justify his services to 'B'. But this would be running a bluff on the engineer's conscience and client 'B', because the conditions at the mine have not materially changed since the examination for 'A'.

This matter should be settled by sweeping aside technicalities and doubts. A statement of the plain facts should be made to client 'B'; let him understand that an examination, except perhaps the question of sampling, would be practically a repetition of the former work; that the previous examination was made at the request of client 'A' (this is discretionary); and that the report to him ('B') is taken largely from the other report. The statement of facts should also be presented to 'A'.

By doing this the engineer would be honest with himself and with his clients, ethics or no ethics. He is entitled to 'B's business and should give 'B' his report.

J. M. LILLIGREN.

Pearl, Idaho, September 19.

Trent Agitators

The Editor:

Sir—Your issue of September 6 contains a communication from Walter E. Techow which emphasizes the fact that the Trent agitator is easily started after a shut-down of a number of hours. The point of interest lies in the statement that as the ore is clayey and pulp is 1.25 to 1.35 sp. gr., he "does not know of any other agitator that would do the same thing under parallel circumstances."

After the wave of reaction against the Pachuca tank, which has been dubbed by many distinguished metallurgical essayists, "a metallurgical fad that would run its course," it is of interest to note that, under very similar circumstances, the Pachuca tank has exceeded the length of time mentioned in Mr. Techow's instance, with no bad results.

I refer to the battery of Pachuca agitators at El Tigre, Sonora, Mexico, during the siege and capture of that camp in September 1912 by Inez Salazar and his band of 'red flaggers.' These particular tanks are 40 ft. high, with average depth of pulp 38 to 39 ft., and the pulp, like Mr. Techow's, is clayey and varies between 2.2 and 2.6 to 1.0 in ratio of liquid to solid.

On September 13, 1912, the camp was attacked at 6:30 a.m., but the air-compressors ran till about noon that day. From that time on the agitators were 'dead' and the mill was idle until 7 p.m. September 17, at which time the camp was recaptured and work resumed. On returning to the plant, it was noticed that clear solution had gathered on the surface of the charge to such a depth that the pulp, proper, could not be seen. Nevertheless, all the tanks were put into commission once more without the aid of anything save the regular air-pipe equipment of the tank itself, and inside an hour all eight were agitating as freely as usual.

The pulp yields about 80 to 85% of −200 mesh material, and was of that nature during the episode referred to above. Disregarding other points of comparison, one can well believe that the Pachuca

need not accept odds on this score from any other agitating device now in use.

DONALD F. IRVIN.

Yzabal, Sonora, September 9.

[It is but fair to Mr. Techow to state that his original letter was not intended for publication and was printed through a mistake on our part. It has, however, served a useful purpose in calling out this discussion by Mr. Irvin, and Mr. Techow has kindly pardoned our mistake.—EDITOR.]

Some More Reasons Why Mining Languishes

The Editor:

Sir—I would like to throw into the mortar of correspondence a few old random samples for the various 'fans' of mining to pulp up and pan out. In the first place, it is right to concede all diversity of opinion as the case fits the many authors or correspondents especially on these lines. It is an established and undisputable fact, that, with a few exceptions, from the professional mining engineer to the pseudo-prospector, all are trying to make money easily, and here I would emphasize the fact that within the borders of the United States the day has long ago vanished when it was possible to find great bonanzas lying on the surface or projecting above ground. The almost universal knowledge of ores and the ready access to assay offices has in the past 15 years pretty thoroughly covered every mining district and much other territory; and henceforth mines will require more work and time before they are on a paying basis than in the past. The traditional get-rich-quick idea in mining must be eliminated. There is a new lesson for the mining engineer to learn, that is, to recognize and to know a prospect that will make a mine from one that will not. I fail to see any ability, credit, or honor for the mining engineer or geologist who has to have the property developed by a shaft 500 ft. deep and a level 500 ft. each way from the shaft at every 100 ft. before he can form an idea of its value. In reality he is not needed, it is simply a matter of careful sampling and ordinary arithmetic, and while telling how it happens that the ore really is there, is of some satisfaction, it is of no value from a dollars and cents standpoint. It is perfectly correct to go out prospecting among the prospectors, but it is wrong to imagine that anyone is going to find a prospector with a bonanza and brains of too poor a quality to convert the ore into money, or who does not know a good thing when he has it. However, the prospector is generally a poor man, and when there is anything in sight it always evolves itself into a long bond and easy terms, which shows that the buyer has no confidence in the property, and the result is that sales are few. If your judgment is unreliable, hire some one who is possessed of it, or quit the business. Experience has taught me that bonding mines and prospects is an expensive luxury, and I quit it years ago. Now when I look at a prospect or a mine, I take with me three articles, a hand pick, some sample sacks, and a check book. Here let me cite a few striking illustrations, namely: three men owned a group of three slightly developed claims which I examined and found satisfactory. I asked them for their lowest price and best terms, and was told $15,000; $5000 down, balance in six months and one year. I told them I would be at a certain place until 10 o'clock the next day, and if they wanted $2500 cash to come and see me, with the result that I bought the property. In another case a man had just located a beautiful vein having a heavy iron cap from 3½ to 6 ft. wide and continuous for over 2000 ft. in length. I asked him what he would take for his find; his answer was, "Not a cent less than $1000." I told him I would give him $50, and in 10 minutes the prospect was mine. Another property, which includes 158 acres of patented land, with a bond price of $10,000, I bought for $1150. It is not only impossible for every prospect to make a mine, but it is a good thing that such is the case. As it is, there are many good properties that can be had at a very reasonable price for cash, and in doing business on a cash basis the actual capital required is greatly reduced, and people feel more secure in their investment or speculation if you choose to call it such.

A few words on mine reports. All mine reports that I have ever made have always been divided by 2, 4, and even 6. All the reports that have in one way or another come under my observation have received the same treatment. Therefore, I believe a personal investigation is the most satisfactory, whether it is reliable or not.

Modesto, California, October 16. J. D. VOSE.

Securing Capital for Mines and Prospects

The Editor:

Sir—A great number of articles have been published during the past few years bearing directly and indirectly upon this subject. The owners of prospects and partly developed mines complain that it is almost impossible to interest capital in the development or purchase of their property, and, on the other hand, representatives of mining capital complain of the lack of good prospects or mines to buy. In a general way, there are good grounds for both these complaints.

The kind of a property that large capital is looking for is becoming scarcer every year. First, for the reason that the available area of new country, in which mines are likely to be found by prospecting, is very limited. When Colorado was new, when Nevada was new, in fact when the whole Western part of America was new, the field was large. There were more mines than money. The supply was large and many prospects were being worked, some of which, in due course of time, developed into mines. Second, experienced mining capital, which at the present time is largely concentrated, takes few chances and bothers but little with prospects which are but slightly developed. Prospects, as a general rule, are developed by the owners themselves or by a small aggregation of capital secured by the owners from their friends, usually people of limited means and following other lines of business, or by incorporating a company and selling treasury stock. In 'boom' days and under the stimulating effects of a mining excitement, the two latter methods were used frequently with great success, in so far as the raising of money was concerned. Advan-

tage has often been taken of this condition of affairs by the unscrupulous promoter to foist 'wild-cats,' with absolutely no chance whatever of developing into a mine, upon the investing public. A few flotations of this character soon destroys confidence and the good suffer with the bad. In a very short time it becomes impossible to secure money for the developing of a meritorious prospect which has excellent chances for making a mine. This is one of the conditions prevalent at the present time, and as a result the people who have had spare money to invest in mining have sought other avenues for their surplus. As I have stated before, within the the past few years most of this surplus, and some that was not surplus, has gone into the purchase price and the operation of automobiles, and one does not have to go far into the statistics of the automobile trade to learn how this money has been absorbed and that its effect is felt not only in the development of prospects but in the stock markets of New York and San Francisco. A sum which approximates $1,000,000,000 entered Detroit alone the past year for the purchase of automobiles. The purchase of accessories and the operation of these cars consumes another $500,000,000.. With the spending of these sums in a comparatively new industry, is it any wonder that there is no money for the luxury of developing a prospect? This capital, some of which at least was formerly used for this purpose and for the buying of stocks, is gone, as far as mining is concerned. Like the Missouri river after a flood, it has changed channels and left the prospect, stock market, and various other industries stranded on the dry bank. From present indications it will be a long time returning, if ever.

It is on this money, and not on the large aggregations of experienced mining capital, that the prospectors have relied in the past for the development of their ground, and its withdrawal has caused a cessation of activities. Without a prospect, it is impossible to have a partly developed or fully developed mine, and this is about the only kind of a property this experienced mining capital is looking for. Of course, they are scarce, and are becoming scarcer every year until the men controlling this capital will finally have to come to the prospecting. There are any number of fair-looking prospects in the country that need but the expenditure of a few thousand dollars to determine whether they will be mines or not. Starting with a good judicious selection, one out of ten at least ought to make good, and I believe if more attention was paid to this class of property it would not be long before there would be plenty of new mines.

This inability to secure capital for the developing of mere prospects, together with a condition discussed by Albert Burch in his article in the *Mining and Scientific Press* of August 30, that the "chances for success in prospecting have been steadily diminishing for years" has caused a withdrawal of prospectors from the field. However, I do not believe that the solution of the question will be found in government aid. I rather believe it will be found in the interesting of mining capital in the developing of meritorious prospects where surface conditions are favorable.

The company and controlling owners, by whom Mr. Burch is employed, and in fact most of the larger mining companies in Nevada, have been very much better in this regard than other companies who control capital. They have been rewarded by the successful development of several prospects during the past few years. I have no doubt that when the others realize the necessity of pursuing this course in the obtaining of mines, they will finally come to it. One successful dividend-paying mine obtained in this way pays for quite a number of unsuccessful prospects, where the expenditure of a few thousand dollars determines their value.

H. C. Cutler.

Reno, Nevada, October 27.

Inclined Baffles

The Editor:

Sir—Your correspondent, L. B. Eames, in his letter printed September 27, is quite right in his belief that, mechanically considered, the ability of a particle to settle in a cloudy solution is limited only by its infinitesimally small weight and by the viscosity of the settling medium, but he is thinking of unhindered settlement, and this is not a condition in which the use of baffles is of assistance.

The principal retardation to settlement is to be found associated with, although not strictly due to, the increase in density brought about by the accumulation of particles in process of settlement, but the cause is not alone mechanical; one particle cannot be considered as falling through a medium of which its brethren are component parts.

The baffle is found useful in settlement from fairly thick pulps, but while it is a mechanical device, it is used to alleviate conditions other than mechanical under which the retardation is set up, and to promote free settlement; it is, in effect, another means for withdrawing the bottom layer and letting down the others, about which I have previously had something to say.

H. G. Nichols.

London, October 13.

Mineral Production of New Mexico

In 1912, according to the U. S. Geological Survey, owing to a marked increase in production, the value of the recoverable copper content of the ores mined in New Mexico exceeded the value of the coal mined. The increase in the copper production was due principally to the operations of one company mining with steam-shovels a large acreage of low-grade deposits at Santa Rita. In 1911 the recoverable copper content of the ores mined in New Mexico was 4,057,040 lb., valued at $507,130; in 1912 this product amounted to 34,030,964 lb., valued at $5,615,109, the quantity in 1912 being approximately 8½ times and the value more than 11 times that of 1911. The coal production increased from 3,148,158 short tons, valued at $4,525,925, to 3,536,824 short tons, valued at $5,037,051. The total value of the mineral products of New Mexico increased from $8,176,229 in 1911 to $14,391,355 in 1912. A large number of different minerals are mined.

Special Correspondence

DENVER, COLORADO

MEETING OF COLORADO SECTION A. I. M. E.—MINE TAXATION DISCUSSED.—COMMITTEE APPOINTED TO MEET LEGISLATURE.

Mine taxation was the subject for discussion at the November meeting of the Colorado section of the American Institute of Mining Engineers. This was the first meeting of the section following its organization at Colorado Springs last September, and there was an unusually large attendance, thanks to the active work of C. Lorimer Colburn, secretary, and the special dinner committee consisting of T. B. Stearns, R. A. Parker, and F. A. Bostwick. Following the dinner, at which W. J. Cox presided as toastmaster, the subject of the evening was taken up. William B. Hodges and D. L. Webb presented the principal papers of the evening, discussing the effect of the present taxing methods on the mining industry of Colorado, the present laws of the state, and comparing these with the laws of other states and countries. A dozen or more members took part in the general discussion and the consensus of opinion seemed to favor a tax on net income from paying mines and on a basis of $5 per acre on those not producing. Further discussion is scheduled for the next meeting and a special committee is to be appointed to consult with the legislature regarding taxation. Those attending the meeting were as follows: Victor C. Alderson, Philip Argall, Howland Bancroft, Francis W. Bosco, Fred H. Bostwick, Frank Shepard, Harry Brown, David W. Brunton, D. L. Webb, John A. Davis, Charles T. Carnahan, William R. Chedsey, Louis Cohen, C. Lorimer Colburn, William G. Dow, William J. Cox, Mason Lewis, J. B. Grant, Ernest Le Neve Foster, J. D. Gilchrist, Robert J. Grant, John Gross, Marshall Draper, A. J. Bamford, L. G. Hammond, J. Foster Syms, J. D. Hawkins, J. T. Hawkins, R. M. Henderson, Victor G. Hills, A. J. Hoskin, S. A. Ionides, George A. Kennedy, W. H. Leonard, James M. McClave, C. J. Moore, Richard A. Parker, William B. Patrick, W. C. J. Rambo, Russell B. Paul, Mr. Paul, T. H. Proske, J. C. Roberts, G. Sessinghaus, T. B. Stearns, Will B. Hodges, W. G. Swart, Henry A Wentworth, Frank A. McGregor, T. M. Taylor, F. W. Traphagen, William F. Ward, O. R. Whitaker, Harry Wolf, C. H. Harrington.

BUTTE, MONTANA

EAST BUTTE PRODUCTION.—PROPOSED ZINC SMELTERS.—REOPENING THE NETTIE MINE.—LEACHING AT ANACONDA.—ORGANIZATION OF A MONTANA SECTION OF THE A. I. M. E.

Construction work at the mill and smelter of the East Butte Copper Mining Co. is responsible for the decreasing production of late. For the quarter ended September 30 there was produced 3,455,282 lb. of copper, as against 3,721,241 lb. in the previous quarter. The increased capacity of the plant, when remodeled, should soon offset this loss. There has been more or less talk of late that a zinc smelter might be erected in the Wyoming gasfields to treat the Montana zinc output. One of the present heavy charges on the zinc industry of Butte is the transportation of concentrate to the Mississippi Valley smelters. As the gas supply for these smelters is waning, it is not impossible that the industry may in part move west to Wyoming if the gas supply proves sufficiently dependable. One of the most significant developments of the month is the preparation by the Anaconda Copper Mining Co. to reopen and explore the old Nettie silver mine west of Butte. The Nettie contains typical manganese silver veins. An attempt may be made to find new silver orebodies in the ground, but the natural assumption is that the Anaconda company will explore for zinc in depth and endeavor to find orebodies similar to those in the Butte & Superior property north of Meaderville. The developments here will be watched with interest. Should this property produce zinc ore of commercial importance, it is certain that many other similar veins in that vicinity will be explored in the near future. It is far from visionary to predict that Butte may soon become the largest zinc-producing district in the world.

The new leaching plant at Anaconda is expected to recover 10 lb. of copper from each ton of tailing treated. As the Anaconda plant handles 4,000,000 tons of concentrating ore annually, this may mean an additional saving of 40,000,000 lb. of copper per year. Also, as the tailing now accumulated amounts to between 20,000,000 and 30,000,000 tons, the leaching of this with a recovery of 10 lb. per ton predicts a large and profitable industry. The leaching method proposed will produce this additional copper at a cost of about 7c. per pound.

Boston-Butte Copper & Zinc Co. is the name of a new

$1,000,000 company formed here to prospect a group of claims northwest of the Big Butte. So as not to fall into the predicament of the Butte & Superior company, which found zinc instead of copper, the company protects itself by attaching both metals to its name. A churn-drill hole in the disseminated copper deposit of the Butte-Duluth Mining Co. east of Butte has penetrated a rich body of sulphide ore at a depth of 180 ft. Samples from the drill-hole assay 30% copper. This ore was found in soft decomposed granite below the oxidized copper silicate zone. If ore of this grade should be proved to occur in large bodies, the finding of it may be considered one of the most important which has been made at Butte in recent years.

The Anaconda Copper Mining Co. is preparing to spend $650,000 in the erection of a slime-concentrating plant consisting of 20 round-table machines of 20 decks each. The capacity of this plant will be 2200 tons of slime per day, from which a 50% saving is expected.

The Butte & Pensacola Copper Mining Co., of Cascade county, is said to have made an important find in its property in the Little Belt mountains. Great Falls business men are financing a company to drill for oil near the town. The reported success of drilling operations to the north of Calgary, Alberta, encourages them in the hope that similar conditions may be found near Great Falls.

The Anaconda Copper Mining Co. seems to have fallen into a good thing near Eudora, in Flathead county. Surface croppings assaying 30 to 40 oz. silver per ton have been found for a length of 800 ft. and a width of 150 ft. Work on the find is to be pushed vigorously. The land was bought by the Anaconda company some years ago from the Northern Pacific railway for its timber value. An English company has taken a lease and bond on the old Emery mine near Deer Lodge, in Powell county, and will explore it further. The new company goes by the strange name of Butte Daryumsu, Ltd.

Montana members of the American Institute of Mining Engineers met at Butte, October 17, and organized a local section. Meetings will be held twice yearly, in February and October. It was voted to participate with the Spokane section in a joint meeting to be held at Wallace, Idaho, November 15 and 16. The following officers were elected: E. P. Mathewson, of Anaconda, chairman; Frank M. Smith, of Helena, vice-chairman; D. C. Bard, of Butte, secretary. These with Oscar Rohn and James L. Bruce, both of Butte, constitute the executive committee.

MANHATTAN, NEVADA

MINING OPERATIONS AT THE MANHATTAN CRESCENT.—DEVELOPMENT AT THE WHITE CAPS PROPERTY.—BIG PINE COMPANY.

Mining operations on the Crescent property continue to develop more ore. Ore from the property is milled twice a month at the War Eagle mill. The ore is being mined from the stopes between the first and second levels, and assays better than $20 per ton. The ore in the Crescent is found throughout the schist and in many places the ore is from 50 to 60 ft. in width. The Reilly Fraction still continues in the front rank of ore producers of the district. At the present time the mill is treating at the rate of 15 tons per stamp for each 24 hours running time. The highest single day's run was 130 tons, and during this run the mill had to be shut down for lack of ore in the bins. A 16-mesh screen is used in front of the stamps, and a good recovery is made from the plates below the batteries. The water for the mill is now being taken from the Big Four shaft.

The mill dumps on the White Caps property prove to have been considerably underestimated. The measurements of the ore dumps prove that they at present contain 4800 tons of ore. The average of the dumps, as nearly as can be figured, will be $15 per ton, making the ore of a gross value of $72,000. Three-fourths of the ore on the dumps has been mined during the past 90 days. The ore in sight in the mine shows a tonnage of considerably more than has been mined. A very interesting feature of the White Caps is that from the bottom or 300-ft. level the grade of ore as exposed in the great east orebody is of higher grade than on the 165-ft. level, and nearly twice as rich in gold content as the ore close to the surface. Unquestionably the next hundred feet in the property will prove one of the big orebodies of the district. The mining work now being done by the White Caps company consists of the crosscut to make connection with the top of the new vertical shaft, from the 165-ft. level a distance of 45 ft. being necessary to make connection. When connections are made, the shaft will be completed to the surface, the timbering and work being done from the 165-ft. instead of from the 300-ft. level. Upon the completion of the shaft and the installation of adequate machinery, the production from the White Caps can easily keep a 10-stamp mill running at capacity.

The operations at the Big Pine property by Mushett and Wittenberg, lessees, are proving that the heart of the great zone of enriched schist which follows the general direction of the Big Four hill, and has been proved in the Big Four to reach a depth of at least 500 ft., is to be found in the Big Pine. The near future developments on this property will be of immense interest, as now that the mill owned by the Manhattan Milling & Ore Co. has been purchased by the operators of the Big Pine, cheap milling facilities are available. The splendid record established by the Reilly Fraction, milling at the War Eagle mill, should be duplicated by the Big Pine. At present the item of transportation is the main expense, and without some system of tramways it is hard to reduce the haulage cost. Perhaps the coming year will see an aerial tramway in operation at Manhattan.

TORONTO, CANADA

ONTARIO BUREAU OF MINES RETURNS.—PROGRESS AT THE DOME MINES.—NIPISSING PRODUCTION.—NEW DISCOVERY AT THE PENN CANADIAN.

Returns made to the Ontario Bureau of Mines of the gold production for the first nine months of the year, give a total value of $3,281,027, being an increase of $2,163,692 over the corresponding months of 1912. Of this amount all but $174,777 came from the mines in the Porcupine area. The monthly statement of the Dome Mines for October showed a total tonnage of ore treated amounting to 12,370 tons, which is considerably in excess of any previous month's record. The value of the output was $118,000 and the average recovery for every ton milled $9.54. Development underground is making satisfactory progress, driving having been accomplished to the extent of 573 ft., of which 100 ft. was on the 425-ft. level of No. 1 vein, the richness of which is well maintained. A winze is being sunk to the 550-ft. level. The McIntyre during October milled 3900 tons obtaining a 96% extraction, the ore averaging $10 per ton. The mill is now treating 150 tons per day. During October the Nipissing mined ore of an estimated net value of $218,772 and shipped bullion from its own and customs ore of an estimated net value of $348,612. At the Meyer a branch vein has been found on the fourth level near the Keewatin contact, carrying one to two inches of 2000-oz. ore. The high-grade mill treated 180 tons of ore. The Pan-Silver, owning 100 acres adjoining the Beaver and Timiskaming mines, recently found a small vein which, when followed up for 23 ft., widened out to 5 in. of high-grade ore with wall-rock of about 3 ft. in width carrying milling ore. Another good discovery of a 3-in. vein carrying free silver has been made on another part of the property. The Penn Canadian has opened the new vein recently discovered on the 300-ft. level for 35 ft. and it continues good. The production during October was 60,015 oz. Cross-cutting has been undertaken to tap the vein on the fourth level. The financial statement of the Caribou Cobalt, covering the period from March 31 to August 31, shows a total production of 185,228 oz., having a net value of $97,017. The net earnings were $38,773. The ore reserve is estimated at 20,000 tons of milling ore, which with the associated high-grade ore gives approximately 580,000 oz. of silver. The Crown Reserve has declared its monthly 2% dividend, but withheld the extra bonus which was anticipated. The Company has taken options on the Porcupine Gold, generally known as

the Vipond, and the North Thompson in the Porcupine area. The affairs of the Chambers-Ferland are in litigation, Harry Cecil having applied for an injunction on behalf of himself and other shareholders to prevent the sale of the property to the Northern Concentrators, Ltd., on the ground that recent meetings and acts of the Company have been illegal. On the Giroux claim in South Lorrain, where previously no valuable discovery had been made, a small silver-bearing vein has been found in an old trench.

The Albert Oil Shales at Sussex, N. B., after a protracted investigation by leading oil experts has been taken over by a syndicate of British capitalists. The property is valued very high and preparations are being made for the erection of an extensive plant.

BLACK HILLS, SOUTH DAKOTA

HOMESTAKE PLANNING STEAM PLANT AND NEW HOIST.—PRODUCTION FOR THE YEAR.—LABOR UNION LITIGATION.

Upward of $250,000 is being spent by the Homestake Mining Co. for improvements being made during the present year, and according to plans outlined for next year's work the sum expended will be fully as large. For the coming year the big items of expenditure will be for a steam auxiliary to the Spearfish hydro-electric plant and a new hoisting equipment at the Old Abe shaft. For the first mentioned, the work of clearing the site, preparatory to excavation, has already been begun. A large structure to house the boilers will be erected on land just north of the Homestake stables at Lead. This building will contain boilers of a total of 3000 hp., steam from which will be used both for driving the generating units for the operation of the new hoist and for various minor purposes in the nearby mills. The generating station will be across the street and adjoining the new concrete distributing station from which electric power from various sources is distributed to the various plants of the Company. Turbine engines direct-connected to high-voltage generators will be used. At the Old Abe shaft the Company is to erect one of the finest hoisting plants in the West, and the best on its property. The engines will be of sufficient power to hoist material from the deepest point to which may be driven in many years. It will probably be about April 1 when work on this hoist will start, and since the machinery has been designed and specifications for the new plant are in the hands of the contractors, there will be no delay once work is begun. The largest item of the Company's improvement expenditure for the present year has been for the construction work on Recreation Hall, a building in Lead which will be devoted entirely to club purposes, and free to employees. Among the conveniences of the building will be library and reading rooms, billiards, bowling alleys, baths, gymnasium, etc., and in a wing will be one of the finest opera houses in South Dakota. The walls and roof of the building are nearly completed, and in a short time the structure will be entirely enclosed, so that the finishing work on the interior will proceed to a rapid completion despite winter weather. Another important improvement of the present year was the construction of a large and well appointed change-house at the Ellison shaft. This building was constructed of concrete and is the finest structure of its kind on the property.

That a greater tonnage of low-grade ores is being mined in the Black Hills, with a slightly smaller bullion production than last year, is the information conveyed in the annual report of Otto Ellerman, State Mine Inspector, which covers the year that ended on October 31. The total gold and silver product was $7,497,100, while miscellaneous mineral products amounted to an additional $248,135. There are a total of 2960 men employed in the mines of the Black Hills. During the year there were only nine fatal and eight non-fatal accidents. This, in comparison with other states where there is mining, places South Dakota at the head of the list in comparative freedom from accidents, according to Mr. Ellerman. At the Homestake, with 2250 employees, there were only five fatalities and seven injuries. He gives it as his belief that most of the accidents happen to 'new' men, to whom was not given sufficient warning as to the caution necessary. He also calls attention to the fact that many properties are idle for lack of sufficient capital to put them on a paying basis, and that all the operating mines are in good condition and making many new improvements which will result in increased tonnages. Of the miscellaneous minerals produced in the district, the mica was worth $6950; gypsum products, $61,785; tungsten, $2000; lithia ores, $19,500; building stone, $106,000; coal, $12,000; and miscellaneous, $40,000. The following table shows the bullion product and tonnage for the year that ended on October 31:

	Bullion.	Tonnage.
Homestake	$6,250,000	1,533,000
Golden Reward	423,840	53,712
Wasp No. 2	286,930	163,380
Trojan	280,518	68,106
Bismarck	50,000	31,980
New Reliance	73,323	27,100
Mogul	44,117	5,593
Placer (estimated)	2,000	.....
Miscellaneous	86,372	10,600
Totals	$7,497,100	1,893,471

South Dakota's new 'blue sky' law was enacted by the last legislature and went into effect on July 1, under the provisions of which corporations desiring to sell stock, bonds, or other securities in the state for the purpose of financing their operations must secure permission from the State Securities Commission, which is headed by the State Bank Examiner. The law provides that certain information must be furnished the commission, some of which seems rather irrelevant. Following is some of the information required: A list of directors and officers, with their known financial worth, the amount of stock held by each and the price or compensation paid by each for his holdings, and the salary paid him by the company for the services he performs; a complete list of stockholders, with the price or compensation paid by each for his holdings; a copy of the by-laws; copies of all contracts or agreements in force; a statement as to the business to be undertaken, its probable cost, etc.; a balance-sheet of the corporation's books, and considerable other material along similar lines. After this is furnished and is reviewed by the commission the next that the corporation hears is that the commission desires about $50 to pay the expenses of a man to 'view the assets.' Inasmuch as the men sent out know practically nothing of mining, this provision is regarded by the mining corporations as a joke. But eventually the commission issues permission for the corporation to sell a certain block of stock, bonds, or other securities at a certain price and under certain conditions. But, should for any reason the directors or those in control of the corporation desire to change the price or terms, authority must be secured to make such change. Altogether, there is a great deal of 'red tape' connected with the statute, and its benefits are problematical.

Owing to the failure of Congress to provide funds for transportation charges on bullion between assay offices and mints, the bullion depositors at the Deadwod office are required to pay the express charges on their deposits. This amounts to 80c. per $1000, and is not an exorbitant sum. The matter of appropriation was fought out recently in Congress when the deficiency bill was up for consideration. It is hoped that at the regular session, commencing in December, the error will be rectified, so that business at the Deadwood office can be conducted as in the past, as this office is a great convenience to the mines of the Black Hills district.

In a case recently heard in the local courts, wherein the Western Federation of Miners attempted to secure possession of the building of the Lead City miners' union, the decision, partly in favor of the local union, was in part as follows: That the Lead City miners' union was the sole owner of the property; that the deed given to C. H. Moyer, as president of the Western Federation, was in law a mortgage only against the property and for $8100; that this mortgage was subject to a prior mortgage for $25,000 given the Butte, Montana, union in 1911; that the Butte union, through the Federation, had forwarded to

Lead, as relief, $25,000, the consideration for the giving of its mortgage, that no application having been made to the court to foreclose these claims against the property, the court had nothing further to do than to declare the effect of these instruments. The litigation grew out of the late labor struggle in the Black Hills, at which time the Western Federation paid out, according to evidence introduced, over $409,000 in benefits, and in return for a portion of which attempted to secure title to the building at Lead, which is worth over $50,000. The Lead union admitted an indebtedness of $13,100 to the Butte union, and will probably appeal from those parts of the decision making it liable for further sums.

Lawrence county has just received from the federal government the 10% of receipts from sale of timber in national forests which recent legislation by Congress provides shall be turned over to the county treasury in which the timber is cut. The payment, which covers the past fiscal year, amounts to $4056, of which $406 will be placed to the credit of the school fund of the county, and the balance, $3650, to the road fund. Splendid progress is being made by the Mogul Mining Co. in the construction of its new mill near Terry. The building is nearly all enclosed, and a few more days of good weather will see everything under shelter. The constructing engineer has 25 men at work, and believes that everything will be completed and the plant in operation by the middle of January. Operations have been suspended at the Wasp No. 2, and it is not likely that they will be resumed before spring. A shortage of water is given as the cause.

NEW YORK

QUARTERLY REPORTS.—RAY, CHINO, UTAH.—BRADEN SHOWS DELAY.—LA DURA CLOSED.—BUTTE & SUPERIOR.

The feature of last week was the appearance of the Quarterly reports of the big 'porphyry' copper companies. The Ray showed operating profits for the three months ended September 30, of $661,085. There was a slight decline in the output of copper, as compared with the preceding quarter, and a marked decline in operating profits. Figures as to earnings have a certain amount of indefiniteness, however, as they are based on a selling price of 15c. for copper and the metal in transit is inventoried at 13.15c. Dividends so far this year have amounted to $1,087,560 on the 1,450,000 shares outstanding. The average cost per pound of copper was 10.155c., as compared with 9.56c. for the preceding quarter, and 9.51c. for the first quarter of the year. Alterations on the mill during the quarter, which were charged to operating expense are responsible for the increased cost.

Chino yielded 15,187,000 lb. copper during the third quarter. The average grade of the ore treated during the quarter was 2.23% and the mill recovery 67%. This is lower than the usual recovery and the September output showed a marked decline. One of the technical problems at Chino is the irregular character of the orebodies, as sulphide ore occurs in some places above the oxides and at others below them. In order to mine economically it is necessary to go ahead and take the ore as it comes. As a result the mill feed shows big fluctuations as the steam-shovels pass out of the oxides into the sulphides, or the reverse. When the property is more fully stripped it will be possible to counterbalance this to some extent by pushing the shovels in one place and holding them back in another, but it will always be more or less of a problem to the management.

The Utah Copper reported a yield of 32,287,452 lb. at a cost of 8.187c. per pound. The ore treated averaged 1.25% copper, of which 0.8% was recovered and 0.45% lost in the tailing. The net earnings for the quarter amounted to $2,206,399, leaving a net surplus over the payment of the quarterly dividends of $1,186,695. The average tonnage handled by the two mills during the quarter was 22,000, and during September the average was 24,000 tons per day. The present situation of Utah Copper is the logical outcome of its policy, and it is interesting to note that by increasing the tonnage handled as the grade of the ore goes down the management is able to keep the production cost down. It is stated that it is intended to accumulate a reserve so that the Company will hereafter carry its unsold copper until it is disposed of. It is the general practice for companies on shipping blister copper to the refineries to borrow from their banks on the metal as security. Shipment, refining, and selling require about three months, and the interest charge on the cost of the copper for this period is thus an element in the cost of production. Naturally, the bank rate on money advanced is higher than the interest paid upon corporate funds deposited with it, and it is a saving, therefore, for a company to carry its own copper until it is sold. As the Utah Copper Co. has unsold copper amounting to about $5,000,000, Nevada Consolidated over $3,000,000, and the other big producers in proportion, the interest charge question is of not a little importance. Nevada Consolidated reports an output of 15,835,563 lb. for the quarter, a good deal of a decline from the preceding one. The Cananea Consolidated made an output in October about equal to the preceding months. This is only at part capacity, but the Company is doing better, following the troubles at the plant earlier in the year, than was expected in some quarters.

The long period of depression which the Braden has undergone exhibits itself in the announcement that the time for the conversion of its 7% bonds has been extended until March 1, 1916. The expected early improvement in the results attained at the property still seems to hinge, and the Hardinge mills are still expected to do great things, while the hopes for the improvement to be attained by the Minerals Separation process are still green. Exploration work continues to add to the ore reserves, but this is only partly consolatory for poor operating profits. Braden seems to be only repeating the history of numerous other properties where it has been found that thousands of miles of distance between the head office and the mine constitute a very real handicap in equipping and operating it. The trouble with the American companies is that they try to operate such properties under the direct supervision of the technical staff at the head office, English companies get better results by putting technical operations completely in the hands of the local manager, while the London office occupies itself with the financial end of the mining game. Excellent reports come from Chuquicamata, where drilling work is stated to have raised the ore reserves of the Chile Copper Co. to over 200,000,000 tons.

The Mines Company of America has had to stop work at its La Dura property, and the manager, Ben T. Wells, has returned to El Paso. For a long while railroad communication with the property has been cut off and shipments of supplies and bullion have been made by way of the Creston-Colorado. Now that its operations in Mexico have been brought nearly to a standstill, the Mines Company has been pushing its examination work in the United States in the search for good properties on home soil. W. B. Thompson and W. H. Aldridge are interested in the Company and seem to furnish the chief impelling influences as the controlling interests, steel and iron men, are somewhat unfamiliar with the metal-mining business.

The failure of H. B. Hollins & Co., members of the New York Stock Exchange, created comparatively little stir in the financial district. The firm had no connection with mining shares, and of recent years has acted more as a promoter of industrial enterprises, one of the firm being president of the Vacuum Cleaner Co. The firm has been impecunious for years and its failure has often been rumored.

The Butte & Superior continues to make good profits while its infringement suit drags along. Judge Bourquin has refused to enjoin the Company from operating, but has ordered it to give a bond. The Company officials now claim that the flotation process as now in use is of their own devising, but it scarcely seems possible that they will be able to do other than eventually to give in and pay the royalties demanded by the Minerals Separation.

Samuel Montagu & Co. report a net influx of gold at London for the week that ended on November 5, of £61,000. The net import into India in October was £1,687,266. Rand cables to London announce additional regulations regarding dust prevention in mines. Shaft bottoms are to be washed with a hose to facilitate finding missed holes.

General Mining News

ALASKA

Nome

The [illegible] completely demolished Solomon, floating some of the buildings inland about a mile and a half. Incidentally the railway terminal was not destroyed though

WRECKAGE FROM SOLOMON SPREAD ON THE TUNDRA. DICKSON NEARLY AT FLOOD STAGE OF THE WATER.

badly hit. The railroad was washed out for about two miles.

Fairbanks

According to figures that have been compiled, the output of the Shushana district will amount to about $74,000. This, however, is greater than the first season's operations in the Fairbanks district. When it is considered that the stampede did not take place until near the close of the season, the output exceeds that of many of the Northern camps and indicates that big things may be looked for from that district as a result of the prospectors' activities who are wintering there. The miners have been engaged in getting into shape for winter by building cabins and getting in a supply of wood. Food was scarce, but the arrival of winter will cause prices to drop, as there are hundreds of tons of provisions at several points within distance of the 'diggings.' Latest arrivals from the district state that the benches, which have been prospected, are everywhere showing encouraging results, although no one has as yet reached bedrock owing to the ground being frozen. The bench ground on Gold Hill is known to carry gold averaging $5 per yard.

Port Wells

A contract has been entered into by M. J. Callaghan to drive an adit 200 ft. long into the ground owned by Peter Black and William Hogan, on Harriman ford. Mr. Callaghan is to receive a one-third interest in the property and has also an option to purchase at a price of $50,000. The ground is within 200 ft. of tide-water and both timber and water-power are available. The lead at the surface is five to ten inches wide and assays $50 per ton in gold. The ore is a white quartz and the vein parallels an acid dike about four feet wide. Mr. Callaghan lives at Vancouver, but has provided for the driving of the adit this winter. Harriman ford is an arm off of Prince William sound, northwest of Valdez. It was named in connection with the explorations made by the E. H. Harriman party. The rocks of the district are similar to those at Valdez.

Valdez

The Midas mine, which is near Valdez, has been sold to the Granby Con. M. S. & P. Co. and a crew will be set to work developing and mining at once. It is understood that the Company is contemplating the establishment of steamship service to southwestern Alaska.

ARIZONA

Gila County

Development work at the Iron Cap Copper Co. is progressing in a satisfactory manner. The stope on the 650-ft. level is 400 ft. long and the ore is of good quality. The east drift on the 650-ft. level is now within 20 ft. of the Eureka shaft of the Arizona Commercial company, and with this connection made, ventilation will be greatly improved. The raise from the 800-ft. level to connect with the 650-ft. level will be completed some time this month.

Work on the mill is progressing rapidly and the steel work is nearing completion. The main shafts are now being overhauled preparatory to concreting. The Joe Bush shaft is being worked occasionally. Within six weeks more both the main east and west shafts should be connected on the sixth level with the other workings. During the month of October, development work underground was greater than the previous month by about two-fifths and about twice as great as the month of August. In October there were 17,182 tons of waste and 6866 tons of ore hoisted, making a total of 17,544 tons hoisted and an advance of 2061 ft. of development work done.

At the Superior & Boston the most notable change instituted since Mr. Tinker, the superintendent, assumed charge of the property, is the manner of doing away with the expense of timbering as the ore is mined between the 600 and 800-ft. levels. Formerly the ground was timbered as the ore was stoped upward, but by the new arrangement the only timber to be used will be that required in the raises that will be kept open between the levels as air channels and means of extracting ore and rock broken in development work. As the ore is mined along the vein the waste will be filled in behind and whatever rock is needed for complete filling will be sent down through the raises as the development and exploration work above the 600-ft. level is carried forward. Through this manner of obviating the necessity of timber the operating costs will be reduced to a marked extent. As the ore is stoped eastward the lack of change in its general appearance and width makes it seem probable that it will maintain its average size in that direction. The 1000 drift eastward is at present in the altered rock characteristic of the faulted zone. Diamond-drilling is proceeding eastward from the face of the east drift on the 600-ft. level to explore the vein in that direction. On the 1000-ft. level a small pump is being installed to pump drinking water to the surface, an abundant supply of excellent water being available at that level. The mine's output of ore remains at somewhat more than three carloads per day.

Pinal County

Operations at the Ray Consolidated Copper Co. during the past quarter have been somewhat impeded by a shortage in the water-supply, which is reflected in the report for the quarter ended September 30. Steps have been taken which will prevent a recurrence of this condition and a period of increased activity is looked forward to. In spite of the shortage of water, the results were not much below those of the June 30 quarter.

A comparison of production and cost is shown in the following table:

	Sept. 30, '13	June 30, '13	Sept. 30, '12
Tons treated	575,190	587,877	429,411
Grade, per cent....	1.72	1.7	1.61
Copper, pounds ...12,969,120		13,402,394	9,295,818
Cost, cents	10.15	9.56	10
Total net profit...	$661,086	$726,759	$650,713
Assumed copper price	15c.	15c.	17.13c.

YAVAPAI COUNTY

A report from Prescott states that an English company has arranged for the purchase of the Nigger Brown and Henrietta mines, and preparations are being made to conduct operations on a large scale. The deepest working on the Henrietta is a 550-ft. shaft, but the ground above this level is far from worked out. It is the plan of the new company to complete the lower adit, now in 1300 ft. and within 200 ft. of cutting the ore-shoot. The completion of the adit will open virgin ground 200 ft. below the present workings. The Nigger Brown has a 200-ft. shaft. In the bottom the ore-shoot is 9 ft. wide and the average in all the workings is $35 per ton. A mill will be placed on this property as soon as it has a sufficient tonnage of ore developed.

CALIFORNIA

BUTTE COUNTY

(Special Correspondence.)—No. 1 dredge of the El Oro Gold Dredging Co. has finished its area of gravel and is now being dismantled. It is probable that the machinery will be sent to a property in another state, or another part of California. The Indiana company's dredge is to be moved to Michigan Bar, in Sacramento county, and may be started early next year. No. 1 boat of the Pacific company was partly taken to the American river, near Auburn, Placer county, where a complete dredge is in operation on river bars. The Oro Water, Light & Power Co.'s boats are working south. The Company has a large area of ground some distance from this point to be turned over. The Pennsylvania dredge recently cut through a road, and is operating in a new tract. A new bucket-line is being installed on the largest of the three dredges of the Natomas Consolidated on the Feather river. Old dredge tailing from the Oro Vista boat, owned by L. Gardella, is being leveled by a drag-line scraper. This area is about five minutes' walk from the town centre.

Oroville, November 17.

SACRAMENTO COUNTY

(Special Correspondence.)—During the first week in November, the dredge of the Ashburton Mining Co., operating near Natoma, was stopped for good. The boat had been working for six years, and the hull, bucket-line, and stacker got into bad order, and as the Company only had a few acres more to turn over, the gold recovered from this area would not yield enough profit after the dredge was overhauled. The electric motors, buckets, ladder, and stacker are now being dismantled. With 7½-cu. ft. buckets, the boat handled 1,000,000 cu. yd. of gravel yearly, and has had a maximum month of 165,000 cu. yd. The average gold content was 11c. per yard, and the Company has found the work very profitable.

Natoma, November 14.

SHASTA COUNTY

(Special Correspondence.)—C. R. Russell has taken personal charge of the Russell placer claims at Igo and is working excellent gravel with the drag-line machine. As soon as sufficient water is available, a part of the ground will be mined by sluicing. It is reported that the Shasta Dredging Co. is about to test the gravel on the Gibson ranch with a diamond-drill. The property is on Clear creek, on the outskirts of Redding. The Field Process Co. is completing the building of its experimental smelting plant near Redding. The first test will be on a shipment of sulphurous ore from the Balaklala mine, Frank M. Leland, the manager, having donated the material for this purpose. The refrigeration plant is in position and the balance of the equipment will be installed as soon as it is received from Richmond. A. J. Field, the inventor of the process, plans to recover the sulphur in a solid frozen state, using liquid sulphur dioxide, produced from the ore, as the refrigerating agent. It is expected to make the initial experiment about November 20. The Balaklala Copper Co. is installing precipitating tanks for the recovery of copper from the mine waters. Tests indicate that the Company may expect upward of $1500 per month from this source. From 50 to 60 tons of ore is shipped monthly to the Mammoth smelter, the ore containing about 3.5% copper and $2.50 in gold and silver per ton. The hoist is in position at the Donkey mine, near Ingot, and deep shaft-sinking is about to start.

Redding, November 3.

The work of hauling 300,000 lb. of steel pipe from Redding to Stuart's fork, where it will be used by the La Grange Mining Co., is progressing. The pipe will be used for the construction of a siphon to carry water across the Stuart Fork cañon. The Company has a 36-in. siphon, but that does not carry water enough to meet the demands of the mine, so a supplementary siphon is to be constructed. One arm of the siphon is 1300 ft. long, the other 1100 ft. The point of delivery is ten miles up the stream from Minersville. It takes the teams nine days to make the round trip. Between Minersville and the siphon site, Stuart's fork, a turbulent stream, has to be forded nine times. Six 8-horse teams are rushing the work of delivery so as to put the pipe on the ground before winter.

SIERRA COUNTY

It has been reported that negotiations have been entered into whereby the El Dorado mine will be purchased by Butte, Montana, interests. The mine is an early-day discovery and has at times yielded small fortunes from surface pockets, the aggregate yield amounting to several hundred thousand dollars in gold. Yet the mine is a mere prospect in development, though it has an adit 1000 ft. long which was run upon the vein from its Kankaka creek outcrop. It is a north extension of the Croesus mine at Plumbago and carries the typical arsenical sulphurettes of the district and also free gold. The new management will drive on the vein for new shoots as well as sink and raise on the old ones. The property is equipped with a 10-stamp mill operated by water power.

YUBA COUNTY

A complaint has been filed against the Consolidated Willow Mining Co. by George W. Lister, in which it is asked that the directors of the Company be ordered to pay for thousands of dollars' worth of stock which they are accused of having illegally received, and to show what disposition has been made of $110,000 which was paid into the treasury. The mining property is at Weeds Point, in Slate Range township, Yuba county, and comprises the Horse Valley placer mine, Four Hundred placer mine, the Bull of the Woods mine, and the Debris Dam of the Horse Valley creek, the Horse Valley or Upper Weeds Point ditch, heading in Oak valley, and a reservoir used in connection with the Horse Valley mine. According to the allegations, shares in the corporation to the amount of $130,000 were sold. The mine was worked until 1909, at which time active operations were suspended. It is stated that but $20,000 was expended in operating the claims and that no accounting has been made of the remaining $110,000 in the treasury.

COLORADO

EAGLE COUNTY

One of the richest discoveries which has been made in the Eagle district was recently made at the North Dakota mine, when a vein 5 ft. wide was found which assays 460 oz. silver per ton. The vein was found at the surface, and the lessees believe that it will continue with depth. This mine is near the Lady Belle property and is being operated under lease by the Marion Henry Mining Co. The Lady Belle mine is shipping a carload of ore every other day.

LA PLATA COUNTY

The Eagle Pass Mining & Milling Co. is making good progress. The work on the adit continues, and a good grade of ore is at present showing in the breast. The Bulldozer is still doing work on the cross-cut and making fair progress. The Copper Hill was incorporated for $500,000 and has $90,000 cash on hand for development work. The

Company is working a full force at excavating for a power-plant and other buildings at the mouth of Bed Rock and expects by the first of January to have the plant in operation with sufficient power for a 6-drill force. The diamond-drill between Bed Rock and Madden is still in operation, but has revealed nothing.

MESA COUNTY

A rush to the recent gold discoveries near Collbran has started from all parts of the state. Scores of men are coming in from De Beque on every stage and the mining camp in Clover gulch is taking on the appearance of a tented city. Over 150 claims have already been staked, and the claims extend for 14 miles up and down Clover gulch, while prospectors are now staking other claims on Kimball creek. The advance prospectors from the Eagle district report that they will be followed by scores of other prospectors if early reports of discoveries are borne out. Additional assays of ore have been made and show from $138 to $150 per ton, with indications of a streak of uranium. Merchants of Collbran have ordered large quantities of tents and other camp supplies.

TELLER COUNTY

It is believed that the coal situation in the Cripple Creek district will be serious if the strike continues another 30 days. It is said that in that time the coal shortage will have reached such a stage as to necessitate the closing of several of the larger mines. At the present time the cost of operation has been greatly increased owing to the fact that nothing but lignite coal can be secured in any quantity. As most of the mines are fitted with hard coal furnaces, the lignite coal gives poor service. Already many of the mines in the Cripple Creek district are practically without a coal supply, and the larger power-plants at Pueblo and Canon City are facing a coal famine which threatens to close them. Should this happen the mines of the Cripple Creek district and the smelters at Pueblo would be without power. Even the most optimistic of the mining men admit that the present situation cannot be continued beyond the first of the year without harm to the industry.

It is reported that a new ore-shoot has been discovered in the Burns shaft of the Acacia Mining Co. Assay tests on two feet of the ore show as high as $500 per ton, but the average value per ton is probably $50. The full width of the vein is not yet determined, though there is good reason to expect that it will be four or five feet wide at the point of discovery, and one wall has yet to be crosscut. Free gold occurs in the vein quartz. The vein is supposed to be an extension of a rich vein that occurs in Stratton's American Eagles mine, a nearby property. The run during the past month at the Dante Gold Mining Co. was curtailed by a break-down of the machinery in the crushing department of the mill. In breaking the ore for treatment at the Dante mill, a rich ore-shoot has been opened and is now under development, and shipments from the new orebody will materially increase the profits resulting from the operation of the mine and mill.

MISSOURI

JASPER COUNTY

Announcement has been made that sufficient funds have been raised to keep the pumps going at the Providence property, and it is believed that the present equipment is sufficient to keep the water below the levels that are being mined in the adjacent properties. In most instances each mining company operating in the threatened district pledged $50 per month toward the pump fund, and most of the landowners subscribed $100 per month. In this way a fund of nearly $1000 per month has been raised, which will pay the actual expense of running the big pumps in the Providence mine. Had the operators failed to raise the fund of $1000 per month, the Providence Mining Co. had determined to take out its pumps and the whole district would have been flooded.

The Sapulpa mine, which is situated on a lease of the American Zinc, Lead & Smelting Co., has been leased by Webb City interests. The Company has developed a large area of mineralized ground on the 40-acre lease and the mine promises to be a big producer. There is a 200-ton mill on the lease and ore is hoisted from three shafts. There is a high face of rich ore in the drift, it is said, and drill-holes near the mill show that a wide area of rich ground remains to be mined. The mill is in splendid condition and is equipped with modern concentrating machinery. Operations will be conducted at the Sapulpa on a large scale and the output of the mine is likely to be greatly increased.

Slides of earth, which have recently occurred at the property of the Daylight Mining Co., have endangered the mill. Two weeks ago about 300 tons of earth fell, this slide occurring opposite the mill, and during the past week several slides large enough to alarm the owners of the mill have occurred. The Daylight mine is perhaps the most unique in the district, in that all the workings are in a large cave. Considerable amounts of zinc and lead ore are contained in these slides.

The Wilson Mines Co. is at present producing a large tonnage of lead and zinc ore. For several months the mine has been the second greatest producer in the Duenweg district, the Coahuilla alone excelling it in point of production. The Company is mining a rich ore deposit at a depth of 170 ft. and hoisting ore from two shafts. The mine is equipped with a splendid concentrating plant.

The Durston Mining Co. obtained a lease on part of the Luscombe and McElroy land, southwest of Galena and near the old New Century mill, some time ago, and it was decided that a mill should be erected on the ground, but the plans were not formulated until recently. Mr. Edwards, the manager, has succeeded in finding a suitable site, and the ground work and the foundation will be started at once. The Company expects to move one of its mills from near Joplin to this place, and it is believed that by the time the mill is torn down the foundation and other work being done at Galena will be completed and the mill may be erected without delay. The Luscombe and McElroy land has been mined only on a small scale. This Company expects to mine it thoroughly and it is said some good ore exists there.

MONTANA

SILVERBOW COUNTY

(Special Correspondence.)—The leaching process being tried at Anaconda is so far giving excellent results. The Laist method of precipitating copper by means of iron reduced from powdered ore by coal is giving satisfaction and may prove of wide importance. A McDougall furnace is being prepared for use in this connection in an effort to get a continuous process. A little copper is volatilized in the chloridizing roast, but an electrical precipitating unit is being installed to recover this and such acid as is formed in roasting.

Butte, November 8.

NEVADA

ESMERALDA COUNTY

Shaft sinking has been resumed on the Silver Pick Consolidated property, and three shifts are being employed for this work. The shaft is down a little over 400 ft. and the bottom is apparently in a vein of large size. It is planned to continue the shaft to a depth of 1000 ft., but some lateral work may be done at a depth near the present bottom of the shaft.

Development work at the Florence Goldfield property is satisfactory, according to report, although the Company has ceased shipping ore to the Bonnie Clare mill. It has not been definitely announced whether the Company will resume shipping to this plant, but it is stated that there is a large tonnage of excellent milling ore in the mine and a good profit can be made in the treatment of this ore. During the period in which the Florence company was treating ore at Bonnie Clare it is said to have effected a recovery better than 85%. The presence of copper in the ore coming from some parts of the mine prevented as high a recovery as was at first expected. Some of the ore yielded a recovery in excess of 90% by simple crushing, regrinding, and cyanidation. The mine is said to be in excellent condition, with some encouraging new devolepments on three levels, and in addition to the ore recently placed in sight there are

quantities of mill ore stored in old mine workings and on the old dumps.

Work at the C. O. D. Consolidated property is at present being confined to the 30-ft. level, which level was started from the Gold Bar shaft and has been connected with the Victor shaft at a depth of about 350 ft. Quantities of good milling ore have been exposed on both levels, although some of the ore is refractory and may require other processes of treatment to successfully recover the mineral content than those now in use in the district. At a point near the Victor shaft on the 300-ft. level, seams of shipping ore are exposed and several shipments have been made that have yielded a good profit. It has been the plan of the Company to block out its milling ore in case a sufficient tonnage can be made available to erect a mill of 50 tons daily capacity.

Eureka County

The mill construction at the Buckhorn mines is about a month behind the scheduled time, owing to the severe storms that have prevailed during the summer months, but both mill and power-plant will be in readiness to be tried out about December 1. The power-plant is situated at Beowawe, and will be operated by petroleum generators, oil to be delivered at the plant in tank cars. The mill and power-plant will cost in the neighborhood of $400,000 when complete. Approximately $500,000 has been spent on the development of the mine. Fully $1,000,000 will have been expended upon the Buckhorn Mines Co.'s properties before any returns can be realized, in addition to the purchase price of the mine. The mill will have a capacity of 350 to 400 tons of ore per day and a large tonnage is already blocked out. Operations will be conducted largely through tunnels, and the ore can be brought to the mill at an unusually low cost. It is estimated by the Company's engineers that with the plant operating on a normal basis a net profit of $50,000 per month will be realized for a long time to come.

Humboldt County

It is reported that the vein on the Big Four lease of the Rochester Mines Co. has widened out to 12 ft. and contains shipping ore which will assay $40 per ton. The ore is in the bottom of a 150-ft. winze from the main level which was driven to cut the vein. On the south drift at a point 200 ft. from the tunnel level a lens of ore 10 ft. wide was found. It is said to average more than $100 per ton, and in places free gold is seen. This is the first time that free gold has been found in the adit and is considered indicative of greater richness at increasing depth. For some time there has been a small output from this property, because of the dead work that was being done to develop the property at depth.

Lyon County

The following report has been received from the general superintendent of the Nevada-Douglas property at Ludwig, Nevada. "I am glad to report that development work on the Company's properties continues to bring to light highly gratifying conditions. In the Ludwig the 8th level advanced 81 ft. during the month of October. In the last report I spoke of the high-grade ore found on this level, and to date we have continued in ore with the grade running slightly lower, but with the metal more evenly distributed throughout the deposit. There remains now only 23 ft. to be driven to reach the objective point, and from this point a raise of 38 ft. will give connection with the bottom of the 750 winze. The 100 drift at the Casting Copper continues in ore of a high grade, and is now 180 ft. from the shaft, the drift having been in ore for all of that distance. Daily samples during the week have given assays from 8 to 47.7% copper. This ore lies between the limestone and the intrusive, and is following along the base of the limestone hill, where surface conditions are much more favorable for large and rich bodies of copper than they have been in the country recently passed through. These surface conditions indicate that the ore will continue clear around the hill to the Amalgamated shaft on the southern side. This deposit promises fair to outstrip, both in quantity and quality, anything previously found on the property."

Nye County

A new vein of high-grade ore was recently found on the 950-ft. level of the North Star mine, but was subsequently cut off by a fault. A raise is being made to connect with an intermediate level of the Martha, after which this vein, which is the Martha vein in North Star ground, will be followed. The purpose of the raise was to get the east extension of the Martha vein in North Star ground and the fault raised on was the hanging wall of the same fault against which the Martha vein cut off practically at the North Star line. The dump continues to produce good ore, some forty tons having been secured to date. On the 1250-ft. level the two cross-cuts show no change and are being continued. On the 1150-ft. level stoping continues on the two blocks of ground underneath the 950-ft. level, in which ore was opened by the two prospect raises several weeks ago. The winze from the 1050 is down 85 ft. and driving east and west has just begun. A vein of low-grade is in the bottom of the winze.

White Pine County

The report of the Nevada Consolidated Copper Co. for the quarter ended September 30 shows a decline in production and a decrease in the grade of ore being milled. The Company reports for the September 30 quarter a deficit from operations amounting to $95,157, as against a surplus in the corresponding quarter of 1912 of $798,136. The creation of this deficit was directly due to a decrease in production of 2,569,904 lb. of copper, as compared with the same quarter in 1912. The production during the quarter was 15,835,563 lb., against 17,928,746 lb. in the quarter ended June 30 last, 14,523,565 lb. in the quarter ended March 31 last, and 18,405,467 lb. in the quarter ended September 30, 1912.

The Nevada Consolidated ore milled during the quarter amounted to 813,513 tons, as compared with 762,880 tons in the previous quarter. Ninety-three per cent of the tonnage was supplied from the pits and 7% from the underground working of the Veteran mine. The grade of ore treated averaged 1.53%, as compared with 1.76% for the previous quarter, and 1.74% copper in the quarter ended September 30, 1912. The cost per pound of copper produced, including Steptoe plant depreciation and all charges except ore extinguishment was 10.09c., as compared with 8.95c. for the second quarter, and 8.33c. for the last fiscal year. The overburden stripped during the quarter amounted to 976,664 cu. yd., at an expense of $316,898. On account of the character of the ore now being milled, the degree of concentration is less than formely and consequently the concentrate carries less copper, which increases the cost per pound. Experiments are being conducted to devise a cheaper method of treating the low-grade slime.

NEW MEXICO

Grant County

The tonnage of ore treated and the output of copper for the past quarter is the largest that has been recorded by the Chino Copper Co. In the quarterly report to the stockholders it is stated that the total amount of ore milled during the quarter was 507,650 tons; as compared with 492,850 tons, for the previous quarter and 429,750 tons, for the first quarter of 1913. The average percentage of copper contained in the ore treated for the third quarter was 2.23, as against 1.88 for the previous quarter, and 1.91 for the first quarter of 1913. The average extraction for the quarter was 66.98%, corresponding to a recovery of 29.92 lb. of copper per ton of ore milled, as compared with an average extraction for the previous quarter of 64.48%, corresponding to a recovery of 24.33 lb. of copper per ton of ore milled. The average grade of the concentrate produced for this quarter was 14.46% copper, as against 15.72% for the previous quarter. The cost per pound of net copper produced for the quarter, after allowing for smelter deductions and without making any credits for miscellaneous revenues, was 8.41c., as compared with 9.01c. per pound for the previous quarter, and 8.24c. per pound for the first quarter of 1913. At the close of the quarter the total amount of copper on hand and in transit (sold and unsold) was 19,540,748 lb. During the quarter there was removed by the steam-shovels, a total of 1,123,688 cu. yd. of material in place, an

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region. Work will be begun soon on a railway line from Port McNeill and a through line from end to end of the island, running near the properties, is being built. It is believed the mines will have been sufficiently developed to begin shipping by the time the railways are operating.

Spokane, November 15.

COSTA RICA

The report of operations at the Abangarez Gold Fields of Costa Rica, issued on November 7, presents the following figures:

	Month of Sept. 1913	9 mo. to Sept. 30, 1913.	9 mo. to Sept. 30, 1912.
Ore crushed, tons.....	6,144.00	48,477.00	38,526.00
Tailing leached, tons....	737.80	4,791.20	5,616.90
Slime treated, tons.....	4,953.00	39,789.00	28,123.00
Ext. by amalgamation..	$9,801.24	$98,777.09	$206,668.45
Cyanide extraction.....	46,216.68	325,500.85	285,268.36
Total extraction	$56,017.92	$424,277.94	$491,936.81
Less cost of operation, marketing, and administration (exclusive of betterments)	51,853.19	453,902.99	576,611.81
Profit from operations	$4,164.01	*$29,625.05	*$84,675.00
Betterment expenditures.	3,923.46	61,180.22	187,909.17

*Deficit.

CANADA

Ontario

The Mond Nickel Co. recently purchased the Levack properties, the purchase price being $750,000. This property has an area of 1600 acres and is situated 30 miles west of Sudbury. This property has been under option for some time, and six diamond-drills have been constantly prospecting the orebodies. It is learned that they have over 2,000,000 tons of ore developed. The sum of $40,000 was paid by the Mond company when the option was granted, and under the terms of the agreement the balance and final payment is due in December unless amended arrangements are entered into. The Levack properties were discovered and located about the year 1882, by one of the present owners, James Stobie.

MEXICO

Michoacan

The shaft which is being sunk on the property of the Cia. Minera de San Vidal y Anexas has now reached the fourth level, and cross-cutting to the vein has been started. This Company was organized about a year ago with Charles Hoyle, general manager for the Esperanza Mining Co., as president.

Sonora

(Special Correspondence.)—Mineral exports through the customs house at Agua Prieta during the month of October was valued at ₱3,755,800, being an increase of ₱450,700 over the preceding month. Considering the condition of the country, the increase in exports of mineral is nothing short of remarkable, and the amount of last month is the largest ever shipped through that port in any one month heretofore. The October gross smelter production of the Cananea smelter will be a little over 7,000,000 lb. Of that amount the output from the Cananea company's own ores will be in the neighborhood of 2,800,000 lb. Over 40 ft. of fairly high-grade ore has been opened on the 300 ft. level of the Palo Seco mine of the Moctezuma-Arizpe (Mexican Metals) company, situated about 18 miles southeast of Cananea. La Dura mine, situated in the Yaqui district, and owned by the Mines Company of America, has been shut down, the first intermission in operations for over thirty years. The employees have all been dismissed and the Americans returned to the States. An El Paso group of financiers have organized a company for the purpose of taking over the Monte Cristo property, owned by C. C. Soto and situated in the Moctezuma district. The property is considered a rich one, and during the past ten years over $100,000 worth of mineral has been shipped.

Nogales, November 15.

Personal

Professional men are invited to send news of their engagements and travels. Such news is interesting to friends.

O. C. Perry is at Oroville.

Charles Janin is in London.

F. H. Morley is in San Francisco.

F. Lynwood Garrison is on his way to California.

H. W. MacFarren has been at Jackson, California.

Harold C. Cooke is in the city from British Columbia.

Francis J. Dennis has gone to London on professional business.

George E. Farish has returned to New York from British Columbia.

Charles E. van Barneveld has returned to San Francisco from the East.

M. W. von Bernewitz has returned from his visit to the dredging fields.

J. Moisan is back from the Philippine Islands and will return to Virginia.

F. W. Nons, manager at the Leonesa mine, Matagalpa, Nicaragua, is visiting San Francisco.

C. L. Larson, who has been with the Chicksan Mining Co., has returned to the United States.

H. Kenyon Burch, chief engineer for the Inspiration Copper Co., is at Greenwich, Connecticut.

Augustus D. Cox has gone from Manhattan to Tonopah, where he will be for the next three months.

J. D. Hubbard and J. Spiers were inspecting a drift mine near Chico, Butte county, California, last week.

R. Y. Williams has resigned from the U. S. Bureau of Mines to organize the Miners Institutes for the University of Illinois.

Charles Helman, of the El Oro Gold Dredging Co., has returned to Oroville, after several months in Montana and other states.

Fayette A. Jones, president of the New Mexico State School of Mines, is examining mining property in Elko district, Nevada.

Arthur W. Burgren, of the A. S. & R. Co., Matehuala, San Luis Potosi, Mexico, is in San Francisco, his address being 443 Holbrook building.

H. N. Bowen will leave Carson City, Nevada, on December 1, to take charge of the mines of the Continental Copper M. & S. Co., at Hill City, South Dakota.

G. M. Colvocoresses has returned to New York from professional work in the West. He is now consulting engineer to the Consolidated Arizona Smelting Company.

Webb Smith, manager for the Kennedy Mining Co., Jackson, narrowly escaped a fatal accident in a skip in the shaft early last week, and has been laid up on account of the bad shaking received.

C. E. Grunsky, Jr., formerly superintendent for the Standard Con. M. Co., has joined the staff of the American Engineering Corporation at San Francisco, and will take charge of the mining work.

L. F. S. Holland has returned to Telluride, Colorado, after examining mines in Beaver county, Utah, and Park county, Colorado. He is arranging to make his headquarters at Los Angeles during the coming winter.

William S. Mann, formerly metallurgist for the New York & Honduras Rosario Mining Co., is erecting an all-sliming cyanide mill for the Socorro Gold & Silver Mines, Ltd., Valle de Angeles, Honduras, Central America.

H. W. Hardinge has gone on an extended tour through the Northwest, including British Columbia, to inspect the recent large installations of Hardinge mills in that district. He expects to be gone between six and eight weeks.

W. R. Nons, who died at Maracaibo, Colombia, September 14, was a Stanford graduate who was formerly connected with the K. T. & O. Co. at Coalinga. He was in Colombia for the Caribbean Petroleum Co. and became infected with tetanus while quinine was being administered to him for fever.

The Metal Markets

LOCAL METAL PRICES

San Francisco, November 20.

Antimony	10—10½c	Quicksilver (flask)	$39
Electrolytic copper	17¼—17⅜c	Tin	44—45¼c
Pig lead	4.60—5.65c	Spelter	7—7¼c

Zinc dust, 100 kg. zinc-lined cases, 7½ to 8c. per pound.

EASTERN METAL MARKETS.

(By wire from New York.)

NEW YORK, November 20.—The copper market is weaker, consumers are holding off, and but little buying is reported. Yesterday closed with electrolytic at 15.25 to 15.50 and Lake at 16.50. The London market is quiet with spot at £67 7s.6d. and futures at £66 17s.6d. At Boston there was noticed a slight reduction in the official quotations of copper, this, however, was unimportant. The lead and spelter market remain dull.

SILVER

Below are given the average New York quotations, in cents per ounce, of fine silver.

Date.		Average week ending	
Nov.	13	Oct. 8	61.27
"	14	" 15	61.12
"	15	" 22	61.14
"	16 Sunday	" 29	59.98
"	17	Nov. 5	59.52
"	18	" 12	59.62
"	19	" 19	59.26

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	56.25	63.01	July	60.67	58.70
Feb.	59.06	61.25	Aug.	61.32	59.32
Mch.	58.37	57.87	Sept.	62.95	60.53
Apr.	59.20	59.26	Oct.	63.16	[illegible]
May	60.88	60.21	Nov.	62.73	....
June	61.29	59.03	Dec.	63.38	....

Samuel Montagu & Co.'s report of November 6 contains the following regarding the position of silver: The tone of the market is somewhat better. Speculative sales from India and from China have gradually come to an end. Coincident with the reduction in China sales, a certain amount of China buying set in, which checked the fall in rates. Yesterday the steadiness of the market became obvious, and China sales ceased, whereupon some 'bears' felt inclined to cover, and the price rose to 27½d. for both deliveries. Although the improvement may continue, it is not possible to be certain as to the future, for speculation in China exchange may produce unexpectedly a resumption of China sales of silver. The stock in Bombay is now much smaller than it has been for years. This week it has fallen from £300,000 to £245,000; the off-take is about 55 bars per day.

Shanghai reports a stock of £6,225,000, compared with £6,250,000 last week. It appears to be well known that between £1,500,000 and £2,000,000 of this stock is deposited with the banks, foreign and native, mainly with a view to safe custody. A reabsorption of this amount for trade purposes would reduce the present stock to about £4,225,000, at which it would not look quite so unwieldy. Now that unrest in China has simmered down, there is a possibility of such a reduction taking place. An Indian currency return showed an increase of 10 lacs under the denomination of rupees, of 120 lacs under that of silver under coinage, and of 24 lacs of sovereigns under that of the standard reserve in India. There was a decrease of 60 lacs under the denomination of gold in India.

ZINC

Zinc is quoted as spelter, standard Western brands St. Louis delivery, in cents per pound.

Date.		Average week ending	
Nov.	13	Oct. 8	5.24
"	14	" 15	5.28
"	15	" 22	5.10
"	16 Sunday	" 29	5.25
"	17	Nov. 5	5.13
"	18	" 12	5.09
"	19	" 19	5.05

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	6.42	6.88	July	7.12	5.11
Feb.	6.50	6.13	Aug.	6.96	5.51
Mch.	6.57	5.94	Sept.	7.45	5.55
Apr.	6.63	5.52	Oct.	7.36	5.22
May	6.68	5.23	Nov.	7.23	....
June	6.88	5.00	Dec.	7.09	....

Rudolf Wolff Krueger & Co., in their weekly spelter report, write: "The spelter market has been interesting. The low prices attracted the demand from consumers which had been anticipated in a previous report, and this has resulted in values being gradually stiffened until November is bid for at £20 12s. 6d. There has been more trading in galvanized iron, and it is to be hoped that the more normal prices now ruling for copper may stimulate the brass trade. The outlook for the future is excellent, but in the meanwhile rather heavy stocks are weighing upon the market. The stocks in the hands of the syndicate have been considerably reduced. The syndicate price in England is £21 5s. for November and £21 7s. 6d. for December, but in France and Belgium a considerable reduction was made which has since been followed by a slight advance of 1s. 6d. On the whole, the outlook and position is considerably improved, in spite of the surrounding depression in other metals. The only unfavorable feature from a 'bull' point of view is the heavy premium on forward spelter, which even now stands at 16s. 3d. above the price of spot metal.

COPPER

Quotations on copper as published in this column represent average wholesale transactions on the New York market and refer to electrolytic copper. Lake copper commands normally from 1-5 to 1-4c. per lb. more. Prices are in cents per pound.

Date.		Average week ending	
Nov.	13	Oct. 8	16.27
"	14	" 15	16.11
"	15	" 22	16.38
"	16 Sunday	" 29	16.55
"	17	Nov. 5	16.26
"	18	" 12	15.54
"	19	" 19	15.08

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	14.09	16.54	July	17.19	14.21
Feb.	14.08	14.93	Aug.	17.49	15.42
Mch.	14.68	14.72	Sept.	17.56	16.22
Apr.	15.74	15.22	Oct.	17.32	16.31
May	16.03	15.42	Nov.	17.31	....
June	17.23	14.71	Dec.	17.37	....

The German consumption of foreign copper for the months January to September, 1913, according to L. Vogelstein & Co., was as follows:

	Tons.
Imports of copper	174,300
Exports of copper	7,327
Consumption of copper	166,973

The consumption for the same period in 1912 was 153,374 tons. Of the above quantity, 150,564 tons was imported from the United States.

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.		Average week ending	
Nov.	13	Oct. 8	4.38
"	14	" 15	4.40
"	15	" 22	4.35
"	16 Sunday	" 29	4.35
"	17	Nov. 5	4.20
"	18	" 12	4.19
"	19	" 19	4.18

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	4.43	4.28	July	4.71	4.35
Feb.	4.03	4.33	Aug.	4.54	4.60
Mch.	4.07	4.32	Sept.	5.00	4.70
Apr.	4.20	4.36	Oct.	5.08	4.37
May	4.20	4.34	Nov.	4.91	....
June	4.40	4.33	Dec.	4.20	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California, being the largest producer. The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending			Nov. 5	39.00
Oct.	22	39.00	" 12	39.00
"	29	40.00	" 19	39.80

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	43.75	39.37	July	43.00	41.00
Feb.	46.00	41.00	Aug.	42.50	40.50
Mch.	46.00	40.20	Sept.	42.12	39.70
Apr.	42.25	41.00	Oct.	41.50	39.37
May	41.75	40.25	Nov.	41.50	....
June	41.30	41.00	Dec.	39.75	....

TIN

New York prices control in the American market for tin since the metal is almost entirely imported. San Francisco quotations average about 5c. per lb. higher. Below are given average monthly New York quotations, in cents per pound.

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	42.53	50.45	July	44.25	40.70
Feb.	42.96	49.07	Aug.	45.80	41.75
Mch.	42.58	46.95	Sept.	48.64	42.45
Apr.	43.92	49.00	Oct.	50.01	40.61
May	46.05	49.10	Nov.	49.92	....
June	45.76	45.10	Dec.	49.80	....

The Stock Markets

SAN FRANCISCO STOCKS AND BONDS

(San Francisco Stock and Bond Exchange.)

BONDS

November 20.

Listed.	Bid	Ask	Unlisted.	Bid	Ask
Associated Oil 6s	$ 97½	99½	General Petroleum 6s	$—	55
E. I. du Pont 4½s	—	87	Natomas Dev. 6s	99	—
Natomas Con. 6s	—	70	Pac. Port. Cement 6s	99½	—
Unlisted.			Standard Cement 4s	90	—
Ass. Oil 6s	78½	—	Santa Cruz Cement 6s	—	90

STOCKS

Listed.	Bid	Ask	Unlisted.	Bid	Ask
Amalgamated Oil	77	—	Mascot Copper	—	2½
Associated Oil	38½	39	Noble Electric Steel	2½	—
Giant	87½	—	Natomas Consol.	5	—
Pac. Cst Borax, com.	60	—	Pacific Port. Cement	63	75
Pacific Crude Oil	—	35c	Riverside Cement	45	—
Sterling O. & D.	85c	—	Santa Cruz Cement	—	48
Union Oil	55	—			

NEVADA STOCKS

(By courtesy of San Francisco Stock Exchange.)

San Francisco, November 20.

Atlanta	$ .08	Mizpah Extension	$ .30
Belcher	.36	Montana-Tonopah	.96
Belmont	7.50	Nevada Hills	.50
Big Four	.15	North Star	.44
Cash Boy	.07	Ophir	.23
Florence	.21	Pittsburg Silver Peak	.37
Goldfield Con.	1.45	Round Mountain	.35
Goldfield Oro	.08	Sierra Nevada	.09
Halifax	1.40	Tonopah Extension	1.62
Jim Butler	.71	Tonopah Merger	.57
Jumbo Extension	.08	Tonopah of Nevada	4.60
MacNamara	.10	Union	.13
Mexican	1.27	West End	1.20
Midway	.38	Yellow Jacket	.38

COPPER SHARES—BOSTON

(By courtesy of J. C. Wilson, Mills Building.)

November 20.

	Bid	Ask		Bid	Ask
Allouez	$ 33	33¾	Mohawk	$ 40	41
Ariz. Commercial	4⅛	4⅛	Nevada Con.	14⅛	14⅛
Butte & Superior	30	30⅛	North Butte	23¾	23⅞
Calumet & Arizona	62	62½	Old Dominion	48	48½
Calumet & Hecla	401	403	Osceola	72	75
Copper Range	35¾	36	Quincy	55	56
Daly West	2	2½	Shannon	6⅛	6¾
East Butte	10	10⅛	Superior & Boston	2¼	2⅜
Franklin	3	3½	Tamarack	27	28
Granby	68½	69	U. S. Smelting, com.	36½	37
Greene Cananea	31	31¾	Utah Con.	7⅞	8
Isle-Royale	17	18	Winona	1⅛	1⅛
Mass Copper	2	2½	Wolverine	41½	42

NEW YORK CURB QUOTATIONS

(By courtesy of E. F. Hutton & Co. Kohl Building.)

November 20.

	Bid.	Ask.		Bid	Ask
Braden Copper	6⅝	6⅞	McKinley-Dar.	1¼	1⅜
Braden 6s	135	142	Mines Co. Am.	2	2⅛
B. C. Copper	2¼	2½	Nipissing	8	8¼
Davis-Daly	1¾	2	Ohio Copper	¼	½
Dolores	2	4	San Toy	18	22
El Rayo	1	2	Sioux Con.	1	2
Ely Con.	2	4	So. Utah	¼	⅝
First Nat.	2⅛	2¼	S. O. Calif.	200	202
Greene Can.	6	7	Tri Bullion	⅛	¼
Giroux	1	1½	Tuolumne	¾	1
Iron Blossom	1.15	1.25	United Copper	¼	⅜
Kerr Lake	4½	4⅝	Wettlaufer	7	8
La Rose	1¼	1⅞	Yukon Gold	2	2¼
Mason Valley	3⅜	3⅝			

NEW YORK STOCK EXCHANGE

(By courtesy of J. C. Wilson, Mills Building.)

November 20.

	Bid	Ask		Bid	Ask
Alaska G. M.	$ 19½	19¾	Miami	21½	21⅝
Amalgamated	69⅜	69½	Nat. Lead	43⅜	45
Anaconda	33⅛	33⅜	Quicksilver, com.	1⅞	2
A. S. & R.	61½	61⅜	Ray Con.	17¼	18⅛
Calif. Pet.	16½	18	Tenn. Copper	28⅜	28½
Chino	37⅞	38	U. S. Steel, pfd.	105	106
Guggenheim Ex.	43⅛	44⅜	U. S Steel, com.	54⅜	54¼
Mexican Pet	44⅜	45½	Utah Copper	47⅛	48

LONDON QUOTATIONS

(By cable, through the courtesy of Catlin & Powell Co., New York.)

November 20.

	£	s.	d.		£	s.	d.
Alaska Mexican	1	15	0	Kern River Oilfields	2	6	2
Alaska Treadwell	8	2	6	Mexico Mines	5	5	0
Alaska United	3	15	0	Messina	1	8	9
Arizona	1	16	0	Oroville	0	8	9
California Amalg	0	1	3	Pacific Oilfields	0	2	6
California Oilfields	6	1	3	Rio Tinto	72	0	0
Camp Bird	0	13	9	Santa Gertrudis	0	16	9
El Oro	0	13	9	Stratton's	0	2	6
Esperanza	0	16	9	Tanganyika	2	6	3
Granville	0	11	3	Tomboy	1	6	3

AUSTRALASIAN

November 20.

	£	s.	d.		£	s.	d.
British Broken Hill	1	17	6	Mount Boppy	0	16	9
Broken Hill Prop.	1	16	0	Mount Elliott	4	8	9
Golden Horse-Shoe	2	7	6	Mount Lyell	1	5	0
Great Boulder Prop.	0	12	6	Mount Morgan	3	10	0
Ivanhoe	2	16	9	Waihi	2	12	6
Kalgurli	1	10	0	Waihi Grand Junc.	1	5	0

Western Australia Gold Production

The returns for August for the state amounted to $2,339,800, and returns and dividends from the chief mines were as follows:

Name.	Tonnage.	Value.	Profit.
Great Boulder Proprietary	19,010	$241,100	$126,500
Ivanhoe	20,843	190,200	70,000
Bullfinch Proprietary	5,252	74,800	46,600
Kalgurli	11,010	106,800	46,200
Sons of Gwalia	13,975	108,400	30,400
Yuanmi	10,700	87,100	21,200
Fenian	2,745	38,800	18,800
Golden Horse-Shoe	28,157	184,900	18,500
Lake View & Star	18,442	106,900	18,100
Queen of the Hills	4,001	37,000	17,800
Boulder Perseverance	21,809	115,900	14,800
Sand Queen	1,586	26,500	12,500
Edna May	1,116	20,000	8,900
Oroya Links	12,450	67,200	8,600
Mararoa	2,715	24,900	7,900
Black Range	3,000	31,600	7,200
Boulder No. 1	2,682	10,400	6,700
Victorious	8,804	40,200	5,000
Golden Ridge	2,932	23,200	5,000
Mountain Queen	3,496	22,300	4,600
Associated	11,475	64,700	4,500
Kyarra	960	12,900	4,400
Burbank's Main Lode	1,975	22,100	2,800
Associated Northern	1,422	21,600	2,700
Lake View Consols	8,106	7,800	2,200
Commodore	730	7,100	1,600
Ida H.	1,426	23,800	1,100
Great Fingall Consols	5,311	53,300	950
Menzies Consols	2,125	18,400	460
South Kalgurli Consols	9,660	50,900	*3,700

*Loss.

FULLER'S EARTH has been recently studied by the United States Bureau of Mines, which finds that there are American deposits even better suited for use in refining edible oils than those abroad. Previously local material, while used in the petroleum industry, had been considered unsuitable for bleaching edible oils. Fuller's earth is a regular article of commerce that may be sold through jobbers. According to the U. S. Geological Survey, production in 1912 amounted to 32,715 tons, worth $9.34 per ton at the mine. Unground earth costs the refiner about $14.50 per ton and ground earth $16.

ACCORDING to A. H. Brooks, the placer production of gold in Alaska for 1912 was less than for 1911, but the production of lode gold was greater than ever before. The total mineral production for 1912 was $22,285,800, as against $20,505,604 for 1911.

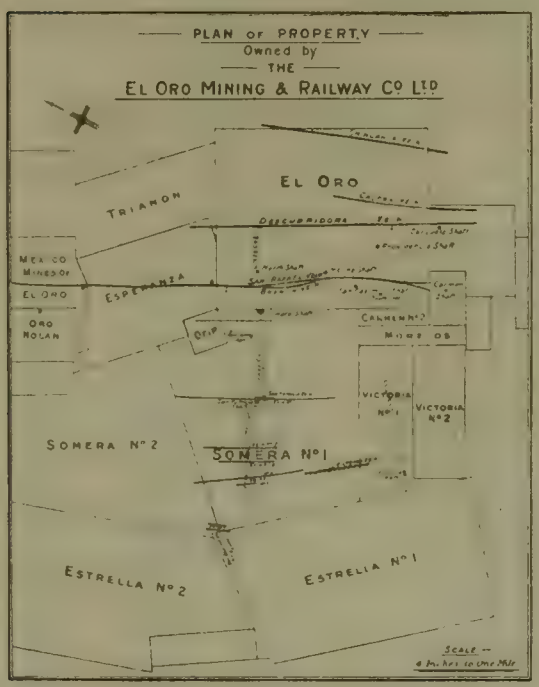
DURING the month of August the sum of £33,375 was paid in dividends by Western Australian gold-mining companies.

Company Reports

EL ORO MINING & RAILWAY CO., LTD.

The El Oro Mining & Railway Co., Ltd., operates in Mexico, and the report covers the year ended June 30, 1913. The principal results may be summarized as follows:

Ore reserves.	Tons.	Gold content per ton.
Northern orebody	109,896	$ 5.70
Southern orebody	120,465	4.59
Lower levels	98,526	18.16
San Patricio	119,166	5.58
Total	448,053	$ 8.11



In addition to the above gold content, the ore averages 3 oz. silver per ton.

Ore mined for these veins from 86 to 1450-ft. depth, tons	253,413
Ore milled, tons	253,434
Sand tailing treated, tons	180,274
Sand remaining for re-treatment, tons	198,005
Recovery from all sources, per cent.	88.39
Bullion realization	$2,188,724
Working expenses	1,490,382
Profit from railway department	117,983
Interest and sundry revenue	40,800
Net profit realized	768,000
Dividend No. 24 for the period	274,000
Dividend No. 25 for current year	274,000
Carried forward	418,000
Total dividends to date	8,563,000

The report of the general manager, A. F. Main, contains full details of the San Rafael vein at the upper levels; the San Rafael and West veins on the lower levels; the Ofir claim in which is blocked out 43,375 tons of ore averaging $23.12 gold and 8 oz. silver per ton, and a total profit in sight of $1,000,348; the western veins in the Somera claim; the Chihuahua vein, and the southern extension of the San Rafael vein in the Carmen mine. Generally speaking, the ore reserves in every part of the property show an increase as compared with a year ago, even without considering the Ofir claim, which, in itself, is proving of the greatest importance. A 500-gal. per minute electric pump was installed on the 1600-ft. level, and a large fan was erected at the mouth of the ventilating shaft to force fresh air to the lower levels. The mill of El Oro Mining & Railway Co. treated 22,940 tons of ore and 13,760 tons of old tailing during September, yielding $177,550. The total profit was $64,140, including $8500 from the railway.

KALGURLI GOLD MINES, LTD.

This Company operates a very profitable mine at Kalgoorlie, and the report of the general manager, R. S. Black, covers the year ended July 31, 1913. From the 100 to the 1850-ft. level, 128,415 tons of ore was mined, and 15,170 tons of $7.50 ore was broken and is in the shrinkage stopes. Development covered 3759 ft., also 3546 ft. of sample holes and 369 ft. of diamond-drilling. The Kalgurli mine is noted for its short, wide, and irregular ore-shoots. The ore reserves are approximately 250,000 tons. On the 100-ft. level, driving opened ore 15 by 80 ft. worth $6 per ton; at 300 ft., the ore was 15 by 45 ft., worth $17; at 850 ft., the main east shoot showed an area of 25 by 75 ft., averaging $9; work at 1000 ft. was not favorable; a winze sunk on the east lode at 1250 ft. passed through 6 ft. of $30, 21 ft. of $20, and 14 ft. of $14 ore; between the 1250 and 1350-ft. levels, a shoot 28 by 90 ft., worth $17, is being mined; the 1650-ft. shoots are entirely satisfactory; while the 1850-ft. level has been disappointing. A geological examination of the lower levels of the mine was made by Malcolm Maclaren, who states that the eastern orebodies passed finally out of the favorable quartz-dolerite at 1650 ft., and the western orebodies a little below the 1750-ft. level. At 1850 ft. no quartz-dolerite whatever has been disclosed, and this level lies entirely in calc-schist. Exploration on the two bottom levels has been fairly comprehensive, and it would seem that it is unsound business to sink deeper in the Kalgurli mine.

The mill treated 128,415 tons of ore, yielding $1,224,000, with 93.17% recovery. Mining cost $1.90 and treatment $2.90 per ton.

MOUNT BISCHOFF TIN MINING COMPANY

This is one of the most important lode-tin properties in the world, and is situated in the West Coast district of Tasmania. The report covers the half-year ended June 30, 1913, and may be tabulated as follows:

Ore mined, tons	116,728
Ore milled, tons (difference being sorted)	116,063
Tin concentrate recovered, tons	580
Smelter operations:	
Concentrate smelted, tons (588 from mill and 1056 from other mines)	1,644
Metallic tin produced, tons (372 + 745)	1,117
Assay of metals, tin per cent.	99.88
Recovery of tin per ton of ore, pounds	7.76
Costs per ton of ore treated:	
Mining	$0.69
Prospecting and development	0.05
Aerial tramway	0.03
Milling	0.30
Electric power	0.01
Assaying, surveying, etc.	0.02
Water-supply	0.03
Administration	0.05
Total	$1.18
Revenue	$375,000
Net profit	163,000
Dividend	173,000
Carried forward	494,000
Surplus of assets over liabilities	240,000
Capital	119,200

BROKEN HILL SOUTH SILVER MINING COMPANY

This Company operates an important silver-lead-zinc property at Broken Hill, New South Wales, and the report under review covers the six months ended June 30, 1913. The general manager, W. E. Wainwright, gives the following information. The effect of the fall in metal prices is reflected in the accounts, and unfortunately the price of zinc has still further receded since the close of the half-year. Lead, however, remains firm. During the half-year

two dividends have been paid, amounting to $768,000, while $27,400 has been written off plant account, and the balance of profit and loss account, $528,000, has been carried forward. The liquid assets amount to $864,000. Work at the mine has proceeded regularly and satisfactorily, except that during the month of April a serious stoppage for three weeks occurred owing to the closing of railway communication on account of the strike of the employees of the Silverton Tramway Co., which considerably reduced the output and the earnings of the period under review. The policy of exploring the southern portion of the property and of shaft-sinking has been continued, and with satisfactory results. The average weekly tonnage of ore treated amounted to 5836 tons. Tailing delivered to the Amalgamated Zinc and Zinc Corporation flotation plants was 129,907 and 39,270 tons, respectively. Experiments being made on the accumulated slime, about 330,000 tons, have been continued with good results, and something definite will soon be decided upon. Other details may be summarized as follows:

Development, feet	5,522
Filling, cubic yards	53,726
Ore mined from 425 to 1170-ft. levels, inclusive, tons	151,836
Deepest workings, No. 4 shaft, feet	1,202
Metal contents of ore milled:	
Lead, per cent	14.4
Zinc, per cent	13.7
Silver, ounces	6.5
Concentrate produced, tons	24,417
Lead content, tons	17,141
Zinc content, tons	1,632
Silver, ounces	554,266
Zincy tailing produced, tons	109,098
Total costs per ton of ore	$5.44
Value of metal production	$ 1,440,000
Water consumption, gallons	29,914,200
Rainfall, inches	1.6

SIAMESE TIN SYNDICATE, LIMITED.

The company was registered in 1906 to acquire and work tin deposits in Siam and elsewhere. An alluvial tin area of 635 acres at Ngow, Renong district, is being worked. Two additional dredges of double the capacity of No. 1 were expected to begin work during the latter part of 1913. Application has been made for a lease of 300 acres bearing alluvial tin, at Bangrin, about four miles from the Ngow area. Drilling has been done. The estimated life of the property is eleven years. The Company also has a cocoanut plantation and a trading business; a small revenue is also obtained from two properties which are being worked on tribute. The capital is £120,000 in 120,000 shares of £1 each, all the shares being issued and fully paid, including 30,000 credited as fully paid. From sales of ore from tributers and sundry income from properties on lease £7,518 was realized. The expenses of dredge No. 1 were £23,582. The year resulted in a net profit for the company of £40,822. Two interim dividends of 10% each have already been paid during the year, leaving a balance of £16,822, out of which the directors recommend the payment of a final dividend of 10%, carrying forward £4,822.

THE TANALYK CORPORATION, LTD.

This Company, which has a capitalization of £300,000 in £1 shares, was organized in April 1912, and holds all the shares of the South Urals Mining & Smelting Co., Ltd. Its land holdings amount to 9500 acres in the Orsk district of the Orenburg government, together with timber rights on 300,000 acres of forest. It is developing copper, manganese, and magnesite deposits. The first report covers the period from April 15, 1912, to January 13, 1913. The property is just emerging from the development stage, but already 70,000 tons of ore assaying 2.9% copper, $7.40 gold, and 7½ oz. silver are definitely in reserve, and a large smelting plant is being erected. The large amount of capital which is being expended for the development of this property is evidence of confidence in its future, and the results of this venture will be awaited with interest.

Decisions Relating to Mining

Specially reported for the MINING AND SCIENTIFIC PRESS

LAND CONTAINING GRANITE DEPOSITS IS MINERAL LAND

Land containing deposits of granite of a quality valuable for building purposes and in quantity sufficient and location suitable for marketing for such purposes, is mineral land and not subject to forest lieu selection under the Act of June 4, 1897.

Merkley John *v.* Hyde & Co., 42 Land Decisions, 144. April 30, 1913.

PATENT IMPROVEMENTS—REPAIRS TO TUNNELS

Where a tunnel has been driven for the development of certain claims which were afterward abandoned and subsequently relocated, the relocators, upon application for patent, cannot accredit expenditures made for the repair of said tunnel as a common improvement counting toward the requirement for patent purposes, when it does not appear that they extended the tunnel or in any way added to its original value for development purposes.

Austin Manhattan Consolidated Mining Co., 42 Land Decisions, 75. March 14, 1913.

ADVERSE CLAIMS—VERIFICATION

An adverse claim by a corporation, filed under Section 2326, Revised Statutes, relating to the contest of patent applications, may be verified by its executive officer outside of the land district where the claim involved is situated, but at the principal place of business of the corporation. Under such circumstances, it is the act of the corporation itself and within the provisions of the statute permitting verifications by claimants in person outside of the land district in which the claims are situated.

Frank Hough Mining Co. *v.* Empire Prince Mining Co., 42 Land Decisions, 99. April 24, 1913.

AMENDED LOCATION—NOT TO PREJUDICE OTHERS

Where a locator in 1900 located a quartz claim and in marking his boundaries paced the distances and estimated the angles at the corners, after a lapse of more than ten years, during which one of his corners became obliterated (if it ever existed), and other parties located adjoining ground and made a discovery thereon, the first locator will not be permitted to amend his location so as to include their discovery point under the pretense of correcting his survey, where a substantial doubt exists as to the location of the original boundary line between the two claims. Such a correction in the boundary line cannot be allowed after a lapse of considerable time where the rights of others have intervened.

Gobert *v.* Butterfield, 17 California Appellate Decisions, 367. October 1, 1913.

OIL PLACERS—POSSESSION PRIOR TO DISCOVERY

A tract of oil land in Ventura county, California, was located as the 'Rawley' placer in 1883 and as the 'Schley' placer in 1910. The earlier locators had made no discovery, done no work, and were not in possession at the time the later location was made. Their claim of right was based upon the theory that the wells which they were drilling on adjoining claims "tended to develop" the oil-bearing character of the Rawley claim. The 'Schley' locators leased their claim, and the lessee went into possession, commenced drilling operations, and continued to work with due diligence, although at the time of commencing this action no discovery had been made. Held, that the locators of the Schley claim, being in actual possession through their lessee and prosecuting discovery work with due diligence, had the better right and sufficient grounds to maintain a quiet title suit against the 'Rawley' locators. The statute permitting work done on one claim to inure to the benefit of other claims which such work tends to develop, applies only to assessment work and does not apply to claims upon which no discovery has been made.

S. R. Smith *v.* Union Oil Co., 46 California Decisions, 287. September 29, 1913.

Concentrates

Most of these are in reply to questions received by mail. Our readers are invited to ask questions and give information dealing with the practice of mining, milling, and smelting.

ARKANSAS has two mountains which, according to a chart published by the United States Geological Survey, are each 2800 ft. in height, Blue mountain and Magazine mountain. The lowest point in the state is 55 ft. above sea-level.

SILICA BRICK are specially made brick used for furnace linings and also in tube-mills. They sell at a much higher price than ordinary building brick, because of the skill and care necessary in their manufacture, and the relatively limited market.

TODE STONE is a volcanic amygdaloidal rock, generally decomposed, occurring as sheets of contemporaneous lava in the Carboniferous limestone of Derbyshire, England. The term is an old one and means 'dead stone,' referring to the barrenness of the rock as regards mineral veins.

CARNOTITE is mined in southwestern Colorado and shipped to Pittsburgh, where the Standard Chemical Co. is producing radium at the rate of about one gram per month. Production began last May, and officers of the Company estimate that the supply of rock available will yield a total of six pounds of radium.

CAM-SHAFTS for a battery of 1000-lb. stamps will, if made of hammered iron or so-called mild steel, be not less than 5⅞ in. diameter, though some builders make them $5^{7}/_{16}$ in. for 5-stamp units. For such units the length would be 8 ft. 2 in., assuming 12-in. posts 5 ft. apart. A 5⅞-in. shaft of this length weighs 760 pounds.

ROCK PHOSPHATE, according to E. H. Sellards, state geologist, was produced in Florida in 1910 to the amount of 392,088 tons. Total shipments exceeded this, 461,353 tons having been sent abroad and 18,745 tons shipped to domestic points. The total production of pebble rock was 2,029,797 tons, of which 606,110 tons was shipped abroad.

NICKEL is not mined as such in the United States. The output of nickel from domestic ores is merely a by-product from electrolytes of the copper refineries. Salts and metal equivalent to 328 short tons of metallic nickel were saved in domestic refineries in 1912 from both foreign and domestic ores. Nickel ore 'imported for consumption' is mostly from the Canadian deposits.

ANTHRACITE, according to E. W. Parker, is mined at an average cost of $1.86 per ton and sold for $2.06; this margin of 20c., however, makes no allowance for interest or depreciation, and in fact probably no great industry is operated on so narrow a margin as coal-mining in the United States. Where prices are high, this is due to transportation and delivery charges rather than to mining costs.

MICARTA is a new material which has been developed by the Westinghouse company to take the place of hard fibre, glass, porcelain, hard rubber, built-up mica, pressboard, rawhide, and other materials used for commutator bushings, brush-holder insulation, noiseless gear blanks, and similar uses. It is insoluble in practically all ordinary solvents, indifferent to ozone, non-hydroscopic, and impervious to moisture.

PROSPECTORS should not only seek to determine the value of the mineral or ore which they have discovered, but they should also endeavor to determine the quantity. Needless to say, a small pocket of ore, although it may be quite rich, often costs more to realize upon than it is worth. On the other hand, a large deposit, even though it be quite low in value per ton, is often an attractive proposition to a capitalist. In the case of most metalliferous mines 'quantity of ore' can only be determined by extensive workings and the expenditure of time and money; but with non-metallic minerals often a detailed study of the deposit will give some information as to the quantity available.

SECTIONALIZED machinery is necessary where the material must be transported by mule-back. The carrying capacity of an ordinary mule is about 300 lb., but the possible weight limit should, as far as possible, be placed at half this, since it is simpler and better to balance the load in two parts on the mule's side, than to attempt to mount it on his back. The extra heavy pieces will cost dearly before they reach their destination.

GOLD AND SILVER mines to a total of 5699 were listed as producing in 1912, in the United States, excluding the Philippine Islands and Porto Rico. Of the total 3553 were deep or quartz mines, and 2146 were placer. The largest number of mines in any one state was 1041, in California. The actual number producing in any one year varies considerably, but ranges between 5190 in 1907 and 5699 in 1911. These figures are from the statistical records of the Geological Survey.

BREAKAGES in cam-shafts are due primarily to fatigue of metal, the fibrous structure of the steel being destroyed by the constant pounding, and the material crystallizing. No way has been found to prevent cam-shaft breakages entirely. Mounting 10 stamps on a shaft rather than 5 makes a better distribution of torsional strains, but throws more stamps out of service when breakage does occur. Good material, good workmanship, and good foundations will minimize but not prevent the breakage.

AN important consideration affecting the efficiency of operation of a wet-crushing mill lies in the provision of an adequate water-supply, and due attention should be paid to this point in all preliminary estimates. Heavy running expenses, both in treatment methods and residue disposal can be reduced, and in some instances almost eliminated from the cost of operation by ample water provision. Even a heavy initial outlay for water-supply is invariably fully justified by subsequent economy of practice.

BRIQUETTING of slime, or 'slum' as it is locally called, is accomplished at Anaconda by mixing with water in an ordinary pug mill such as is used in making brick by the stiff mud process. The briquetted material is delivered in the form of a horizontally moving clay bar traveling on a flat belt. Formerly it was cut into regular bricks by means of the usual wire wheel, but since the only object of the process is to make the material stick together long enough to become buried in the furnace, even this was abandoned as an unnecessary refinement. The bar is now broken irregularly as it passes from the original belt to one which travels in the same direction at a more rapid rate; the usual form of delivery in clay-working plants. The whole equipment is simple, cheap, and effective.

SILICA is used for many different purposes and the total sold amounts to over 65,000,000 tons per year. The total value, however, is small, approximately $21,000,000, according to the United States Geological Survey. The powdered silica quoted monthly on another page of the *Mining and Scientific Press* is a prepared product and a large part of the price is due to the cost of selection and preparation. The crude material is abundant and of little value. To make it merchantable, a finely divided silica of absolutely uniform grade and composition must be offered. The largest part of the miscellaneous market is supplied from Ottawa, Illinois, where in the St. Peter sandstone there is an enormous quantity of unusually pure and unusually uniform sand, available for the digging and grading. There are large concerns engaged in preparing and marketing this sand, and anyone wishing to compete would need to study the business as a manufacturing industry rather than a mining enterprise. An excellent article upon glass sand and other sands, written by E. F. Burchard, appears in the 'Mineral Resources' for 1911. It may be obtained from the Director of the U. S. Geological Survey at Washington.

Recent Publications

The Cobalt-Nickel Arsenides and Silver Deposits of Temiskaming. By Willet G. Miller. Bureau of Mines report. Fourth edition. P. 279. Ill., maps, charts, index. Toronto, 1913.

Report on Scenery-Preservation for 1912-13. By John Strauchon. New Zealand Department of Lands and Survey report. P. 10. 5 plates. During the year ended March 31, 1913, an area of 55,140 acres was set aside for scenic, historic, and thermal-spring purposes, making 211,562 acres to date.

Bulletin of the Seismological Society of America. September 1913. P. 47. Ill. Stanford University, Palo Alto, California.

La Irrigacion del Valle de Ica. Por C. W. Sutton. Boletin No. 79 del Cuerpo de Ingenieros de Minas del Peru. P. 198. Ill., maps. Lima, Peru, 1913.

The Strength of I-Beams in Flexure. By Herbert F. Moore. University of Illinois Bulletin No. 68. P. 40. Ill. Urbana, Illinois, 1913. The bulletin gives new formulas for the strength of I-beams. It is of direct interest to all who have to do with the design or construction of steel-framed structures, bridges, buildings, etc., and is of general interest as an effort on the part of a state testing station to increase the safety of buildings and bridges.

University of California publications, Berkeley, 1913:

A Peculiar Horn or Antler from the Mohave Miocene of California. By John C. Merriam. P. 5. Ill.

Nothrotherium and Megalonyx from the Pleistocene of Southern California. By Chester Stock. P. 17. Ill.

Notes on the Canid Genus Tephrocyon. By John C. Merriam. P. 13. Ill.

Vertebrate Fauna of the Orindan and Siestan Beds in Middle California. By John C. Merriam. P. 12. Ill.

Report on State Nurseries and Plantations for 1912-13. By John Strauchon. Department of Lands and Survey report. P. 53. Ill., maps. With a view to the future supply of timber, the New Zealand government has been raising and planting useful trees for many years past, until the total new trees in the North Island is now 31,364,105, and in the South Island, 17,913,475. The report is well illustrated and shows how well the California redwood, Douglas fir, Oregon pine, and Sitka spruce grow in New Zealand.

Technologic papers of the Bureau of Standards, Washington, 1913:

The Effect of Preliminary Heating Treatment upon the Drying of Clays. By A. V. Bleininger. No. 1. P. 53. Ill.

The Function of Time in the Vitrification of Clays. By G. H. Brown and G. A. Murray. No. 17. P. 26. Ill.

Dehydration of Clays. By G. H. Brown and E. T. Montgomery. No. 21. P. 23. Ill.

Effect of Overfiring upon the Structure of Clays. By A. V. Bleininger and E. T. Montgomery. No. 22. P. 23. Ill.

Technical Control of the Colloidal Matter of Clays. By H. E. Ashley. No. 23. P. 118. Ill.

Maryland Geological Survey publications, Baltimore, 1913:

Lower Devonian. Text. Introduction by C. K. Swartz, Charles Schuchert, and Charles S. Prosser. Description by Charles Schuchert, C. K. Swartz, T. Poole Maynard, and R. B. Rowe. P. 560. Ill., maps, index.

Middle and Upper Devonian. Text. By Charles S. Prosser, Edward M. Kindle, and Charles K. Swartz. P. 720. Ill., maps, index.

Devonian. Plates 73.

These three volumes deal with the systematic geology and paleontology of Maryland. The first is devoted to a consideration of the lower Devonian deposits and their contained faunas. The record is the combined work of a number of individuals, most of whom are specialists in their own particular field of research. In the compiling of this work the Maryland Survey has had the cooperation of the U. S. Geological Survey. The second is devoted to a consideration of the Middle and Upper Devonian deposits and their contained fauna. As in the previous volume, this work comprises the combined efforts of a number of individuals. There is also a volume of plates accompanying these works which illustrate the paleontology of the Lower Devonian of Maryland. The volumes are indexed and fully illustrated.

U. S. Geological Survey, Washington, 1913:

Advance chapters from 'Mineral Resources of the United States, 1912':

Production of Platinum and Allied Metals. By David T. Day. P. 7.

Precious and Semi-Precious Metals in Utah. Mine production. By V. C. Heikes. P. 35.

Production of Petroleum. By David T. Day. P. 141.

Production of Mineral Waters. By George Charlton Matson. P. 43.

Production of Coal. By Edward W. Parker. P. 219. Chart.

Precious and Semi-Precious Metals in Arizona. Mine Production. By V. C. Heikes. P. 36.

Precious and Semi-Precious Metals in New Mexico and Texas. Mine Production. By Charles W. Henderson. P. 36.

Statistics of the Clay-Working Industries of the United States. By Jefferson Middleton. With notes on the occurrence of the different varieties of clay, by J. H. Hance. P. 100.

Production of Metals and Metallic Ores in 1911 and 1912. By J. P. Dunlop. P. 9.

Copper in 1912. General report. By B. S. Butler. P. 64.

Precious and Semi-Precious Metals in Nevada. Mine Production. By V. C. Heikes. P. 49. Flow-sheet.

Precious and Semi-Precious Metals in Idaho and Washington. Mine Production. By C. N. Gerry. P. 46.

Precious and Semi-Precious Metals in Montana. Mine Production. By V. C. Heikes. P. 37.

Advance chapters from Bulletin 531, 'Contributions to Economic Geology, 1911, Part II':

The Williston Lignite Field, Williams County, North Dakota. By Frank A. Herald. Bulletin 531-E. P. 69. Map, charts.

Coal and Lignite in Boise and Cassia Counties, Idaho. By C. F. Bowen. Bulletin 531-H. P. 20. Maps.

The Barber Coal Field, Johnson County, Wyoming. By Carroll H. Wegemann. Bulletin 531-I. P. 24. Maps, charts.

Advance chapter from Bulletin 540:

The Weaverville Quadrangle, California: Auriferous Gravels by J. S. Diller, and Gold Lodes by H. G. Ferguson. Bulletin 540-A. P. 73. Ill., map.

Mineral Resources of the Inyo and White Mountains, California. By Adolph Knoph. Bulletin 540-B. P. 44. Ill.

Borate Deposits in Ventura County, California. By Hoyt S. Gale. Bulletin 540-O. P. 25. Maps.

Advance chapters from Bulletin 541:

Oil and Gas in the Northern Part of the Cadiz Quadrangle, Ohio. By D. Dale Condit. Gas from Mud Lumps at the Mouths of Mississippi. By E. W. Shaw. Bulletin 541-A. P. 15. Map.

Mineral Resources of Alaska, 1912. (a) Administrative report; the mining industry in 1912. By Alfred H. Brooks. P. 51. Map. (b) Marble resources of Ketchikan and Wrangell districts. By E. F. Burchard. P. 77. Map. Extracts from Bulletin 542.

Water-Supply Paper:

The Ohio Valley Flood of March-April, 1913. By A. H. Horton and H. J. Jackson. Paper 334. P. 96. Ill., maps, charts, index.

Mechanical Shoveling Underground

Many attempts have been made to perfect a machine which would do the hard and expensive work of shoveling broken rock underground. At the surface, steam-shovels, grab-buckets, and similar devices are available, and to a limited extent the smaller 'steam-shovels', usually driven by compressed air or electricity, are in use in the mines. Ordinarily they can not be used because the quarters are too cramped. This is especially true in tunnel work where speed is all important and where, accordingly, mechanical shoveling would be especially important. Every experienced tunnel driver realizes that the essential problem is how to get rid of the broken rock in the shortest possible time. In coal mines and in all properties where loading is done from the floor, the cost of shoveling is serious, and any relief will be welcome. In driving one of the long adits in the Coeur d'Alene region, Thomas Cox used a mechanical conveyor for loading cars and greatly expedited his work. Even here, however, it was necessary to have men shovel from the floor to the conveyor, though there was a great gain in that the broken rock was raised inches rather than feet.

MYERS-WHALEY SHOVELING MACHINE.

The Myers-Whaley Co. is now manufacturing a mechanical shoveler, which is shown in the accompanying picture. This machine is now in use in coal, iron, salt, and lead mines, and in contracting work on the Catskill aqueduct. It may be driven by electricity, compressed air, or steam, is self propelling, requires but one operator, and permits using the conveyor as a preliminary picking belt. It is built in several sizes weighing from 6000 to 16,000 lb., and is said to require but 7½ to 12 hp. The capacity is given at 1750 lb. coal or one-half cubic yard of rock per minute for the smallest, No. 2 machine, and 2875 lb. coal or 0.82 yd. rock for the No. 4 or largest. A No. 4 machine working in a lead mine at Flat River, Missouri, is reported to be averaging one ton per minute on the day shift and a little less at night. It has been in use since December 4, 1912. Its output in April for 22 days was 6626 tons, and in May, 24 days, 6612 tons. During the week from April 25 to May 1, inclusive, it loaded 1958 tons, or an average of 163 tons per shift. The machine is run entirely by one man. Two men are used to break rock too big to go through the mine chutes, though the machine itself will handle lumps weighing 800 to 1000 lb. and of large dimensions. One man is used to couple cars and clean up the tracks. Total crew, four men.

In a salt mine at Retsof, New York, another machine is reported to be loading over 5000 tons per month. The construction and method of operation are shown in the accompanying illustration.

Commercial Paragraphs

The Bury Compressor Co., Bury, Pennsylvania, is just starting the erection of an addition to its plant, extending the main plant 100 ft. This is necessary on account of increase in business.

The Keystone Driller Co. was awarded the contract August 22 for its largest Downie double stroke pump for the city of Naperville, Illinois; capacity 350 gal. per minute, 300-ft. head; pump to be direct connected to motor.

The Western Electric Co. reports that it has been given a contract for mine telephones by the Oklahoma Coal Operators Association. Eight hundred of the Company's standard No. 1336 type mine telephones, with complete wiring and installing material, are included in this order, which is the largest ever placed at any one time for such equipment.

The Truax Manufacturing Co., for many years makers of small cars for mining and industrial purposes, announces its removal to new and larger quarters at Eleventh and Wazee streets, Denver. Hyatt flexible roller bearings and special car and cart construction are keeping this well known concern busy.

The S. Flory Mfg. Co., Bangor, Pennsylvania, reports that since the fire sustained some months ago, temporary buildings have been erected and equipped with improved high-grade machinery, and it is ready to take care of orders as in the past. The business will be continued in Bangor and the permanent building erected as early as possible.

The Hardinge Conical Mill Co. reports that it has been awarded a contract for grinding machinery by the National Copper Co., Wallace, Idaho. This includes machinery for preliminary granular fine crushing as well as the final regrinding. Also that the Atbasar Copper Co., of Russia, has just placed an order through the London office of the Hardinge Conical Mill Co. for six of the largest size Hardinge mills to be equipped with Hardinge type manganese steel liners. The Britannia Mining & Smelting Co., which is at present installing a flotation process for the separation of ore, has decided to increase its capacity, and has ordered more Hardinge mill equipment, bringing the present installation up to nine mills.

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EDITORIAL

ECUADOR has authorized a loan of £2,000,000 for the purpose of sanitation at Guayaquil, and a representative of J. G. White & Company has been called from London to arrange terms for the contract.

OWING to failure of certain drawings to arrive from London in time for use, publication of the remaining parts of Mr. C. B. Horwood's series of articles on the Rand bankets has been necessarily suspended for a week or two.

BUJUN is a Japanese variant of Fushun, the better known name for the coal mines near Mukden opened by the Russians and now operated by the South Manchurian Railroad Company, and described on another page by Mr. Reiji Kanda.

THE barometer of the Mexican situation seems to be embodied in the person of Victoriano Huerta, and the clear, cloudy, threatening, and storm readings as daily recorded in press bulletins present a true log not only of the status of diplomatic relations, but also the daily consumption of fermented grape juice by Don Victoriano.

AWARD of the gold medal of the Mining and Metallurgical Society of America to Mr. H. C. Hoover and his wife, Mrs. Lou C. Hoover, for their "distinguished contributions to the literature of mining" is announced at New York. This is a pleasing and appropriate recognition of the magnificent gift to the profession embodied in their translation and editing of Agricola's 'De Re Metallica.'

ONE of the peculiar situations that has developed as a result of the present conditions in Mexico is the fact that coin silver as such, at the present rate of exchange, is of less value than the market price of bar silver. In consequence of this state of affairs, Mexican coin is being melted into bars for export, and a decided shortage is reported. To put a stop to this practice an executive degree has been issued providing severe punishment for those guilty of melting coin. The situation recalls that of a number of years ago when the melting of Mexican silver coin and parting it for the gold content proved a profitable industry. With the silver coin being exported as bullion, and most of the new currency being in the form of I. O. U.'s, forced on the Mexican public by revolutionary leaders, the Mexican currency question is becoming interesting.

DECIMALS are generally looked upon as affording the best means for scientific expression of numerals and it is, therefore, a pleasure to note that a real decimalist has been employed to compute for the United States Geological Survey the value of gold for the year 1912. The factor used was $20.671834627323 per fine ounce. The millionth part of a mill would have been fairly accurate from a dollar and cents standpoint, but carrying the figure to three decimal places further leaves no doubt as to the actual value of gold for that year.

GEOLOGISTS will find much of interest at the twenty-sixth annual meeting of the Geological Society of America which will be held at Princeton, New Jersey, from December 30 to January 1, inclusive. The sessions of the society will be held in Guyot hall of Princeton University, where the accommodations are so ample that the Council has decided to continue the plans adopted for the management of last winter's meeting. The morning sessions will be devoted to papers on subjects of general interest; the noon recess will be long, in order to give time for social intercourse, group discussions, and the examination of exhibits. The afternoon sessions will be somewhat short and will be devoted to papers of less general scope. The program provided is a most attractive one and a hearty welcome is assured to those who make the journey to 'Old Nassau' for this meeting.

AT A RECENT congress of 'scientists' at Halle, for the purpose of testing the efficacy of the divining rod in the discovery of underground water and mineral deposits, so much enthusiasm was stirred up by the forked stick that it was decided to organize an international association to investigate its prowess. A report of the proceedings of this congress states that experiments conducted by 'experts' present resulted in the discovery of three potash veins, coal deposits, water courses, and a leak in the city water main; but inquiry addressed to one of the professors in the University of Berlin brings the information that while in Germany there is a school of technologists who swear by the divining rod, "when one asks for visible results, he finds nothing new." When our German friends master this lost art it is not improbable that the quest for Captain Kid's treasure and the leak in some of our modern corporations will be greatly expedited.

ENDOWED prospecting is now proposed following the lead of the Empire Mines Company, which owns the only endowed gold mine of which we know, and the Canadian Mining & Exploration Company, which has practically endowed a staff for examining mines with a view to purchase. The latest proposal comes from Douglas, Alaska, where the Northwestern Development & Mining Company has been organized to grubstake a couple of prospectors. The peculiar feature of the plans of this Company is that it is proposed to invest half the capital stock in some commercial business, preferably a local store, from the returns on which 4 per cent dividends are to be paid, the surplus going into the prospecting fund. This is one way to reëstablish the old relation between local merchants and prospectors, but will run counter to the human prejudice in favor of each controlling his own reinvestments. Aside from that, neither prospecting nor country stores have as yet proved good fields for investment of company capital in small units, since the personal element is so large a factor in the success of each. Such a plan, while opening the way to unusual profits as well as losses, does not seem to offer much hope of stabilizing prospecting, the matter of chief concern.

AS noted last week, the committee of Colorado editors who have been investigating the strike in the coalfields and before whom appeared representatives of the operators, the strikers, and the Governor, decided that there was no justification for a further continuance of the strike. The committee found in favor of the strikers on four points and of the operators on two. It was held that the men are entitled to an eight-hour day, to checkweighmen, to the right to trade at any store, and to the strict enforcement of all the mining laws. It was further held that, while recognition of the union must be optional with the operators, the right of any man to belong to a union without prejudice or discrimination is guaranteed by the laws of Colorado and full support was pledged to the Governor in enforcing all the laws. The advance in wages asked for was refused on the basis of the showing of the operators that the average wage paid was more than a 'living wage' and that it compared favorably with that in other Colorado industries. Since announcement of the conclusions of the editors, the operators have given formal consent to the award. The action of the men is awaited with interest. On one point we do not agree with the committee, which held in favor of employment of mine guards. Police work belongs to the state, and mining companies should not be put to the expense of protecting their property; neither should they have the privilege of maintaining what amounts to private armies. It is absurd on the face of it that either companies or men should maintain military forces and wage private war at any time.

Mining and the Departments

Transfer of the Bureau of Mines from the Department of the Interior to that of Labor or Agriculture has been seriously proposed at Washington this year, and certainly some reorganization of the Department is in order. Established in 1849 and originally considered of no particular consequence, the office of Secretary of the Interior has become one of the most important in the Cabinet. The main duties centre in the custody of the public lands, though for some unfathomable reason the Bureau of Pensions was placed in the Department. The custody of the Indians, another of the duties of the Secretary, is more naturally found here, since the Indians, so long as they are wards of the nation, live upon reservations set aside from the public lands. The Commissioners of Patents and of Education also report to the Secretary of the Interior, though for

no very tangible reason. The truth is that the Department has become one for administering any bureau for which no definite place exists elsewhere. The Land Office, the Geological Survey, the Reclamation Service, and the Bureau of Mines constitute a closely related group of bureaus devoted to the study, utilization, and custody of the public lands. The Forest Service, which belongs naturally with this group, is in the Department of Agriculture, an accident due to personal factors at the time the Service was created. As it now stands, the most active Secretary of the Interior has by far too little time to do justice to needs of more than two or three of the bureaus under his charge. A time record some time since showed that three of the bureaus in the Department absorbed 92 per cent of the time of the Secretary, leaving him to apportion as justly as he might the remaining 8 per cent among the other five. No wonder there is delay, and no wonder that important matters of policy are left undecided until friction has developed undue heat. Mr. Franklin K. Lane, the present Secretary, is an experienced administrator, and is unusually well informed about the subjects that fall within the range of his office. He is hard working and faithful, but after four months in office the head of one bureau had had less than a half hour of his undivided attention.

The miners have asked and are still asking the creation of an independent department, and certainly the conduct of public business would be facilitated if some better classification of the bureaus at Washington were made. There are objections to putting the Bureau of Mines in either the Department of Labor or the Department of Agriculture as they are now constituted. As regards the first, the Bureau must make recommendations regarding mines to both operators and men, and these will undoubtedly be better received if they come from a department not avowedly consecrated to either party in controversy. In considering transfer to the Department of Agriculture, it is to be remembered that the dominant interest in the Department is likely long to be agricultural, however the name may be changed. Just now, when there are so many points in controversy between farmers and smelters, for example, the miners may naturally prefer to be independent. What is really needed is a department corresponding to that found in most Latin-American countries and called 'Fomento'; a department designed to promote development. The Department of Agriculture affords the basis for such a department, since it has the tradition that it is right and proper to spend money to encourage development. Requests for funds made by its secretary receive much more recognition from the Committee on Agriculture in the House of Representatives than similar requests made by the Secretary of the Interior in behalf of the Bureau of Mines or the Geological Survey. In the one case the Congressmen are placed upon the Committee to spend money, provided it be wisely done. In the other, the members of the Committee, exposed to demands in a multitude of directions, devote their whole energy to conserving the public funds as much as possible. The Chairman of the Appropriations Committee is looked upon as the 'watchdog of the Treasury' and usually earns his title, though, as might be suggested by the name, he is not usually adverse to the opening of an occasional 'pork barrel.'

Development projects, whether they relate to experimental farms, studies of mines, reclamation of arid land, reforestation, or gauging the streams, should not be financed upon the basis of expenditure by congressional districts. It is necessary to get away from this system, and either a new Department of Promotion should be organized or some of the accidental bureaus should be transferred from the Department of the Interior and a not too large coördinate group of bureaus dealing with the public domain brought together.

Sinking in Wet Ground

Mining engineers will read with pleasure the article by Mr. Francis Donaldson, in this issue, in which is described the methods of sinking and lining shafts on the Catskill aqueduct. It is to be regretted that costs are not also given, since those we have seen are much higher than any under which an American mining engineer is forced to work. Given money enough, almost any shaft may be sunk, but generally, since mines are by nature temporary works, capital cost is the controlling factor in choice of a sinking method. We grant freely that it should not be allowed to dictate plans so often as it does. Our Japanese friends are right when, as at the Miike mine, they build steel and brick stations and lay their underground tracks with heavy rails in rock ballast. On the average, mines are much longer lived than the material put into their equipment, and there is no economy in interrupting work to renew rails, stations, or shaft linings.

The method of grouting described by Mr. Donaldson is of much interest and may well be more widely used. Something of the same sort has been done in the lead mines of southeastern Missouri where great cracks and crevices deliver enormous quantities of water to the workings, and in other mines resort is occasionally made to the same method. Probably the most extensive use of cement for such a purpose is in 'cementing off' oil wells when a water-bearing sand is penetrated. In California, and lately in Oklahoma, this means has also been adopted in drilling through sands filled with natural gas under heavy pressure. The details of the operation have been described in a number of papers published by our local contemporary, *Western Engineering*, and need not be repeated. It is sufficient to call attention to the possibility of adopting oil-drilling methods for shaft-sinking through wet ground. Where difficulties are anticipated, it might prove feasible to drill an exploratory hole with an ordinary churn-drill, and, in case a heavy flow of water is found, cement it before sinking. In case of a large shaft, more than one drill-hole would be necessary, though if there was but one water-bearing bed, and it a thin one, it would probably be cheaper to drill the supplementary holes from the bottom of the shaft when a short distance above the already determined troublesome horizon. Has anyone tried this, we wonder?

The Sinking and Lining of Shafts

By Francis Donaldson

*When mining was begun in America timber was cheap and plentiful, the deposits of virgin coal and ore were widely distributed and could be reached at no great depths, and the development of the rectangular timbered shaft was the natural result. Nowadays shafts are becoming deeper, mining equipment expensive, and mining men are beginning to think they could possibly get better results by a part return to European methods, and by the use

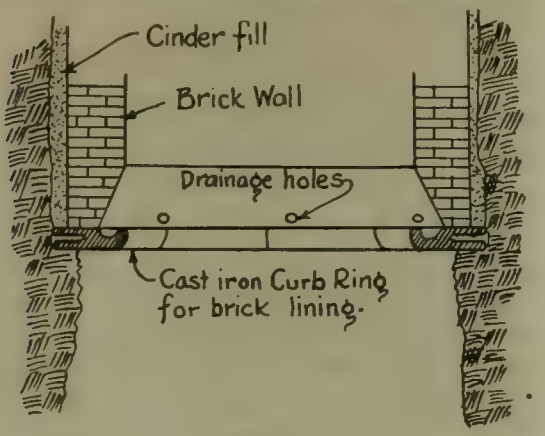


Fig. 1.

of permanent linings. European shafts are generally circular, about 20 ft. in diameter, and where the rock is moderately dry they are lined with brick excluding the water that may occur in the fissures. As the shafts are sunk, and at intervals of about 75 ft., iron curb rings are placed as shown in Fig. 1.

Supports for Brick Lining

A cast iron ring made of sections bolted together with a groove or gutter on the inside is placed in a notch cut in the rock. With this curb as a foundation, the brick lining is built up to the ring above. As a rule the brickwork is built from a staging or platform suspended in the shaft in such a way that the sinking bucket can go up and down without interference. The lining is placed rapidly, as many as 3000 bricks per day being laid by one man. The water that comes in through various seams in the rock is drained through passages in the curb ring to the gutter and conducted thence to a pipe in the shaft running down to the pump. The interior of the shaft is thus made absolutely dry and none of the water can fall into the shaft and interfere with the operation of the cages.

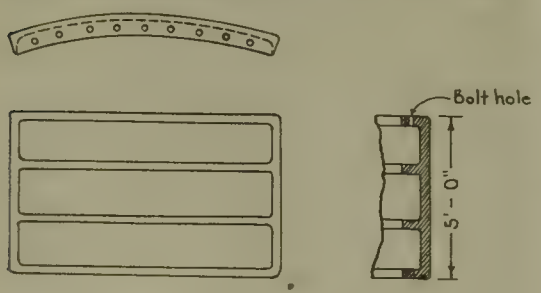


Fig. 2.

Cast Iron Tubbing

Where the rock is very wet the Europeans do not believe in pumping and keeping 3000 or 4000 hp. in boilers to run pumps, so they use a shaft lining made of cast iron plates, sometimes as much as 2½ in. thick—this is very heavy, of course, but effective. There are two types of plates or 'tubbing,' the German and the English. The sections of German tubbing (Fig. 2) are made with internal flanges and are connected by heavy bolts; the English tubbing sections have external flanges and are so constructed as to lock together without bolts or gaskets (Fig. 3), and are made watertight by wedging. The English sink straight through the wet rock into an impervious stratum and then set a curb ring upon which the regular tubbing is built up. I am going to read an account by an Englishman giving a detailed description of the method of placing this tubbing and

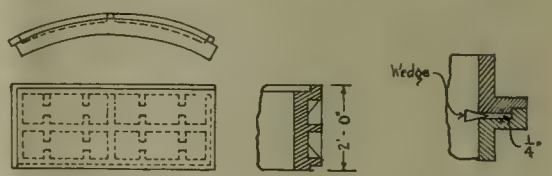


Fig. 3.

also illustrating the great difficulties sometimes encountered in England.

"The shaft was sunk about 9 or 10 ft. into the impermeable stratum, of the full diameter of, say, 23 ft., and then decreased abruptly to the finished size of the shaft, say, 20 ft., and the sinking was continued a further distance of 6 or 8 ft. The cradle was then lowered into the pit bottom, and a temporary wood water ring was fixed on dowels about 9 or 10 ft. above the site selected for the sides of the shaft; water was then collected in this temporary ring and allowed to run off in canvas 'hoggers' or trunks at two or three different positions to the wind bore of the pumps. As much as 6000 gal. of water per minute was collected in this manner, above the place where the sinkers were employed preparing the bed for the wedging curb, with the result that in all cases the beds were properly leveled and prepared for the curbs in the most favorable circumstances possible under such conditions.

"The cradle having been fixed in position, the sinkers proceeded to level the surface of the rock bed with mattocks, and when this was accomplished to the satisfaction of the engineer, a wedging curb, three segments of which were fitted with valves to pass gas or air accumulating behind the tubbing, was laid on the bare rock, seasoned redwood sheeting ⅜ in. thick was placed between all end joints, and

*From *Proc.* Engineers' Club of Philadelphia, October 1913.

the spaces between the back of the curb and the rock were filled with dry wood wedges to bring the inside of the curb up to the finished diameter of the shaft. Afterward well seasoned tapered dry wood wedges were driven into the wood packing between the back of the curb and the strata until the steel chisel points refused to enter. Then a layer of ⅜-in. horizontal sheeting was placed on the top of the wedging curb, and the 2-ft. foundation course of tubbing was put on, breaking joint with the curb. ⅜-in. end and horizontal redwood sheeting being placed between the joints, and the course was brought up to the correct radius of the shaft by means of wood packing. Next one or two courses of plain tubbing were put on, the fourth course usually containing three or more special segments (technically termed 'valve segments'), cast with holes of 4 to 6 in. diameter in the centre, with the object of permitting the water to pass from the back to the front side of the tubbing, and so to the pumps, when the temporary wood water ring was removed.

Method of Wedging

"The next operation was to wedge lightly the vertical joints of the three or four courses of tubbing, and to run the whole up solid with good cement grout. The temporary water ring was then removed, and additional courses of ordinary tubbing were built on, to a total height of about 60 ft. The joints were now lightly wedged, commencing from the top with the vertical joints, and from the bottom with the horizontal seams, using redwood wedges. Additional courses of segments of suitable height being used to close up to the wedging curb above, the vertical and horizontal seams were again twice wedged alternately as before, and the small centre holes in each segment were plugged. Finally the large holes in the valve segments passing the feeders were plugged simultaneously, with long tapered plugs of wood, the excess being sawed off flush with the front side of the orifice, the cast iron caps were bolted on to the flanges, and the shaft was rendered dry if the work had been well carried out."

These two shafts were sunk by John Joseph Prest at Horden, through magnesian limestone, in northeast Durham county. Six thousand gallons of water per minute was pumped out of one shaft.

The reason I read all that was to show to what trouble and expense they go to in Europe to get a tight shaft. A 2½-in. cast iron lining 20 ft. diameter is very expensive.

Working in Wet Shafts

As long as we are on this subject of wet shafts, I may say that I wrote Mr. Prest and asked him how he could get men to work in the shaft with 6000 gal. of water coming in every minute. Somewhere in this article he says that the water as a rule was 3 ft. deep. He wrote back to me as follows: "I am in receipt of your letter, and in reply thereto I beg to inform you that after a round of holes is fired, the material is loaded up from the pit bottom in the ordinary way, and when exceptionally large stones are met, the sinkers dip down below the water and collar hold of them, as you suggest. It is not customary in this part of the world for sinkers to wear anything except rough flannel trousers and shirt, with a waterproof buckskin, when sinking, and in the case of our shafts the sinkers are wet through practically the whole of their shift except on the back. Sumps are made under each set of pumps, and are kept as much as possible in advance of the pit bottom, and holes are drilled systematically round the whole of the shaft bottom to a depth of six or seven feet, as required, and are fired electrically from the surface. Under ordinary conditions, a new section of wet spear rod can be put on and bolted up in three hours; when any additional ground spears were required, the time occupied was usually from 9 to 12 hours. The maximum boiler horse-power in use at any one time would not exceed 3000."

The water was handled by the old type Cornish pumps and the method has not been improved.

In 1838, the Murton shafts were sunk and there they handled 9300 gal. of water from a depth of 450 ft., where the impervious rock began. This is a greater quantity than we are able to handle in sinking in this country today with all modern appliances. It is generally known that the Europeans are away ahead of us when it comes to difficult mining problems.

Sinking in Soft Ground

The Kind Chandron process has been developed to bore a shaft 15 ft. diameter from the top to a depth of 600 or 700 ft., to line it with cast iron tubbing and to seal it to an impervious stratum without a man going down into the shaft. The Europeans have also evolved a sinking drum system similar to our caisson method, but on a more extensive scale. They sink a circular masonry caisson for 50 or 60 ft., building into the upper part a cast steel reaction ring, then build up circular cast iron tubbing with an outside diameter slightly smaller than the inside diameter of the caisson. From the bottom to the under side of the reaction ring a heavy cutting edge is provided. Powerful hydraulic jacks are placed between the reaction ring and the top of the tubbing, and the whole thing is jacked down, rings being added and the material being removed with a grab bucket. In that way they have penetrated five or six hundred feet in quicksand without anybody going down into the shaft. In this country when we go down 150 ft. without anybody going in the caisson, we think we have done a particularly remarkable piece of engineering.

Brick or cast iron will not wear out; they are safe against fire, and in a long lived mine are cheaper in the end than less permanent linings. On the other hand, they call for a circular shaft, and in a shaft with several compartments rectangular construction is much more economical and includes less waste of space than any other. In Europe the development has been largely due to the geological conditions. The Europeans have been forced toward their methods by the fact that the coal and the minerals are all deep down; they have had to go down through great depths of marl and limestone. Ninety per cent of the total footage of shafts in this country is in solid rock, and our problem is to meet the European requirements of safety, permanence, and the exclusion of water without going to the great expense

that they are put to in lining shafts in soft ground.

In pursuance of this idea a number of mining companies in this country have sunk shafts and lined them with concrete. The United States Coke & Coal Co. was the pioneer and they sank two elliptical shafts in West Virginia about 200 ft. deep and lined them with concrete. About three months after the mine started operation there was an explosion which wrecked the mine and killed eight or ten people, but the shafts were not injured in any way, and the operation of the cages was not stopped for an hour. The officers were able to go right ahead with their work of rescue and the rehabilitation of the mine itself.

The Catskill Aqueduct

It is only lately that the European requirement for the exclusion of water has been met, and that has been done on the Catskill aqueduct. The condition

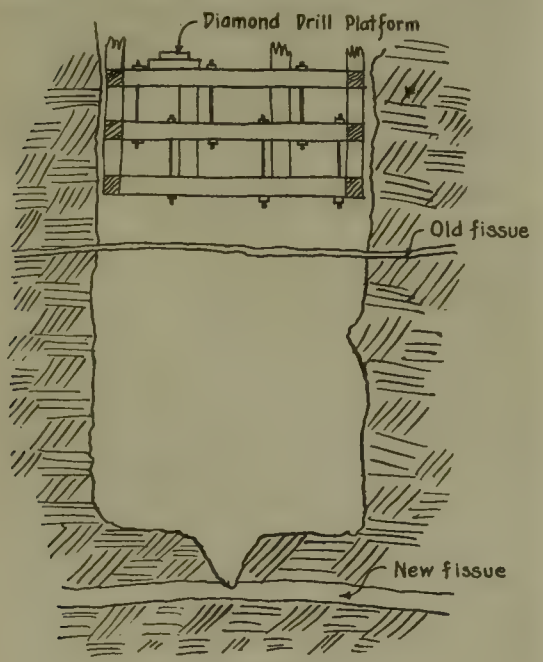


FIG. 4.

has been met by cement grouting. The T. A. Gillespie Co. had a contract for the Rondout siphon, which was a deep circular pressure tunnel under the Rondout valley. The tunnel was about five miles long, and it was expected that they would meet considerable water. They did not, however, except in one shaft which was put down on a fault between limestone and conglomerate; great quantities of water were encountered here. This shaft was sublet to a Pennsylvania contractor; he struck about 1500 gal. of water per minute, put in all the pumps he could get, and could not do anything with it. The shaft had reached a depth of 350 ft. when it stuck. There had been a lot of water coming in on the side of the shaft (Fig. 4)—a rectangular construction shaft, by the way, lined with timber—and when the sinkers struck two or three more fissures in the bottom and got still more water it was the last straw and it broke the back of the pumps. John P. Hogan, a division engineer of the Board of Water Supply, then suggested that cementation be tried, and it was tried there for the first time in this country. The shaft was full of water, so they put in a platform as low as they could, installed a diamond-drill, and drilled six 90-ft. holes in the bottom of the shaft. They pumped them full of cement grout, forcing it through the diamond-drill casings. Before they went much farther they encountered another leak of about 750 gal. per minute; as they drilled the bottom the water poured in through the machine drill holes they were going to shoot. So they simply plugged up those holes, then removed the plugs one at a time, drove in pipes connected to a grouting machine, pumped grout into the holes, and cut the water off that way. By that means they were able to reduce the flow until they could put in a permanent pump station and handle the water.

Plugging Seams

The next shaft on the aqueduct where water was encountered was shaft No. 4 (which I had charge of), in New York City, Borough of the Bronx. We went ahead and made good time until we got to a depth of about 100 ft. We were then drilling into the bottom when we struck a stream of water of about 150 gal. per minute in the first hole we drilled. We plugged that with a hard-wood plug and cut the water off, drilled another hole and got the same flow, and so on all around the shaft. We drilled 12 sump holes, all pointing in, and found water in all of them but two. We saw there was no use pumping them, and we made ready for grouting. I would like to describe the method by which we choked off the water.

As soon as each hole cut the water-bearing seam we plugged it, as stated above, with a tapered wooden plug. After all the holes in the sump had been drilled and plugged in this way, we made the grout connections one at a time so as to restrict the flow of water into the shaft. Each connection is made with a piece of 2 or 2½-in. iron pipe about 3 ft. long. This is threaded at one end and given a long taper at the other. The tapered portion is made rough on the outside by nicking it with a chisel. A heavy iron 'stop cock' is screwed to the pipe, the tapered end is wrapped in several thicknesses of burlap, the wooden plug is then removed from the drill-hole, and the tapered pipe driven in, the stop cock being left open. This is the most exciting and wet-test part of the job. After the pipe has been driven in hard the stop cock is closed.

Grouting Machines

In this case we put connections in all the wet holes before grouting. The grouting machine or tank used on the aqueduct was the Canniff machine (see Fig. 5) in which the grout is mixed by air. It is built like an air lock with a door on the top through which cement, sand, and water are introduced, a 2-in. discharge opening in the bottom and air connections top and bottom. The discharge opening is connected to the grout hole by a heavy rubber hose. Another 2-in. stop cock is placed at the outlet of the tank and a 2 by 1-in. tee is placed between the hose and the cock attached to the pipe in the drill-hole. Into the side opening of this tee a 1-in. stopcock is screwed.

The machine is taken to the bottom of the shaft, is connected to one of the holes and also connected to the high-pressure air-supply. The 2-in. stopcock on the machine is closed and the other opened. The door in the top is opened, a sack of cement, three or four buckets of water, and, if the cavity to be filled is large, a sack of fine sand, are poured in, the air connection at the bottom is opened and the air allowed

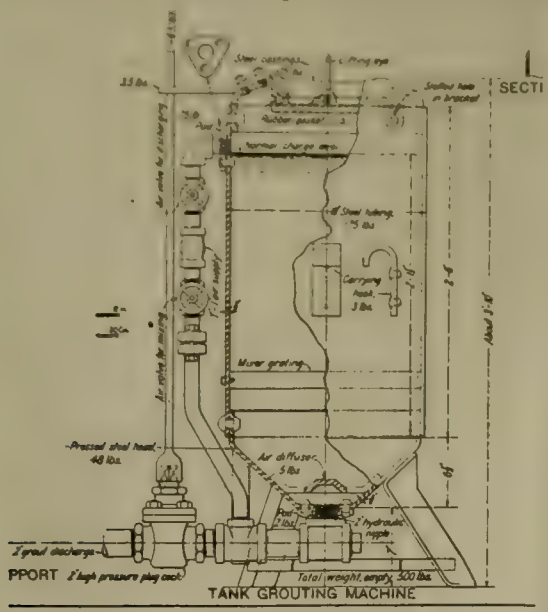


FIG. 5.

to bubble through and mix the grout. Then very quickly the door is closed, the lower air connection is closed, and the discharged connection and the upper air connection are opened and the air enters and drives the grout into the cavity. A man stationed at the 1-in. stop cock keeps opening into a crack; when air shows instead of grout he closes the 2-in. stop cock and the machine is recharged. If the cavity is open the charge is injected in three or four seconds, and by working continuously over a thousand batches can be placed in 24 hours.

The Use of Cement

In one hole on the aqueduct we put in 4000 sacks of cement before the fissure was entirely filled. In shaft No. 4 we put in about 100 in the first fissure. A little farther down in this shaft we encountered a layer of sand. The rock is folded very much; the sand was formed by the crushing of the rock due to the folding, was pretty fine and was carried up out of the drill holes by the water. Grout will not permeate sand and we had to continue drilling holes and pumping in grout, raising the pressure at the end from 100 to 400 and 500 pounds to the square inch. We tamped that sand so full of cement that when we sunk through it it was compacted like sandstone. We found big balls of grout when we cut through it, some as big as a man's fist and some as big as his head.

The most interesting piece of grouting was done on the Hudson siphon, which is a deep siphon tunnel under the Hudson river; 14 ft. diameter inside the concrete lining, and at a depth of 1100 ft. below tidewater. There was practically no water in the rock and the shaft sinking was done by the city forces. When they reached the bottom they concluded it would be cheaper to turn the job over to a contractor, and this contract was let to The T. A. Gillespie Co. On the east side of the river the city had driven 200 ft. of tunnel through dry rock when the men broke into a stream of water which flowed 300 gal. per minute. They struck it at night, and the shift boss shot his holes and broke away all the rock that should have been there to fasten the grout connections to. When we saw the job we decided the next thing to do was to build a concrete bulkhead. We boarded up the face and put in 8 ft. of concrete across the full tunnel section (at this point a top heading 7 ft. high and 14 ft. wide) and then reinforced it with rails. The concrete was mixed 1:2:4. We let the concrete set for a week and then started grouting. Grout pipes were put through the bulkhead, terminating in the fissures. At an elevation of 1100 the hydrostatic pressure is 500 lb. per sq. in., and we had hard work to force in any grout against it. We had eventually to raise the pressure to about 1000 lb. per sq. in., and to do this we had to use a high-pressure plunger pump and pump water in on top of the grout in the tank. We put two carloads of cement into that hole, and after it was set up for a week we shot the bulkhead out and went ahead with the tunnel.

The contractor for the lower end of the city tunnel in New York has encountered a good many streams of water at depths up to 500 ft., and has grouted them successfully.

Where we met the sand bed in shaft 4 we were unable to get the water entirely shut off and we had to rely on the concrete lining to get the shaft entirely dry. In good rock as in the Hudson siphon a concrete lining is not needed in order to cut off most of the water because if you drill into the seams you can grout them off. On the other hand, if the rock is very much fissured it is practically impossible to grout it. When this is the case it is necessary to design a concrete lining strong enough to withstand the total water pressure that can come against the outside. In the case of an elliptical shaft that lining has to be thicker on the sides than at the ends; you can figure the stresses on the concrete if you are a good mathematician. We have found that 1:2:4 concrete 18 in. thick in a 14-ft. tunnel will stand 600 lb.

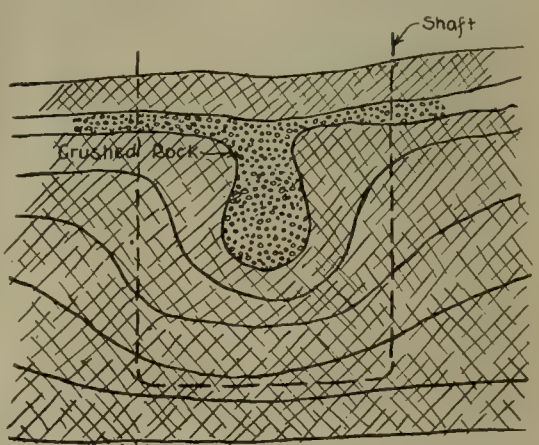


FIG. 6. SAND FORMED FROM CRUSHED ROCK IN NO. 4.

to the square inch. Anything higher than that broke it.

If you met a little stream, just a few drops per minute, a pipe must be set in opposite that stream and the water led through the lining. After this concrete has set two or three weeks and is good and hard you connect the grout machine to this pipe, drive a little grout in, and stop the water. It is absolutely impossible to stop water coming through concrete when it is soft. You have to provide a drain until it sets. In one case we overlooked a small spring, and after we had concreted about 60 ft. of shaft above it, we noticed the forms bulging over an area of about 10 ft. square. We found that the accumulated pressure from the little spring had pushed the lining out over this area and we had to cut it out and replace it.

Shape of the Shaft

The question of a water-tight lining brings up the shape of the shaft. The shaft with the maximum area and the minimum lining is of course circular, and this is by far the cheapest shaft to sink. That was proved on the aqueduct. All the construction shafts at first were made rectangular and lined with timber, while the waterway shafts were made circular. On the Rondout siphon shafts we started out with the idea that the rectangular shafts would be easier than the circular, but it was the other way. When we started the first circular shaft we did not do much the first month. The last month we made 138 ft. The next siphon we moved to we had the same gang, and they knew how, and jumped the progress up to 170 ft. in one month in shale. The same gang was then moved across the Hudson river to a granite shaft, and we made 183 ft., which is the American record.

The way it was done is this: The drilling is all done on one shift. Enough drills are put into the shaft so that all the holes in the round can be drilled and the sump loaded and shot in eight hours. The other two shifts clean out the shaft and get it ready for the drilling shift the next morning. We drilled 33 holes to a round.

The same method is used in South Africa on rectangular shafts, but in this country it has not been successful in rectangular shafts. I personally have tried it in four shafts and it would not work. However, in circular shafts we tried it and made it work.

I mentioned the rectangular construction shafts being slower to sink that the circular. In South Africa they hold the world's record for sinking, and the shafts there are rectangular. In this country most rectangular shafts are about 12 by 26 ft. and about 10 to 12 men are used on a shift. There will be two or three drill runners, three helpers, and about six shovelers. In South Africa they use 35 to 40 men on a shift in a shaft of the same size. I was talking to a man from South Africa who had been engaged on some of this sort of work out there, and I asked him how he could get so many men in. He said they use Kaffir labor. These Kaffirs wear no clothing to speak of, and the temperature gets up to a great height with 30 or 40 men all bunched together; they sweat and their greasy bodies just slide past each other without any trouble. He said that the smell down there is so strong that when a little bit of rock is dislodged, it just shoots right up out of the top of the shaft of its own accord.

Wherever the entire area of a circular shaft can be used, as for ventilation, a circular shape is best. Where this is not practicable, as in a hoist shaft with several compartments, the best plan is to cut the ends off the ellipse adopted by the U. S. Coal & Coke Co. and make a compromise between an ellipse and a rectangular out of our circular arcs. In dry or moderately dry rock the concrete lining need not be over 15 to 18 in. thick, but in wet and seamy rock it must be thick enough to resist the hydrostatic pressure after the shaft is lined.

In New York City lately the contractors have been putting in as high as 25 to 30 ft. of concrete in a 14-ft. circular shaft, and in six days, including getting started, putting the forms in, and taking them out again, they will put in 100 to 120 ft. The cost of a concrete lining is greater than the cost of a timber lining by just about the cost of the cement. As a rule, concrete outside the cost of the cement can be put in for the price of the timber; you have to pay for your cement and you have a permanent lining.

Production of Gold and Silver in 1912

The production of gold and silver in the United States from domestic ore in 1912, according to a recent publication of the U. S. Geological Survey, is shown in the following table in distribution by states.

State or Territory.	Gold. Quantity.	Gold. Value.	Silver. Quantity.	Silver. Commercial value.
Alabama	795	$ 16,400	200	$ 100
Alaska	831,981	17,198,600	539,700	331,800
Arizona	183,117	3,785,400	3,445,500	2,118,000
California	967,887	20,008,000	1,384,800	851,200
Colorado	906,606	18,741,200	7,933,100	4,876,500
Georgia	526	10,900	200	100
Idaho	67,810	1,401,700	7,862,900	4,833,400
Illinois	.....	.....	1,800	1,100
Maryland and Pennsylvania	60	1,200	700	400
Michigan	.....	.....	543,500	334,100
Missouri	.....	.....	30,000	18,400
Montana	179,371	3,707,900	12,524,000	7,698,500
Nevada	656,722	13,575,700	13,851,400	8,514,400
New Mexico	36,506	754,600	1,460,800	898,000
North Carolina	7,544	156,000	2,300	1,400
Oregon	36,749	759,700	54,000	33,200
Philippine Is.	22,331	461,600	5,800	3,600
South Carolina	744	15,400	.....	.....
South Dakota	378,470	7,823,700	205,800	126,500
Tennessee	557	11,500	112,000	68,800
Texas	105	2,200	379,800	233,500
Utah	208,623	4,312,600	13,076,700	8,033,300
Virginia	14	300	700	400
Washington	33,023	682,600	350,800	215,600
Wyoming	1,176	24,300	300	200
Total	4,520,717	$93,451,500	63,766,800	$29,197,500

The figures in this table are also those of the Director of the Mint. They result from coöperation of the U. S. Geological Survey and are agreed upon after conference and adjustment between the two bureaus. They are, therefore, final for both. The totals are based on bullion deposits in the United States mints and assay offices and on returns to the Bureau of the Mint from the smelting and refining companies. The distribution is adjusted by information collected by the U. S. Geological Survey direct from the producing mines and tabulated for the mine reports later discussed. The data giving the total production, and in part the distribution, are obtained from government and private records.

La Plata Mountains, Colorado

By Rensselaer H. Toll.

Recent discoveries and exploration in the La Platas, in the southwestern corner of Colorado, recall the early days of forty years ago, when the land belonged to the Indians and no white men except a few adventurous explorers and prospectors had penetrated the fastnesses of these rugged hills in the eternal search for gold.

First Gold Discovery

It was late in 1873 that Capt. John Moss, an old-time California miner and the first promoter known to the La Plata district, saw at Del Norte some rich specimens of gold ore which had been brought from the La Plata river by some roamer whose name became lost too early to become inscribed on the roll of fame. Moss immediately purchased the property from which the ore had been taken and was soon upon the ground.

LOOKING DOWN LA PLATA RIVER FROM THE MOUTH OF BOREN GULCH.

A considerable 'stampede' was created by the news of this discovery and of others which soon were made, and at the mouth of La Plata cañon quickly grew a money-mad border town, duly christened Parrott, that being the name of the backers of Moss, who were bankers of San Francisco. Parrott City being the only town in La Plata county at that time, it was, perforce, the county seat; but all signs of the important position of this once thriving camp have been removed, and its namesake is now situated a mile eastward at the end of the railroad spur and near the productive Idaho and May Day mines.

The lode on which the first discovery was made was named as was fashionable at that time and for many years after—the Comstock; and for some time it gave promise of proving a worthy namesake of the mine that made Nevada famous. The ore was extremely rich, and the shoot was about forty feet long and from three to four feet wide. Operating expenses at that time were naturally enormous, and old-timers state that in the case of this property the extravagances were even larger than the expenses. Ore was hauled by ox-teams to Pueblo, a distance of 350 miles, over three mountain ranges, one-third of the distance there being no road; and supplies were brought in from this point, Colorado Springs, or Denver, an important item of 'supplies' being a barrel of whisky which was set up on the dump at the mine, the head knocked in and tin cups hung about the chime for the benefit of white men and Indians.

Decline of the Property

This ore was too good to last, however, and at a depth of 40 ft. the high-grade disappeared. The shaft was continued to a depth of 85 ft. and about a hundred feet of driving done without encouraging results. The property was then allowed to revert to the state of 'innocuous desuetude,' despite a well authenticated production of $75,000 to $80,000 from the small space mentioned. These figures may sound mythical, but there are a number of men of veracity in that district and elsewhere who knew the property in the early days and who testify to the extreme richness of some of the ore which was shipped.

Within recent years lessees have shipped several carloads of ore from near the old workings which assayed about $100 per ton, and a small pocket was discovered on the surface which was almost half calaverite.

This property has been idle 36 years out of the last 38, and the shaft has never been extended much since the early days, being but 160 ft. deep now; while the drifts are less than 300 ft. in total length, all the work having been done close to the original orebody, without development of new ground which may contain bodies of ore equal to the first.

The Comstock is cited not so much for its historical interest as because it may be said to be typical of the old properties of the district, their usual history being: a small production of high-grade ore, desultory gouging about the edges of the ore-pocket, abandonment. Many became involved in litigation, original interests passed to heirs, some holdings were sold for taxes, and many titles became complicated so that the real ownership was hard to determine. The Small Hopes, Cumberland, Bessie G., Durango Girl, Bulldozer, Jenny Lind, and a dozen others have histories very similar to the one above related. the principal difference being that they are farther from the railroad and not so easy of access.

Lack of Development

Considering the richness of the ore and the excellent showing made in recent years by the Neglected, May Day, Idaho, and other mines of less importance, it is surprising that so little real development has been done in these mountains. A good deal of money has been wasted on mills and other equipment where it was not justified, and some forlorn hopes have been followed in an expensive and disappointing manner; but there are good prospects which are worthy of considerable judicious development. The best two mines of the district are finds of recent years which had been overlooked for a third of a century. Perhaps some of the old-time producers would do as well with equal development.

At present there is little prospecting being done except in the region of the La Plata river, where the Idaho and May Day employ 30 to 40 men each and maintain a steady output. The Bay City and the Southern Boy are being operated by lessees and some ore is being taken out; and the Lucky Moon company is placing a compressor plant at Comstock and laying a mile or so of air-pipe to the mine high up on the mountain, where extensive development is planned.

Near the mouth of Madden gulch, about a mile below La Plata City, some Denver mining men are prospecting the placer and underlying ground by means of a diamond-drill. This placer, it may be mentioned, contains a considerable quantity of coarse gold, and about twenty years ago an effort was made to operate it profitably, and systematic work was begun by the company which owned about four miles of the bars; but quarrels and threatened litigation discouraged the work and nothing has been attempted since. With modern equipment and economy these extensive bars and channels might be very profitable, but considerable capital would, of course, be necessary for such an enterprise. The many large boulders and the floods which often occur in the early fall are serious but not insuperable drawbacks, for the area is large enough to admit of large equipment and operation on an extensive and economical scale.

The Copper Hill Property

About a mile west of La Plata City is the Copper Hill, the only copper mine which was ever operated in these mountains. The deposit is low in grade, averaging 4 to 5% copper, but it can be worked on account of its favorable position near the Durango smelter, where a very low treatment rate is obtained because of the desirable nature of the ore. The mine is worked by adits, the lower one cutting the orebody at a depth of nearly 300 ft. The production amounts to four or five carloads per week.

The Eureka-Bulldozer is pushing development and producing a small amount of high-grade ore. The Ten Broeck has several men employed on development and is expected to become a producer in the near future. The Lightner Creek Consolidated is doing considerable work on very promising veins which years ago produced high-grade ore. Much prospecting and development over the central portion of the mountains is evident.

One feature of the La Plata district, which is in common with many others and strikes the most casual observer unfavorably, is the number of idle mills which are scattered over every portion, hardly a gulch being free from one of these mournful monuments to false hopes. A few of them were built in the best of faith (or, should it be said, the *worst* of faith?) on insufficient ore reserves or for ore of unsuitable character; but many were merely used to further stock-selling campaigns or to beguile small stockholders into the belief that they were getting something for their money.

Almost every type of apparatus and every known process is exhibited in these mills except modern developments of the cyanide process and the latest concentrating devices, for no mills have been built during the past half-dozen years. This machinery is in most cases practically as good as new, not a single mill having ever been operated for any length of time.

Types of Mills

They vary in character from the arrastre plant erected on the Comstock in the early '80s to the elaborate bromination mill of the Cumberland, which mistake was committed in the late '90s and cost a Swiss company probably $50,000. Metallurgically, it is said to have been a great success, for the recovery was high; but the small item of operating costs had evidently been overlooked when the estimates were made, and the ore proved to be too poor to bear the milling cost of $18 per ton; otherwise, it probably would have been shipped to the Durango smelter. In 1904 this mill was supplanted by a cheaper amalgamating and concentrating plant, in which the cost of operation was no doubt materially reduced, but apparently not enough

for the grade of ore to be treated. It seems strange that, in a district where several properties have recorded productions of hundreds of thousands, and two properties have produced millions of dollars each, there should be no bodies of ore of sufficient size and value to supply a mill profitably; but the record of failure, which has been made, is not conducive to confidence in the future.

The Neglected mine, which made a large production of high-grade ore in 1902 and 1903, and has been involved in litigation most of the time since, is credibly reputed to have a number of bodies of milling ore developed; and it would naturally be expected that the two largest producers of the present time would be able to support a small mill, at least. But these are exceptional. The striking feature of the district is the richness of the ore. When ore is present it is rich and not on the border line between ore and waste—it is either rich or worthless. The orebodies are usually sharply defined, and though comparatively small, they make up in value what they lack in size.

MAP OF LA PLATA DISTRICT.

Grade of Ore

Small shipments from various mines have assayed several hundred dollars per sack, and many carload lots have returned $1000 to $2000 per ton. One shipment from the Idaho mine to the Omaha smelter brought a check for about $34,000 for about 14 tons, and a carload from the same property which recently was shipped to Durango under armed guard, is said to have assayed $2500 per ton. In passing, it may be said that the present daily production of this property is said to be about $1000.

The ore is closely sorted, the largest mines using mechanical washers, and everything that will pay to ship (and, no doubt, a good deal that will not) is sent to the smelter; the remainder, mixed with waste from development, making a pretty lean dump, even though the average value of the ore produced by this district during recent years is $40 to $75 per ton, according to government reports. Because of the richness of the ores—which, by the way, are usually tellurides—this district is more of a 'poor man's camp' than those whose low-grade ores require a large expenditure of capital for development and equipment. The May Day mine, which was discovered about eleven years ago by a poor prospector, on a trail which had been tramped over for 30 years, was sold for $50,000 when the shaft was but 10 ft. deep; and the Lucky Moon, which was stumbled upon by a farmer boy in 1909, was sold for a like sum and the money paid before the discovery cut was below the grass roots.

Naturally, they are many old time prospectors in the hills who have not had any such luck; but there are chances yet, for the territory has not been half prospected and none can say with any assurance that all the rich mines have been discovered. There are chances for the poor prospector in new discoveries, as well as for capital in developing some of the former producers.

The above features of the district have been used to the utmost advantage by unscrupulous promoters in selling stock in many worthless or highly speculative enterprises. Also a great deal of handsome but valueless paper is scattered over the land, representing minute interests in grossly overcapitalized corporations, greatly to the detriment of the district and the annoyance of honest claim owners and operators. However, this state of affairs is not confined to the La Platas alone, being one of the inevitable consequences of success, as every worthy field of production or endeavor soon becomes crowded with impostors, and the layman knows not the false from the genuine.

The district is much more favorably situated for economical operation than the higher and more rugged country known as the 'San Juan.' Along the southern border are extensive fields of the best lignite coal, a railway spur extends from the main line to the mouth of La Plata River cañon, and the entire area is well wooded, providing excellent timber for all purposes. A large hydro-electric power-plant is situated on the Animas river at Rockwood and supplies power along that stream and to the towns north of that point. Its lines might easily be extended to any portion of the La Plata mountains were the service required.

The total production of natural gas in Oklahoma in 1912 as estimated by David T. Day, of the U. S. Geological Survey, was 73,799,319,000 cu. ft., valued at $7,406,528, or 10.04c. per 1000 cu. ft., compared with 67,275,608,000 cu. ft., valued at $6,731,770, or 10.01c. per 1000 cu. ft., in 1911.

Possibly a Joke

*We present below a reproduction of an old drawing found recently at Diamond Springs by P. R. Bradley, and purporting to have been used to illustrate a report on a property near that place, made by an English engineer some years ago. The report itself, unfortunately, has not been preserved, and there are elements in the drawing that suggest doubt as to the serious purpose of the artist. Indeed, one of the members of our staff, himself a citizen of the British Empire, has suggested that the whole thing is a joke. As the Englishman is popularly reported to be unappreciative of humor, we pass the responsibility of deciding this point to our readers. The drawing is entitled:

PLAN OF THE MINE
Known as the
VETA MADRE
(Mother Vein).

Situated pleasantly at the height of only 25,000 ft. above sea-level in proximity to the delightful village of Diamond Springs.

Bonanza King, owner and superintendent.

Surveyed by aerial observations by A. J. B., c. e.

The numbers refer to footnotes as below.

1. Mount Babel, altitude 25,000 feet.
2. The Mother Vein.
3. Mount Cheops, proposed location for stamping-mill.
4. Location of material for making the regular monthly reports.
5. Mount Acme, proposed location for superintendent's house.
6. Line where animal life is impossible.
7. Line of perpetual snow; mercury froze.
8. Antediluvian mill left by primeval miners.
9. Proposed aerial bridge.
10. Balloon refuses to ascend, specific gravity of air lighter than balloon filled with nitrogen.
11. Proposed tunnel, length 8000 ft., through an adamantine material; with double diamond-drills progress may be made at the rate of six inches per day.

†Indicates cemetery, and residence of the town physician, who earns his livelihod in repairing the fractured bones of those who make the ascent to the Mother Vein. He is very poor, from the fact that in most cases patients leave their bones, fractured or otherwise, in Death Gulch.

Note B.—The sign over the door of Shrewd, lawyer, announces that parties desirous of ascending to the Mother Vein will find it much to their advantage to have their last will and testament filed with him before undertaking the journey—rates reasonable. Shrewd is considered to be very wealthy.

*Note by the Editor.

Steel Sluiceway Linings

By W. W. EDWARDS

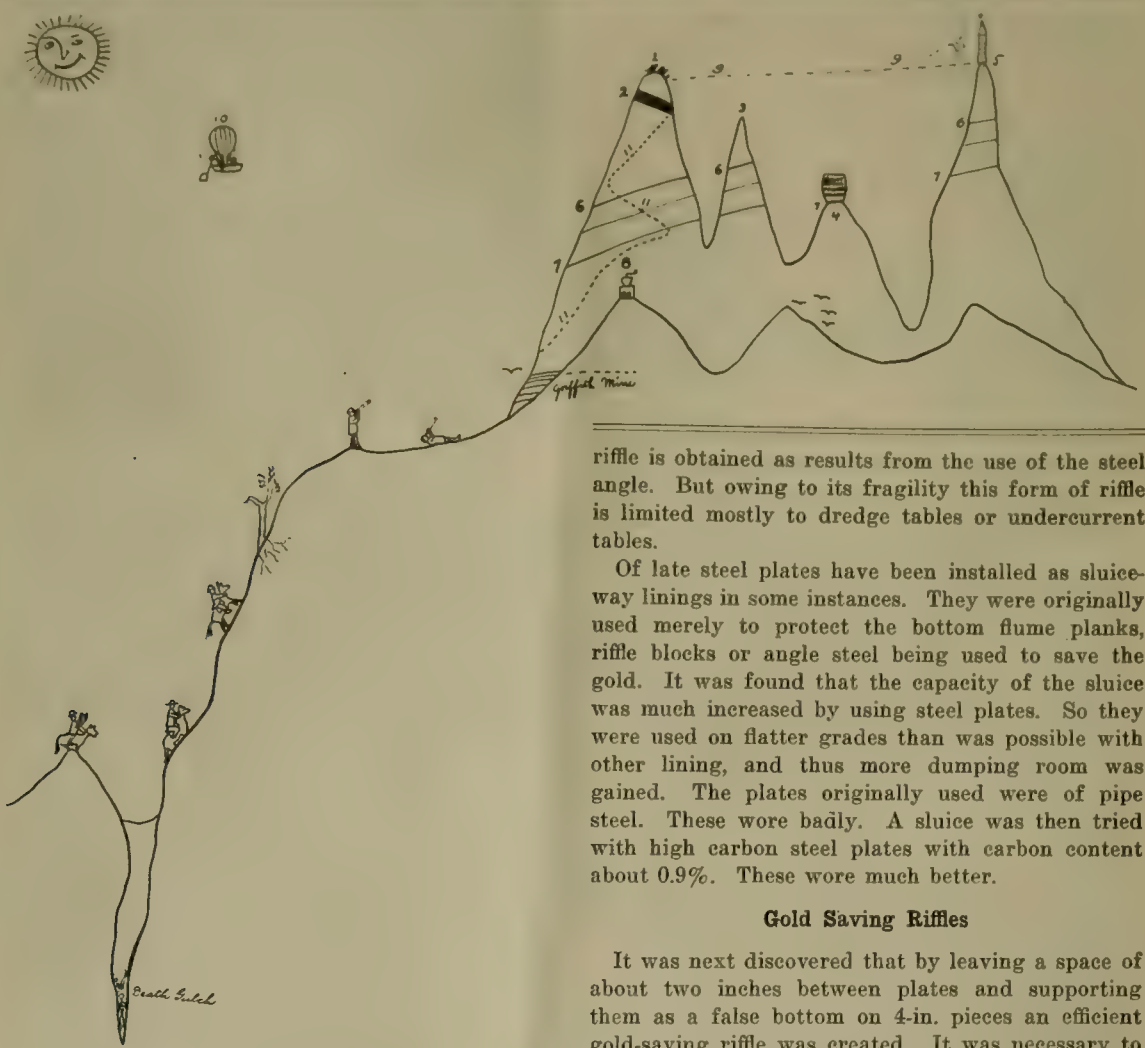
When the pay-dirt in a gravel bank is highly concentrated, the economic working of the mine depends less upon the sluiceway than upon the miner's success in following the streak. In such cases any kind of sluice lining will do; blocks, stone paving, or any other material which will make riffles and protect the flume bottom from wear. But when, as is frequently the case, the gold is disseminated through a bank of gravel in rather small quantities, the miner's success depends considerably upon the wearing and gold-saving qualities of the sluiceway. A little experience in lost time due to patching paving, cleaning-up, and replacing blocks or stone in the middle of a season's run, demonstrates this forcibly. To remedy these difficulties, steel in some form of lining is adopted. There are four ordinary ways of using steel in sluiceways: as rails, angles, cross-strips, or plates.

Rails have been used both lengthwise and cross-

wise of the sluice. Experience generally shows that crosswise is the best way. Then the wear is more evenly distributed and is not so heavy. When the rails are put in lengthwise, small rocks wedge in between them, and the passing stream of rocks and boulders batters the rails, especially those in the centre of the sluice. On cross-riffles, the wear is distributed. Rails placed crosswise make an efficient gold-saving riffle until the top gets worn down, after which the rails serve only to protect the bottom planks from wear. Ordinary carbon steel rails wear out fairly fast, but good wearing results can be obtained from manganese steel rails, although the first cost is high. Sluiceways lined with cross-rails have been used in mines where the total operating cost did not exceed three cents per cubic yard.

Steel angles have been used effectively in sluiceways. Placed as they always are with the flat side pointing down stream, they make what is probably the most efficient form of riffle for gold-saving purposes. Their wearing qualities are, however, not so good. The wear is concentrated in the middle of their length, directly upon the right angle edge. This soon wears through; the two flanges split apart, are bent down stream, and the angle must be taken out. Thus the wear obtained from steel angles is not economical for the weight of metal involved.

Steel cross-strips have been used where the material run is very light. They are screwed to the tops of wooden strips placed crosswise in the sluiceway. They are so fastened that their lower edge overhangs the wooden strip. Thus the same kind of



riffle is obtained as results from the use of the steel angle. But owing to its fragility this form of riffle is limited mostly to dredge tables or undercurrent tables.

Of late steel plates have been installed as sluiceway linings in some instances. They were originally used merely to protect the bottom flume planks, riffle blocks or angle steel being used to save the gold. It was found that the capacity of the sluice was much increased by using steel plates. So they were used on flatter grades than was possible with other lining, and thus more dumping room was gained. The plates originally used were of pipe steel. These wore badly. A sluice was then tried with high carbon steel plates with carbon content about 0.9%. These wore much better.

Gold Saving Riffles

It was next discovered that by leaving a space of about two inches between plates and supporting them as a false bottom on 4-in. pieces an efficient gold-saving riffle was created. It was necessary to raise the lower end of each plate about ¼ in. above grade so as to keep material from striking the upper end of the plate next below and wearing the edge. With these plates the maintenance charges were much reduced.

The plates are held in place by the lining boards. They are easily put in, taken out, and cleaned up. They will stand the season's wear, and hence stoppages to fix paving are unknown. When badly worn on one side they can be turned. If the size of the sluiceway permits of their being made square they can be practically worn out before their usefulness is impaired. The plate lined sluice has a much greater capacity than a block or rock paved or even a rail or angle paved sluice, thus permitting a saving in grade and consequent increase in dumping facilities.

Plates such as these of 1.25% carbon content, 58 in. square, and ½ in. thick were placed in a sluice-

way with a 4% grade. Forty-pound manganese steel rails on a 5% grade were used at the head of the sluice feeding to the plates. After one season's work during which 600,000 cu. yd. of gravel was passed over the plates, scarcely any wear was apparent, and the total life of the plates was estimated at 10,000,000 cu. yd. On this basis the material was handled at a total operating cost of 2c. per cubic yard, which figure includes all charges of water-supply, maintenance as well as operating expenses, and an allowance for sinking fund to replace the plates when worn out. This cost compares favorably with a previous cost on the same property of 4c. per cubic yard with wood blocks and stone paving.

One objection raised against the plates is that the gravel passing through is not sufficiently churned up to separate all the gold particles and give them a chance to get into the riffles between plates, but that the material rather slides through the sluice. This can be remedied by putting in some rail cross-riffles at intervals. A good combination for all purposes is high carbon steel plates coupled with a few manganese steel rails.

It is, of course, not always necessary or even possible to use steel lining in a sluiceway. Transportation facilities to a placer mine are generally poor. Freighting charges are consequently high. Again, the percentage that the sluiceway operation and maintenance bears to the total operating cost of the mine may not warrant anything better than block or rock paving. But it is certain that an investigation of the cost of steel linings is well worth the trouble whenever success depends largely upon steady running and the handling of a big yardage.

Copper From Mine Water

STAFF CORRESPONDENCE

From the two working shafts of the Penn copper mine, Calaveras county, California, a total of 30,000 gal. of water is bailed daily. This averages 15 lb. of copper per 1000 gal. It is run through 14 boxes, 9 of which are 2 by 3 ft., and 5 are 1 by 2 ft. in section, having the common length of 100 ft., with a fall of 6 inches in each length. These are filled with all kinds of scrap iron and refuse from can factories on the coast. The copper is precipitated on this scrap. The boxes are cleaned once a month, the large scrap being lifted out, and the finer material put through a 16-mesh screen. The precipitate is dried, sampled, and shipped to an Eastern refinery. It averages 70% Cu, and the monthly yield is 7 tons, all produced at a low cost.

Gold and silver production of Charters Towers, Queensland, during September was worth $105,000, from the treatment of 6494 tons of ore and 5583 tons of tailing.

The Elmore vacuum plant at the mines of the Sulitjelma company, Norway, produced 1170 tons of copper concentrate during October.

In a cross-cut on the 1300-ft. level of the Waihi mine, New Zealand, a vein of good appearance has been opened.

Zinc Ore Deposits in Boone and Marion Counties, Arkansas

BY KIRBY THOMAS

The zinc ore deposits near Zinc, a station on the White River division of the Missouri-Pacific railway in northern Arkansas, occur in a horizontal bedded series of limestone, shale, and sandstone rocks. The genesis of these deposits is similar to that of the well known lead and zinc deposits in Missouri and Wisconsin. They differ from the very important deposits of the Joplin, Missouri, area in being in a rock series older than and underlying the similar beds (Mississippian) in which are found the Joplin orebodies now mined. In this connection, it should be noted that the Joplin deposits are supposed, by some authorities, to have originated in the underlying Cambro-Silurian beds and to have migrated to the overlying Mississippian beds. This relation is presented to show the strength and weakness of popular ideas as to the Arkansas deposits—based on analogy with the Joplin deposits, which are not far away.

The deposits about Zinc are geologically identical with the other zinc deposits in north Arkansas, and are closely similar to the lead and zinc deposits of Greene county, Missouri, and with those of the Wisconsin areas. There is also a less close relation with the important disseminated deposits of southeastern Missouri, but so far as data are available, deposits of the southeastern Missouri type have not been found in the north Arkansas region, although there is a possibility that they may be found in the lower beds.

Source of Lead and Zinc Ores

The ultimate source of the lead and zinc ores of the Mississippi Valley districts was probably in the Cambro-Silurian limestone beds, in which the metals in separate combinations were deposited contemporaneously with the chemical deposition of the limestone from the sea. These metallic minerals were in a very small proportion originally, but, by fairly well understood processes, they have been taken into solution by the underground waters and, through a long period, have been redeposited and concentrated in favorable places, forming the commercial deposits. These facts of the ultimate origin and of the mode of formation offer a sufficient answer to the assertions made by some that these Arkansas deposits necessarily improve with depth, or that they extend indefinitely in depth.

In the North Arkansas field, the existence of a series of faults or displacements, locally called 'breaks,' has provided the suitable combination of conditions for the assembling and deposition of the minerals, and certain facts in relation to these faults are of importance in the theoretical and practical consideration of the deposits. These faults were caused by regional movements or disturbances. In some instances only a crack in the strata is disclosed, while in others there has been a crumpling or an actual vertical displacement of many feet. In the vicinity of Zinc the faults have an approximate northeast-southwest direction. In some instances

the faults only pass through the brittle strata and do not show in the overlying tougher, flexible shale. These faults probably extend laterally for several miles, although they are generally only discernible on the exposed sides of the hills and cannot be traced continuously for long distances, owing to the covering of soil, débris, and vegetation. There are often several of these faults, roughly parallel, with probably also connecting and branching faults.

These faults have formed the favorable physical conditions for the redeposition of the ore, and hence all the deposits in the area have a direct relation with them. The mineral-bearing solutions coming into these fissures laterally, and perhaps from below also, have deposited part of their content as sulphides and as quartz and calcite. Where there was no chemical reaction with the rock itself, then these minerals constitute the filling of the open spaces in the beds forming the brecciated ore sometimes commercially important. When the rock strata were soluble, the walls were replaced in part or wholly by the minerals from the solutions, forming the replacement or 'disseminated' orebodies, which are generally more extensive than the brecciated deposits.

Deposits of Sulphide Ore

The deposits of sulphide ore, when exposed by erosion, are acted upon by the surface waters, producing silicates and carbonates. This oxidation is usually confined to the surface, but in the more open fissures, it extends to depths of 100 ft. or more. This sometimes results in conditions of secondary enrichment. In the district about Zinc, erosion has cut through the practically horizontal beds for upward of 500 ft., leaving elongated, irregular ridges with long, branching, narrow valleys. This affords the opportunity to view directly the vertical succession of the rock strata over a wide area. The tops of the ridges are generally covered with a clay and chert formation of the Mississippian period, from 100 to 300 ft. thick and usually above the 1000-ft. contour. This rock stratum is not mineral-bearing here. Below this are the strata of the Cambro-Silurian which, while varying in thickness in the area visited, are practically continuous, except for the erosion interruptions. Beneath the chert capping is usually found a red limestone, locally known as 'marble,' and still below this a white sandstone of varying thickness. In the shaly limestone below this occurs the first ore horizon, which is usually separated from the second ore horizon by a fine grained, silicious, brittle, thin-bedded limestone, which grades into shale below. This is followed downward by magnesian limestone with flint, shale, and then a hard crystalline sandstone bed, succeeded by other magnesian limestone beds. These are the lowest beds exposed in the district, but several deep drill-holes are reported to have shown zinc below this fourth ore horizon.

The so-called ore horizons or ore beds represent the intersection of the fault planes with the different strata. The variation of the ore beds and their regular succession throughout the area is consequently characteristic of the rock stratum in which they are. The first ore horizon, usually below the sandstone, but sometimes immediately under the red limestone, is generally in the form of silicious replacements of the shaly beds. The ore is disseminated and occurs in successive thin sheets or in a silicious matrix. There is some lead in places. The bed is missing in some places and is generally only a few feet thick. The second ore bed occurs in a fine grained silicious banded limestone, the ore forming the cementing material. There is little iron sulphide in this or the first ore horizon. The succeeding ore horizons occur in magnesian limestone beds, and have a tendency toward the replacement type of deposit or occur as veinlets in the shattered brittle beds.

These ore beds are not 'blanket' formations in the commonly accepted meaning. They represent the horizontal widening of the fissures at their intersection with the strata in question. The mineralization presumably does not often extend more than 100 ft. laterally. Where there are several near and parallel fractures, the mineralized rock presents a continuous bed of considerable width. These conditions create a series of orebodies succeeding each other vertically, extending horizontally along the fissures, but not necessarily continuous, and of greatly varying horizontal width. The horizons in which there has been replacement, are the most likely for extensive orebodies. The brecciated ores are sometimes rich, but are not so regular or extensive.

Exploration Methods

The genesis of these orebodies suggests methods for their exploration and development. In most cases, the first and second horizons are exposed on the steep hillsides and can be explored and operated by adits. The other ore horizons must be reached by shafts, from 50 to 150 ft. deep. Exploration can be advantageously carried on by drilling, usually. There are surface indications which are important. 'Silica bars,' so-called, the harder rock along the breaks where silicification has taken place, are noticeable on hillsides and in the valleys. There are also other topographic features, as 'sink holes' and flat, indented slopes, which indicate the presence of the faults and their related orebodies.

Practically all the development about Zinc, so far, has been confined to the two upper ore horizons. The chief ore in the deposits is zincblende, and the mill product contains 64% or more in zinc. There is practically no barite and the lead content is small. Asphaltum shows in the second ore horizon in the Iola mine, in small quantities. There is some iron sulphide in the third and lower ore horizons, but not in large amount. Most of the ore is easy of treatment. In all the deposits are considerable amounts of oxide ores, chiefly zinc silicate, occurring at the outcrop. These are difficult to concentrate satisfactorily and are marketed after hand sorting and at a lower price than the blende. In some of the properties the oxidized ores extend to considerable depth and are mingled with the sulphides, a detrimental factor in treatment. Although development has been carried on for years in this region and a small output of zinc attained, the general results have not been satisfactory, chiefly because of the limits of the size of the individual deposits, so far as exposed, and lack of adequate development and exploration.

Bujun Coal Mine in Manchuria

Translated by Reiji Kanda

The Bujun coal mine is situated in the vast Manchurian plain at the distance of 160 miles from Dairen (Dalny) harbor, near Port Arthur. The mine was first opened by Russians a little before the Russo-Japanese war in 1904. After peace was restored, the right of working this coal mine was transferred to Japan; and since then it has been worked by a Japanese company, Minami Manshu Tetsudo Kabushiki Kaisha, which was organized with the capital of 200,000,000 yen to work the mine and to operate the railroads in Manchuria.

The coal seam lies along the side of a hill which runs along the Konka river. The bed strikes east

MAP SHOWING ORE DEPOSITS OF MANCHURIA.

to west, and may be followed along the outcrop for the distance of some eight miles. The hills in which the coal occurs rise abruptly from the great plain of Manchuria, 100 to 300 ft. The thickness of the coal is tremendous, averaging 130 ft. The bed dips toward north at an angle of 20 to 30°, and extends under the Konka river. In the beginning the post and stall system was used and only one-tenth or less of the whole thickness of the bed was mined. As this involves much loss, much attention has been paid to finding a better system of working. Sand-filling was first tried on a large scale in 1911, with the expenditure of 300,000 yen. This system was found to be the one best fitted to working this large seam, and it was determined to adopt it exclusively in mining the Bujun coal. It has been found that by this system 85% of the entire coal can be won. The sand is obtained near by in the Konka river in any required amount. The quality is first class, it consisting of fine sand with no large gravel. As the sand is constantly coming down after every heavy rainfall, there is no fear of exhaustion of the supply.

The quantity of coal existing has been calculated by several engineers. Most of them agree in estimating it at 800,000,000 tons. The coal worked since the organization of the Company is as yet only a trifle compared with such a total. The coal mined to the present has been as follows:

	Tons.		Tons.
1907	230,000	1911	1,320,000
1908	490,000	1912	1,470,000
1909	690,000	1913 (est.)	2,000,000
1910	900,000		

The steady increase in the production of coal year after year as shown above is of much interest. The production of coal in Bujun may be expected to continue to increase with the same speed, as the demand is constantly growing. Although the present production of coal at Bujun is small in proportion to the great magnitude and the ease of mining, yet it is large as compared with the production of larger coal mines in Japan. The largest coal mine in Japan, Miike in Kyushu, produced 2,050,000 tons in 1912, which is nearly the same quantity as the estimated output of Bujun in 1913. The total production of all coal mines in Hokkaido does not amount to more than 2,000,000 tons per year. Bujun coal can be worked for perhaps 300 years in the future, and the right of working this is considered to be a notable addition to the wealth of the Empire.

Ore Crushing Underground

The Witwatersrand Gold Mining Co. has recently inaugurated a system of underground ore crushing. On the fourteenth level a jaw breaker has been installed, and the results secured are stated to be thoroughly satisfactory. In order to economize with native labor and to dispense with 'boys' hitherto engaged in breaking up these large rocks and to render them available for other work, a rock-crusher has been installed, the discharge from which is fed direct into the shaft bins. This is the first rock-crusher to be employed underground in South Africa and its installation at the Knights mine may lead to adoption of the system at other mines along the Main Reef series. Underground rock-breaking is practised in other mining fields. In the Round Mountain Mining Co.'s mine, at Round Mountain, Nevada, are two crusher stations. During the year 1912-13 the following work was done: No. 1 produced 6382 tons of $4.69 ore, and 16,306 tons of waste worth 77c. per ton; while No. 2 produced 15,590 tons of $7.12 ore, and 40,589 tons of waste worth 97c. per ton. The cost of crushing, screening, and transport, including repairs, was 5 to 6c. per ton. Fear has been expressed that the running of crushers underground might have a deleterious effect on mine atmosphere. Inquiries have been made regarding the effect of underground crushing on mine atmosphere at the Knights, and it has been found that the breaker is giving no trouble in this respect whatever. The crusher station is surrounded by atomizers, and the amount of dust created is said to be infinitesimal. Having regard to this testimony, it seems by no means unlikely that the system will be extended to other mines along the Rand.—*South African Mining Journal.*

Work of the Oriental Consolidated Mines

By Alf Welhaven

The total receipts of the Oriental Consolidated Mining Company, operating in the Unsan district of Korea, for the year ended June 30, 1913, were $1,661,476.29. The total operating costs for the year were $1,016,778.22, leaving an operating profit of $644,698.07. New constructions, development work, etc., absorbed $73,313.98, leaving the net earning of $571,384.09. The average value of the ore was better than during the previous year, but the heavier mining costs, higher concentrate treatment costs, and larger construction expenses materially reduced the net profit. The mines yielded 312,818 tons of ore worth $2,000,787, as follows:

	Tonnage.	Value per ton.
Tabowie	112,529	$7.18
Taracol	93,558	6.03
Chintui	28,487	4.18
Kuk San Dong North	12,757	3.92
Kuk San Dong South	13,774	2.72
Kuk San Dong Central	606	4.20
Kuk San Dong Kisen	6,986	3.63
Charabowie	37,658	8.65
Candlestick	6,463	10.61
Tribute mines produced	883	5.30
Total mining operations	313,701	$6.39

This was mined at a cost of $1.95 per ton, including cost of all underground development work done at these mines during the year. The mining cost was 33c. per ton higher than last year, on a smaller tonnage, since 6889 ft. more development work was done this year. It is also necessary to pay Korean miners more for their work, because the cost of living has increased. It is now costing a Korean twice as much to live as it did 5 years ago, and four times as much as it did 15 years ago, on account of the advance in price of rice and millet. In addition, the Charabowie mine flood increased the mining cost for the year by $33,270.94.

*From annual report as general manager for the Oriental Consolidated Mining Company.

Ore Reserves

The estimated ore reserves July 1, 1913, were:

	Tonnage.	Value.
Tabowie	470,000	$2,850,000
Taracol	260,000	1,185,000
Chintui	17,400	67,875
Kuk San Dong	16,200	47,825
Charabowie	38,600	301,100
East Candlestick	3,700	37,000
Total	805,900	$4,488,800

In the active mines 33,248 ft. of development work was done during the year and 1534 ft. of development work was done in prospecting outside.

TABOWIE MILL.

The past year's work has shown that the Tabowie mine ore reserve on July 1, 1912, was underestimated by approximately 53,000 tons and $397,000 in total value. The new ore developed during the year was 139,529 tons at $7.75, or $1,080,825, and the estimated ore reserve July 1, 1913, was 470,000 tons at $6.06, or $2,850,000 as total. In the Taracol mine the new ore developed during the year amounted to 96,558 tons at $6, or $579,436, and the estimated ore reserve July 1, 1913, was 260,000 tons at $4.56, or a total of $1,185,000. The new ore developed during the year in the Chintui mine amounted to 22,887 tons at $4.14, or $94,745, and the estimated ore reserve, July 1, 1913, amounted to 17,400 tons at $3.90, corresponding to $67,875. In the Kuk San Dong mine on July 1, 1913, the estimated ore reserve was 16,200 tons at $2.95, or $47,825, the new ore developed during the year being 23,323 tons at $4.12, or $96,058.95, and the ore mined and milled during the year having been 34,123 tons at $3.38, or $115,234. The tonnage milled at Kuk San Dong during the year was small, because it was more profitable to sort the ore and run only 20 of the 40 stamps. The estimated ore reserve at the Charabowie mine on July 1, 1913, was 38,600 tons at $7.80, or $301,100. The result of

the Charabowie development work, 42,258 tons worth $395,973, was more encouraging and satisfactory. Work during the past year was handicapped by the heavy inflow of water from the river. This has been confined to the south end of the mine and above No. 1 level, but it has been impossible, up to the present, to stop the river water from entering the mine. For this reason the cost of fuel for pumping and hoisting amounted to 45% of the total

TARACOL HEAD-FRAME.

expense. The estimated ore reserve in the East Candlestick mine was 3700 tons at $10, or $37,000, on July 1, 1913.

Prospecting Work

In the West Candlestick prospect the old lower adit was advanced 79 ft. on 10 in. of $4 ore and is now in 1350 ft. There was expended $1693 for taxes and development work on the Chosen district claims, but nothing of value was found. Work on the old abandoned Tong Koll mine was continued during the year, but not much was done, owing to the lack of machinery. As soon as the other mines commence operations by electric power there will be available boilers, hoists, and pumps for carrying on the work at Tong Koll. The old abandoned Chittabalbie mine was again turned over to the Koreans to work on a royalty basis and a revenue of $180 was received as royalty. During the past year Korean tributers delivered at the Taracol mill from tribute mines 883 tons of ore worth $4675.50, for which they were paid $1839.79. The net profit on this ore was $1061.32. All of the tribute ore came from small veins which the Company could not work at a profit. As the Korean prospectors are now working under more favorable conditions, several hundred men are engaged in this work and many new prospects have been found. Development work done by these prospectors on the Sambong vein indicates that the Company may be able to commence regular operations there.

Milling

During the year 313,701 tons of ore worth $2,005,463 was crushed in the Company's mills. Of this gold, 89.4% was saved in bullion and concentrate, and 10.6% was lost in the tailing. Milling expenses for the year were $168,657.32 or $0.54 per ton, 4c. more per ton than the previous year. This increase was due to the heavier cost of motive power. The crushing capacity was reduced, because only 20 of the 40 stamps at Kuk San Dong were at work, and time was lost at Tabowie on account of shortage of water during the winter months, as well as at Candlestick owing to lack of miners. At the Taracol tube-mill plant a total of 25,319 tons with a value of $675,656 was treated. The bullion secured was $571,970, corresponding to 84.7% extraction. Although the percentage of extraction is slightly better than that obtained during the previous year by leaching, the tube-mill plant is, up to now, a failure economically, because the extra cost of treatment amounts to more than the gain in extraction. The staff is working toward an increase in the extraction by improving the classification, grinding, and agitation, and the operating expenses will be reduced by the use of electric power instead of steam. At the Kuk San Dong cyanide plant the extraction was 15% higher than last year and the cost of treatment $1.68 per ton lower.

Kuk San Dong Dump Re-Treatment Plant

The operations at the plant yielded $70,642.73; a 70% extraction. The cost of treatment at this plant was $2.39 per ton, or materially more than last year. The plant ran successfully and made a profit of $27,822.63, which has been credited to the cost of the plant, because the expenses of this construction were charged against the dump. There still remains $10,749.03 to be earned before the plant has entirely paid for itself. During the coming year the plant is expected to yield a good net profit. The cost of treatment at the Candlestick cyanide plant was $1.18 per ton, or $0.30 per ton more than the previous year, due to lower tonnage and the

A GROUP OF MINERS.

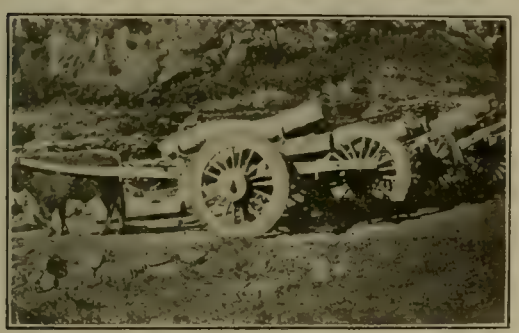
higher cost of fuel. A total of 6511 tons was treated, yielding $10,276, or a 52.9% extraction.

Construction Work

In order to insure sufficient water for the Taracol plants, a pumping plant has been built on the Pukchin river, consisting of boiler and pump, which delivers the water through a pipe-line one mile long against a 400-ft. head. During the coming winter electric power will be used for this pumping plant. The expenditures to date are $8074.61. As the Maibong, Taracol, and Tabowie camps in future will be operated by electricity, the staff has been busy

during the year in remodeling the existing machinery and installing new equipment where needed. Brick and iron sub-stations have been built at Maibong camp, Taracol mill, Taracol mine, and at Tabowie camp. The steam hoists at Tabowie and Taracol mines have been converted to electric drive, and a new electric cage hoist has been installed at the Taracol mine. A new electric hoist has been erected at the Charabowie mine, as well as three smaller electric hoists underground at Charabowie and Tabowie.

Iron-armored lead-covered electric conduit cables have been installed in the Tabowie, Taracol, and Charabowie mines to transmit current to all underground electric machinery. Electrically-driven centrifugal and plunger pumps have been placed in these mines. Induction motors have been installed for the Taracol tube-mill plant, the Taracol mine compressor, and the Maibong mill. A small auxiliary steam-driven electric plant has been built at



HAULING TIMBERS.

Maibong, to run the mine pumps there in case of interruption in the electric power-supply from Okura & Co. The spare water-power plant 500-kw. generator, which has been in stock for several years, has been brought to Taracol and will be connected to the mill engine to provide an auxiliary plant there. The electrification of the three mines is now practically finished and the total expenditure to date is $62,304.46.

Timber Supply

On cordwood railways some $41,000 was expended during the year, including $12,500 for a reforestation tax imposed by the government on the wood company, which, in turn, reimbursed itself by selling cordwood, timber, lumber, and charcoal to the mines and mills at an increased cost. The wood company did good work during the year, furnishing 27,827 cords of wood, 159,697 mining timbers, 57,539 pieces of lumber, and 5644 boxes of charcoal for Tabowie and Taracol. On the advice of the Governor General of Chosen the Company has commenced tree planting here. The government aided in securing the services of Kosaburo Matsushita, a forestry expert, who has charge of the reforestation work. This spring 30,000 acacia trees were planted and nurseries for 120,000 seedlings were established. All of these are growing well. The Company has applied to the government for permission to plant trees on certain hills, near Tabowie, and it is the intention to plant 100,000 trees next year. In this department $2628.16 was expended during the year.

Electric Water-Power Plant

The operating expenses of the electric power plant for the year were $16,262.37, which includes a considerable amount of work on the flumes and ditches in order to keep them in proper working condition. A great deal of construction work was done in the electric department this year, in anticipation of the electric power to be delivered by the power-plant under construction by Okura & Co. at Anshu. The rainfall in 1912 was 51⅜ in., and during 1913 was 48 7/16 inches.

General

Gold bullion amounting to $1,705,497.75 was sent to the Imperial Japanese mint at Osaka at a cost of $6761.86. The bullion was shipped over the government railways and handled by the Bank of Chosen, Ltd. The medical staff treated 29,345 cases at the Taracol hospital during the year; 13,448 cases were Company employees. No charge of any kind is made at the hospital, and people come from far and near to receive the benefits of this free medical service, on which there was expended $8867.89 during the year. On Christmas Day, 1912, the management was authorized by the president of the Company to distribute $10,000 among the foreign employees, on a percentage basis, the older employees receiving the greater benefit. This is the eighth consecutive Christmas that $10,000 has been distributed. It was very pleasant to make this distribution, as the men had rendered very satisfactory services, and the management takes this opportunity to express its appreciation of the loyalty and coöperation shown by its employees during the year.

Sulphur in Louisiana

In one respect Louisiana stands preëminently in the lead of the states of the Union; that is, in the production of sulphur. In 1904 the Frasch process for the recovery of sulphur from beds underlying a heavy cover of quicksand was put into operation by the Union Sulphur Co., of Sulphur City, near Lake Charles, in Calcasieu Parish. Since that time approximately 2,330,000 tons of refined sulphur has been recovered from the Louisiana deposits. Prior to 1904 the only domestic source of sulphur in quantity in the United States was pyrite, from which sulphuric acid is made direct, and nearly all of the sulphur used was imported from Sicily. At the present time the domestic output of refined sulphur, except from Louisiana, is a negligible quantity, and the quantity and value of the imports are insignificant compared with what they were ten years ago. In 1903, one year before the production of sulphur in Louisiana began to exert an influence upon the market, the imports of sulphur into the United States amounted to 191,033 long tons, valued at $3,709,690. In 1912 the imports were 29,927 tons, valued at $583,974. On the other hand, the domestic production of sulphur in 1912, according to the U. S. Geological Survey, exceeded by more than 145,000 tons, or nearly 50%, the imports of Sicilian sulphur in 1903 and was more than ten times the imports of sulphur in 1912.

Selective Mining in the Gold Fields Mines

By H. H. Webb

*The term 'selective mining' is capable of more than one interpretation. The first inference conveyed is that of robbing the mine of its highest or best grade of ore; or it may be taken to mean stoping from the ore reserves of the mine a more or less higher grade of ore than the general profitable average of those ore reserves call for or would appear to indicate as good mining under existing conditions. Such a policy may be dictated by financial reasons or obligations or a desire to give present shareholders the benefit of higher returns, leaving poorer ore to be extracted at some future time, when it is hoped working costs and conditions will be more favorable. There can, I think, be no doubt that, from a purely mining point of view, the policy governing mining operations should be the extraction of the total ultimate values from the profitable rock which a given area or block of ground contains at the lowest average cost without being influenced by higher temporary dividends or share values, and a group or mine following this policy could hardly be accused of selective mining even if at times it was necessary to draw upon higher grade ore reserves than the average to bridge over a temporary period of depression in development or a momentary advance in working costs, or to maintain a fair profit while completing the necessary extraction of low-grade but profitable ore from old abandoned or caving stopes.

Choice of Policy

If a mine on the Rand could be developed to its boundaries and thoroughly equipped before milling operations began, something in the nature of a definite policy could be laid down at the start and followed more or less closely, subject, of course, to varying local factors. But since this is impossible, any policy adopted by a group or by a mine may at times have to be varied or modified, and there are no mines worked which I know of, particularly some classes of low-grade gold mines, in which at times a process of selection is not necessary, and this applies more or less to all the mines on the Rand, and particularly on occasions to some of our lowest grade ones. At such mines there are at times large blocks of ground being attacked which, as stoping proceeds, vary in value, and where the margin of profit is small and where a small and possibly temporary variation may affect the profit of these blocks for the time being. In such cases it is often necessary to draw upon the higher grade sections of the mine to maintain the regular monthly profits until an improvement, as work progresses, takes place, although the general policy or effort may be to mine as nearly as possible the general average of the ore reserves or that indicated as profitable for the mine as a whole; but it should be understood that while mining from reserve ore of average value the mill grade will be somewhat depreciated, due to the inclusion of low-grade ore from other sources such as reclamation and development faces.

Development Problems

It can be readily understood that one of the most important factors affecting the working of each individual mine is the extent and the value of the tonnage kept well developed ahead of the requirements of the reduction plant. Where the average value of this is maintained over large areas and great tonnages, the best policy for working each individual mine is not difficult to lay down and carry out; but when the average grade is slowly falling as additional depth is reached, the difficulties of policy and management are increased. And there can be no doubt that from our experience and in our mines the average value of the ore developed over large areas has been getting lower as greater depth is attained. High-grade areas and patches are found in depth, but these are not as frequent or extensive, nor are they in all cases as high in value as they were nearer the outcrop, consequently the general average over large areas has fallen. True, there are more favored parts of the Rand formation than others, in which the average values in depth are better maintained. But in those parts not so favored the serious question of meeting lowering grade becomes one of working costs, and these, with good management, can best be met by increasing the crushing and treatment and mining capacity, consistent with the existing lay-out as well as the life of each mine. The erection of large plants and the increasing of the capacity of smaller existing ones, resulting in lower operating costs from increased scale of working, has generally been accounted the cause of the lowering of the average grade of the ore sent to the mill, and this has been so in some cases, affording an opportunity to extend the life of the mine by lowering the working limit of its profitable ore. But there are mines on the Rand at which the lowering of working costs has been a necessity to meet the lowering grade of the ore developed, and under this latter heading may be classed such of our mines as the Knights Deep, Simmer Deep, and Jupiter, and this necessity, which through strenuous efforts has brought about working economies, has served to set an example through these mines of what might be accomplished by other more favored ones.

A lowering in average grade of the ore does not necessarily mean a diminution in output or dividends, but it does mean working on a larger scale to maintain them, coupled with close management and low costs, which, besides bringing this low-grade ore within the margin of profitability, also secure increased profit from the better grade of ore formerly constituting the reserve as well as from the excess tonnage treated. Some of the largest and best paying mines in the world are of very low grade, but conditions are favorable for low costs, wholesale mining, and large tonnage.

*From report as consulting engineer to the Consolidated Gold Fields of South Africa.

Fixed Costs

One cannot always take the nominal working costs on a mine as a limit of profit of all of the ore exposed in that mine. There are certain fixed charges on all mines which, as a whole, are not largely affected by the scale of working on the mine, but which, as they appear in the working costs, increase or decrease per ton, depending on the scale of operations; while the reduction plant and certain other charges are not only as a whole affected by the scale of operations, but are also lower per ton on account of the increased tonnage treated. But underground mining, especially as regards breaking costs per ton, is affected by local conditions, especially at the points of attack. Ore having a value even below the nominal or average costs of the mine may, due to favorable local conditions, easily pay to break and send to the mill, and in dealing with each of our mines an endeavor has been made to give attention to this. In going over the records of the mines of the Gold Fields group (excluding Sub Nigel) for the past three years, I find that there were some 563,000 more tons milled in 1912 than in 1910, that the average recovery had fallen off during the three years by 2s.7d. per ton, even though the percentage of extraction had gone up somewhat, and comparing the average working costs of the three months, January, February, and March 1910, with the corresponding period of 1913, a reduction of 1s.0.9d. per ton milled, equivalent to a total of £55,600 from the tonnage treated, has been effected during the latter period. To one knowing our mines, all of this points to an effort during this period to work the mines of the group as nearly as possible for the average value which the profitable ore reserves of each indicated, as well as to a falling off in grade of all of them, noticeably Knights Deep, Simmer East, Simmer Deep, and Jupiter, and this has been the case.

Decline in Grade of Ore with Depth

This fall in average grade with depth at the individual mines has been shown to be true, not only by the screen samples of the ore milled and by the recovery value per ton, but by the careful sampling and assaying of level by level in each mine as greater depth was reached, by careful sampling of stopes on each level sending ore to the mill, and by the yearly re-cast of the ore reserves in each mine. The question of the profit by sorting has been gone into thoroughly during the past year by the engineering staff, particularly as to the advantages at our low-grade mines, where sorting has been estimated at 10% and under. At these it has been found that the tendency was inadvertently to estimate too high a percentage as sorted out, and on these low-grade mines at this low rate of sorting the advantages to be gained by sorting have been found to be very doubtful, and as a matter of fact there is a slight margin of profit in favor of not sorting when large tonnages are handled.

The value of Ohio's mineral production in 1912 was $111,229,656, an increase of $14,139,372 over 1911. Ohio is the premier state of the Union in the manufacture of clay products and the grindstones and pulpstones, according to a summary of mineral production compiled by Edward W. Parker, of the U. S. Geological Survey. It is second in the production of pig iron, bromine, and lime, but is of no importance as a producer of iron ore. It is third in the value of its output of natural gas, salt, sand and gravel, and gypsum.

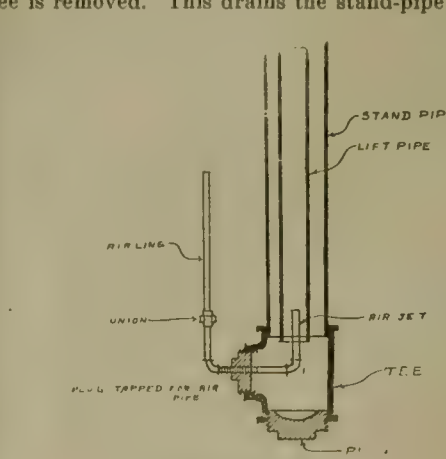
Design for an Air-Lift

R. H. Shaw

*The sketch below is a suggestion for the construction of air-lifts for use in elevating pulp in cyanide plants. This design has been used at the Colburn-Ajax mill for some time past, and has proved satisfactory in every way.

In raising pulp by means of air-lifts, one encounters the problems of broken compressors, chips of wood, pieces of belt, and numerous other things, which, with almost human maliciousness, find their way into the pipes. These cause chokes which are difficult to loosen and may cause serious delay. The design given is made with the object of accessibility and rapidity in removing chokes.

In case of a choke, the plug on the bottom of the tee is removed. This drains the stand-pipe and lift-



CROSS-SECTION OF AIR-LIFT.

pipe, and usually cleans out everything except the air line. Next the union on the air line is disconnected and the other plug, together with the horizontal nipple, is removed from the tee. The horizontal nipple is screwed into the elbow (marked 1) loosely, so that it readily comes apart at that point while the plug is being unscrewed. All the pipes now can easily be cleaned of sand or slime.

To replace the parts the verticle nipple and elbow (marked 1) must be held in place through the bottom of the tee and the air pipe screwed in at the same time as the plug in the side of the tee is replaced. The bottom plug is then put back into place and the lift is again ready to operate. The maximum time usually required for this complete operation is about ten minutes. The loss of pulp and solution is negligible compared to the time saved.

This construction requires the lift to be at least one foot above the floor and supported from clamps around the pipe. Ordinarily, both of these details are readily accomplished.

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*From *Colorado School of Mines Magazine.*

Discussion

Readers of the MINING AND SCIENTIFIC PRESS are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment. The insertion of any contribution is determined by its probable interest to the readers of this journal.

Revision of United States Mining Laws

The Editor:

Sir—I have followed with much interest the discussion on the question of the revision of the United States mining laws contained in the October 18 and October 25 issues of the *Mining and Scientific Press*. The article by Russell L. Dunn is so clear, so logical, so true to the facts that some one ought to be generous enough to publish and distribute it *gratis* to everyone who is interested in mining. He leaves little to be said, and his arguments the opposition, so far, have not seen fit or have not been able to answer. Following closely after Mr. Dunn's article comes the contribution from the pen of George Otis Smith, Director of the U. S. Geological Survey, and, while in no way an attempt to answer the arguments of Mr. Dunn, still the main points of the revisionists are probably as well presented as they can be, so that a little more detailed study of Mr. Smith's article is in order.

To begin with, Mr. Smith starts out by saying: "Whatever the forum selected, public discussion in America tends to evoke more language than ideas." True, and generally admitted. Then he goes on to say: "Plain ideas are dressed up in borrowed or imported finery with all the tender care that a fond mother lavishes upon her little girl going to a first party, so that too often the practical man who knows the workaday world at first hand delivers an address conspicuous for the elegant words which completely envelop and conceal plain facts and solid opinions that deserve more appropriate treatment." I confess that Mr. Smith's meaning is not entirely clear to me in this sentence. Granting that we may be allowed to apply the adjective "elegant" to words, I am still unable to understand why inelegant words should always be selected in speaking of and discussing even plain subjects. Again, I do not think that Mr. Smith's implied charge is altogether warranted, if he means that it is usually the practical, hard-headed, work-a-day man who is guilty of speaking in hyperbole or high-flown language when making a public address. It has been my experience that if the practical man has anything to communicate, publicly or otherwise, he is able to do so in a simple, straightforward, convincing way. On the contrary, the man who has not much to say, owing to ignorance and other defects, but who wishes to make a big noise and a good impression, is the man who makes liberal use of high-sounding terms and who is able to envelop his few ideas in an impenetrable fog of words.

Continuing, he says: "To consider now perhaps the most important matter in which this body is particularly interested, namely, the federal legislation needed to promote mining on public lands, it is imperative to recognize certain ideas that have won large popular support, if not adopted by the majority, especially as these ideas have never been written into our archaic mining laws." Here again I must confess that the author's meaning is not entirely clear to me. If this is a government wherein the majorities rule, why, may we ask, should these ideas be adopted? Following this, our author proceeds to lay down some of these "ideas," after first, however, raising them to the dignity of "principles." These "principles" that the future mining and business man will have to sustain and guide him will be: "Big business more than small is in need of strong control by the people; the day of big business, in the sense of unnatural and unrestrained monopoly and special privilege is passing; (where, may I humbly ask, does it now flourish?) effective inspection and intelligent regulation by the people's representatives will increase; the bright light of publicity should and will shine (possibly the muck rake, too, will be in evidence, although Mr. Smith did not mention it) on the inner workings of all private business which either touches or controls the production and distribution of the necessaries of life. * * * All of these propositions must, I believe, be accepted as premises in the formulation of any new mining statutes whose purpose it is to provide at all adequately for the present and future."

So here we have the case clearly stated. These "principles" must be the foundation upon which all new legislation must be framed. Can we at first sight appreciate fully the significance and far-reaching influence of legislation based upon such "principles"? When we include, as Mr. Smith does, all industries having to do with the "production and distribution of the necessaries of life," we include not only all industries based directly upon mining, but also all agricultural, manufacturing, and transportation enterprises; in fact, everything. All private enterprises are to be turned inside out, in order that "the bright light of publicity may shine" upon the interior workings, and all private business will cease to exist, and what is now one man's business will become everybody's business. Each and all of us will then be compelled to turn to this infinitely exalted, infinitely magnified government from whence comes all sustenance, all life, all intelligence.

Following this course of reasoning, it is easy to see why Mr. Smith advocates all the measures he does; why he advocates leasing instead of selling the land. Some of the reasons he advances to justify this change are amusing, as where he says: "A large burden which the mining industry now has to bear * * * is made up of the various risks and uncertainties which attend it. * * * For this reason, in order to lower the cost of coal, I favor a leasing, rather than the present method of selling government coal lands at an appraised valuation." He therefore admits that the present system, which his bureau strongly advocated and finally put into operation, has been one of the causes for the increased price of coal. Evidently the methods of appraisal have been at fault, and the arbitrary valuations placed upon such lands have resulted in

raising the price of the product. But did this objection have any force when the old system of disposing of government coal land at only a nominal value made that charge only a nominal one? No. Is it going to be possible for the government to appraise the value of a tract of land for leasing purposes any more accurately than where it is appraising the same tract for sale? Certainly not. The framers of our old mining statutes were thoroughly cognizant of all these points that Mr. Smith is at such pains to mention, and because they did clearly perceive all the hazards and risks incident to mining they endeavored to minimize all the artificial ones by (1) charging the miner only a nominal price for the land itself, and (2) granting to him a title in fee simple so that his interest in that land would be of the most intimate and lasting character. Mr. Smith would lead us to believe that by substituting the leasing system for the old, the consumer will be relieved from having to pay the increased risk attached to mining enterprises, as he says: "Any scheme of selling an undeveloped resource involves uncertainties in valuation, and the risk thus created is liberally discounted by the operator * * * but the public pays the bill." Who is going to pay the bill under the leasing system? The same public, of course, only it will be a bigger one.

Our author professes to believe that the important ends to be gained by new legislation along his proposed lines will be "to promote mining on public lands." That is a specious plea, indeed, and one that is always made; but how can anyone make it without ignoring entirely the history of our wonderful mining development? Under the system of mining laws, in the brief period from 1800 to 1907, the value of our mineral products increased from $364,928,000 to $2,071,613,000, or about 5.6 times, while in the same period our population increased only from about 50,000,000 to 90,000,000, or about 1.8 times. Our mineral production, therefore, during this period increased about 3.1 times faster than the increase in population. And it is fair to remark that the increased value of our mineral products has not been gained at the expense of an increase in cost per unit, but in most cases has actually been marked by a decrease in cost, so that quantitatively our mineral production has been even greater than shown above. Does this show that there is any alarming or pressing need for a profound revision of our mining laws? Hardly.

I believe that every careful thinker will admit that the mining enterprises of this country, and especially in the mining states of the West, have stimulated, more than any other enterprise, the rapid and wonderful development of that region. It was the mines and mineral fields that first coaxed the railroads to extend their slender tentacles over hundreds and even thousands of miles of wilderness between. Now are we to lightly discard a system of laws which has been of such vast benefit to our country and substitute for it one which is still untried, and in its very spirit absolutely opposed to the principles and traditions of our nation? Are the people of this country going to voluntarily subscribe to a system of laws that takes from them and from their children forever all hope of securing right or title to any part of the mineral resources of the country? Why extend the privilege to the farmer and deny it to the miner? Why should the consumer be saddled with a government fee for a leasehold, when he knows that all such sums paid in merely goes to pay the salaries and expenses of the collecting agencies? Even if our benevolent purposes were to provide for futurity (as seems to be the underlying motive of most government-ownership advocates), it is difficult to see how the system of leasehold is going to secure these benefits to posterity when all sums thus collected are immediately paid out to keep alive a government bureau. If, as our author states, there has been any widespread demand for "federal legislation to promote mining," it has only been in very recent years and coeval with that period when the government itself, and its various and numerous bureaus, have shown the greatest desire to interfere in all kinds of mining and other industrial enterprises. The clamor for new and more legislation to correct usually some fancied wrong is, as your correspondent, Mr. Dunn, so aptly remarks, "the easy political first-aid device for the politically shiftless." Mining and other enterprises in this country do not stand in need of any more new legislation nearly so much as they do of protection from all sorts of useless and pernicious governmental exactions and interference. Physicians long ago learned that in order to revive the ebbing strength of a patient, copious bloodletting was not always the best measure; and so, possibly, those who are charged with attending to the business of the government may learn from this that frequent and copious draughts from its industrial patients is not always best for their health.

Admitting the fact that we live in a period when legislative shifts and changes are the order of the day; when the multitude are always willing to discard anything because it happens to be old; when quacks and quackery of all kinds enjoy a larger and more influential following than ever before; when everything seems to be in a condition of a flux and change and nothing seems fixed; still let us hesitate, let us deliberate, and study long and carefully, before we decide to cast our old mining code into the scrap heap, and blindly accept in its stead something that has only its novelty to commend it.

ROYAL P. JARVIS.

Knoxville, Tennessee, November 4.

[We asked for the opinions of opponents as well as the advocates of the changes proposed, and Mr. Jarvis has been good enough to state the reasons for the faith that is in him. Passing the persiflage directed at Mr. Smith's introduction, for the Director of the Survey is abundantly able to hold his own in any such contest of wits, Mr. Jarvis' main arguments seem to be that the old plan has in fact promoted development and any leasing system (assuming that a change in the mining laws involves its introduction) would unfairly penalize the mines. As to the first, it will be admitted by all that the liberal laws and more than liberal interpretation of them has promoted rapid development of mining in

our West. To hold, however, that no other system would have done as well, or would do better now, is to shut one's eyes to the history of other countries and even to parts of our own country where development has been equally as rapid though based on other systems. No one wants to check mining or increase its risks. What is wanted is to prevent grabbing of public land by speculators who withhold it from development, and to decrease litigation. With these two impediments minimized, the government will have taken a long step in the right direction. Both these have been accomplished, and are being accomplished, where the system of tenure is different from our own.

In the matter of fee titles versus leases, Mr. Jarvis asks, "Why extend the privilege to the farmer and deny it to the miner?" We are tempted to direct the printer to set the reply in large black type, since the answer has so often been given without seeming to have attracted the notice of the protestants. A farm is permanent, a mine is not. When a farm is brought under cultivation, a productive industry and a family is added to a community for all time. The farmer takes an annual return from the ground without necessarily decreasing the capital involved. The mine brings in a temporary population and the miner takes out ore once for all. His annual 'profit' is really a division of capital. It is possible to assess the farmer his share of general expense by taking a part of his crop, which is what taxation does. It is impossible to do the same with the miners except on a basis of tonnage tax, which amounts to a royalty. If farming necessarily involved permanent destruction of land, we think it would quickly be found that public opinion would prevent free giving of land for all time to whoever asked. The farmer would be held to strict accountability. He would be required to use the land only on terms dictated by the general public for the general good. This is all that it has been proposed to ask of the miner; to reserve a measure of control while he exercises rights delegated to him by the people as a whole. It is this difference between disposition of income and of capital, that warrants a different system of tenure and taxation. In fairness to others less radical than ourselves, however, it should be stated that the revision proposed does not necessarily involve going over to a leasehold basis.—EDITOR.]

Stirling v. Babcock & Willcox Boilers

The Editor:

Sir—The article on 'Waste Heat Boilers in Reverberatory Furnace Flues,' which you published in the October 11 issue, is a very interesting example of partly calculated data. Mr. Sorensen has shown clearly that a battery of 520 hp. will save, or lose, more money than one of 375 hp. An analysis of his own figures will, however, disprove some of his conclusions.

The following 'per horsepower' figures are taken out with a 5-in. slide rule and so I do not claim great accuracy:

	Babcock.		Stirling.	
	Total.	Per hp.	Total.	Per hp.
Average boiler horse-power	520.00	.....	375.00	.....
Number of boiler repairs	11.00	0.02	23.00	0.06
Average cost of repairs, and cleaning and repair, per repair, total, dollars	172.17	0.33	95.34	0.25
Repair cost per 100 days, dollars	189.39	0.36	100.69	0.27
Water evaporated by battery of two boilers per day, lb.	861,111.00	1,660.00	621,472.00	1,660.00
Water evaporated in 100 days, less days lost cleaning and repairing, pounds	78,998,598.00	152,000.00	57,840,429.00	157,000.00
Evaporation lost during cleaning and repairs, pounds	7,112,802.00	13,700.00	4,306,803.00	11,500.00
Equivalent oil recovered, dollars	27,708.00	53.50	21,785.00	58.00
Equivalent oil lost, dollars	2,494.00	4.80	1,512.00	4.05
Cost of cleaning and repairs per 100 days, dollars	189.39	0.36	100.69	0.27
Total lost and cost per 100 days, dollars	2,683.39	5.18	1,612.69	4.30
Net recovery in 100 days, dollars	25,024.61	48.00	20,172.31	54.00
Balance in favor of the Stirling type per hp. per 100 days	.....	.....	.....	6.00
In favor of Stirling per horse-power year	.....	.....	.....	22.00

The Stirling boilers needed many repairs compared with the others; it seems to be their only weak point, and, judging from my memory of the work at Anaconda, Montana, it seems abnormal. Unfortunately, the first cost of the two batteries of boilers, as installed, is not given, so no comparison can be made of the cost of the power obtained upon a correct basis. Mr. Sorensen, however, concludes with a balance of $17,710.90 in favor of the Babcock boiler. This divided by 520 gives a profit of $34.20 per horsepower-year. My analysis indicates that the Stirling boiler is worth about $22 per horsepower-year more than the Babcock. The difference is large and is worth attention.

The Stirling is apparently a much smaller boiler than the other. Probably the flue gases in the downtake behind the Stirling are much hotter than behind the Babcock, showing that a larger boiler could be used.

HERVEY GULICK.

Los Angeles, October 18.

A chronological list of the more disastrous coal-mine accidents in the United States shows that 275 accidents have occurred since 1839, in which five or more men were killed at one time, representing a total of 6777 fatalities. Of these accidents, there were 135 that killed from 5 to 9 men each, a total of 859; 82 that killed from 10 to 24 men each, a total of 1237; 25 that killed from 25 to 49 men each, a total of 870; 18 that killed from 50 to 99 men each, a total of 1221; 11 that killed from 100 to 199 men each, a total of 1534; three that killed from 200 to 299 men each, a total of 695; and one that killed 361 men. Of these larger disasters, gas and coal-dust explosions caused 183 accidents and 5111 deaths.

Special Correspondence

NEW YORK

ZINC METALLURGY DISCUSSED BY A. I. M. E. AND AMERICAN ELECTROCHEMICAL SOCIETY.—CONTINUOUS FURNACE IN SIGHT.—FLOTATION AND THE M. & M. SOCIETY.—SMELTING FLOTATION CONCENTRATE.—GOLD MEDAL AWARDED MR. AND MRS. H. C. HOOVER.

The November meeting of the New York Section of the American Institute of Mining Engineers, held in the United Engineering Societies building on November 20, was a joint meeting with the American Electrochemical Society. The topic of discussion was the present status of the metallurgy of zinc. Lawrence Addicks presided and the first paper was by George C. Stone, metallurgist for the New Jersey Zinc Co., who briefly summarized the limitations imposed on zinc metallurgy through the fact that zinc oxide is only reduced by carbon at a temperature above the boiling point of zinc, so that the metal must be produced as a vapor. This vapor is easily oxidized by contact with oxygen or CO_2, so that its condensation can only be done in a reducing atmosphere, and within certain limits of temperature in order to obtain a commercial product. Within the bounds imposed by these peculiarities, much progress has been made; the amount of fuel required has been greatly reduced, the life of the retorts has been doubled, and the labor necessary has been greatly decreased as compared with earlier practice. The chief possibilities of further progress seem to lie in increasing fuel economy through decreased radiation losses and otherwise, further decreases in the amount of labor required, and a general lowering of costs through the better design of plants in the light of experience. He was followed by W. R. Ingalls, who discussed the possibilities of the electric smelting of zinc, concluding that as yet experimental work in this line has not progressed to a stage where its success can be confidently predicted. Electrolytic refining of zinc was to have been discussed by Victor Engelhardt, chief engineer of the Siemens-Halske Co., but in his absence the topic was taken up by J. W. Richards, professor of metallurgy at Lehigh University, who read an abstract of an earlier paper on the subject by Mr. Engelhardt and interestingly supplemented it with the results of his own experimental work. The ensuing discussion, over which L. D. Huntoon presided, was opened by C. F. Chandler, emeritus professor of chemistry in Columbia University, who related some amusing incidents in his early experiences with zinc. W. McA. Johnson followed with a short account of the results of his experimental work in developing a continuous zinc furnace, in which a slag, with an extremely low metal content, is obtained, copper or lead is obtained in the form of matte or bullion, and the zinc is condensed, about 75% of it yielding spelter and only 1 to 5% blue powder. The furnace yields 15 to 20% flue-dust. On the basis of present experiments, it is estimated that the cost of electrodes will be 25 to 50c. per ton, and that, using a 250-kw. furnace, the thermal efficiency will reach 65% and the power consumption will be 750 to 800 kw-hr. per ton of material smelted. Dr. Cowles related the results of some early experiments made by himself upon the electrolysis of zinc, and E. G. Spilsbury described some early experiences in zinc metallurgy. J. W. Richards made an interesting comparison of the various types of electric furnaces, and the discussion was closed in a witty speech by J. F. Kemp, who proposed a vote of thanks to those who had spoken. The meeting was followed by a smoker in the Institute rooms.

The meeting of the New York Section of the Mining and Metallurgical Society, November 18, was devoted to the discussion of flotation and alternative schemes for improving the saving of slime in copper and zinc mills. J. Parke Channing introduced the discussion with a summary of present conditions. He brought out the fact that in one case where a 35% copper concentrate was made by wet milling and flotation, the original concentrate would contain about 20% silica, for example, and the flotation concentrate 30%. This was found to be due to the presence of magnetite in the ore which did not go into the flotation concentrate; and that this introduces a smelting problem. He furthermore said that it had been found that if ore was treated by leaching to recover the oxidized metals, it was not possible to follow this by flotation to recover the sulphides, but that the reverse process is applicable. He announced that at the Miami a new Deister classifier is to be placed in the mill. It consists of a vertical tube of about 10 in. diameter, a couple of feet high, and slightly larger at the top than at the bottom. Inside this are ten or a dozen cones, supported with the point downward. These have six slots, about ½ to ¾ in. wide, extending from near the edge to the point where they come together and make an opening. They are placed so that the slots in one are at 45° to those above and below. This classifier has been found to give greatly improved results. Experiments with Butchardt riffles on a Deister table were also cited as showing that 40 tons per day could be treated on one roughing table. Otto Sussmann gave most interesting details as to difficulties in smelting the Butte & Superior flotation concentrate. The drying of the concentrate is one of the big problems, and the water now accounts for $1 per ton of the freight rate. The moisture furthermore makes trouble in roasting the very fine concentrate because it boils. The greatest difficulty, however, is that the oil in roasting dissociates, the hydrogen burning off and leaving finely divided carbon on the particles of ore. At a later stage this reacts with the partly roasted material, producing metallic zinc which distills off. The oil also causes the concentrate to 'ball up' in the roasters, and there are incidental difficulties in charging the retorts to capacity.

It was announced that at the meeting of the Council the same day, the gold medal of the Society had been voted to Mr. and Mrs. H. C. Hoover for their distinguished contributions to the literature of mining.

BOSTON

AMALGAMATED COPPER.—RAY CONSOLIDATED RESULTS.—NEVADA CONSOLIDATED AND DAVIS-DALY.

The taking of testimony here in the case of some stockholders in the Alice company who are suing the Anaconda Copper Mining Co. to set aside its acquisition of the Alice mine, brought out the fact that two men claim credit for the origin of the Amalgamated Copper Co. These are Thomas W. Lawson and his former partner in mining ventures, A. C. Burrage. The suit, which is in progress at Butte, called for the testimony of Lawson and Burrage as principals in the formation of the Amalgamated company. The former claimed that he first brought the matter to the attention of Henry H. Rogers, while Burrage said that his recollection differed from that of Lawson. He said that he went to Butte and inspected the ground and recommended that Rogers and the Standard Oil Co. should buy the whole hill. Lawson, he said, was interested in selling Butte & Boston to the Company, but beyond that he did not recall any specific matters in which Lawson figured in forming the Amalgamated. Burrage said he did not think much of Butte & Boston at the time, but recommended its purchase, together with the hill as a whole. Lawson testified that, although Amalgamated was not formed until 1899, it was talked about as early as 1896. He said the formation of Amalgamated and the taking over the control of the United Metals Selling Co. was for the purpose of getting control of the production and marketing of copper, the main idea being greater stability in production and price.

The quarterly report of the Ray Consolidated Copper Co. is somewhat disappointing in Boston. Some people are asking if it will not be necessary for the Company to borrow money upon its unsold copper in order to pay the next dividend. The main troubles of the Company are attributed to the drought in that district, which always comes along in the fall of the year. A Boston visitor to the district said when he was there in the spring the river was a torrent, but when he returned in the fall it had

almost disappeared and only a dry creek bed remained.

Charles Hayden, of Hayden, Stone & Co., has returned to Boston after a trip of seven weeks, inspecting the properties in which his firm is interested in Butte, Ely, Bingham, Ray, Chino, and Juneau. He stated that Nevada Consolidated has only 12 or 13 years to live at the current rate of production.

The hearings before the magistrate here in the suit of Louis Ross, mining engineer, against A. C. Burrage, claiming $2,500,000 of the stock of the Chile Copper Co., is still going on and will probably continue the balance of November.

Former Senator William A. Clark has many admirers in Boston who are interested in the honors paid him by way of celebrating his fiftieth anniversary as a citizen of Montana. He was one of the first pioneers into the Bannack and Alder Gulch districts in Montana, and the first year he was there cleaned up about $2000 in gold-placer workings. He afterward dealt in merchandise extensively, later moving to Butte, which he has ever since called his residence, notwithstanding that he owns palatial New York and Paris homes.

Davis-Daly, on the Boston Curb, has recently been easier in price, selling under $2 per share. It is announced that full operations have been resumed at the mine. The Creden management has practically reversed the underground procedure of its predecessors. Davis-Daly now has a comfortable treasury, and instead of Boston sending money to Butte, Butte is sending it to Boston.

MIAMI, ARIZONA

TEST MILL AT THE INSPIRATION CONSOLIDATED.—THE ARIZONA COMMERCIAL.—CHANGES AT THE BOSTON & SUPERIOR.

The Inspiration Consolidated probably will begin operating its new test-mill December 1. However, this will depend upon electric power and water. An 8-in. pipe-line has been laid from Wog's ranch to the mill, but no water as yet has been sent through the line. The power is dependent upon the Roosevelt-Miami-Superior transmission line, now in course of construction, and it is not certain that the wires will be at the Inspiration plant by December 1. The mill will have a daily capacity of 600 tons and will be equipped with two 20-in. conveyor belts, one automatic weighing machine, two 48-in. fine reduction disc crushers, one 36-in. disc crusher, one 48-in. roller mill, four Hardinge mills, four drag classifiers, three No. 6 Wilfley tables, two Deister multiple decks, one No. 4 Deister table, two No. 2 Deister tables, two double-deck slimers and one improved slimer, two elevators, and the flotation machinery. The mill will be so constructed that the method of treatment may be changed as often as desired with but little trouble. The excavation work is progressing rapidly for the air-compressors and transformer building, and within a few days concrete pouring will be in progress. The crushing plant at the Scorpion shaft has been completed and is ready for operation. The American Bridge Co. has four gangs busy riveting the ore-bins, and one span of the conveyor housing between the bins and the coarse-crushing plant is now in place. The MacArthur Brothers company is making rapid progress at the preliminary grading for the smelter, and the railroad will be laid to the site in a short time. Since the arrival of the Inspiration's new locomotive the Southern Pacific engine has been returned to that company, and the Porter locomotive is handling the work.

At the Arizona Commercial property, a concrete dam has been built in the drift on the 1200-ft. level at a point between the shaft and the cross-cuts that were recently driven into the vein. The water, which seems to come altogether from the vein, is diminishing in volume, and at the present has a pressure of less than 10 lb. It is probable that the flow will disappear as the vein is drained.

The Iron Cap has about 40 ft. to cut before the connection with the Eureka shaft of the Arizona Commercial is established. The raise from the 800-ft. level will connect with the 600-ft. level about the same time that the drift does. The Iron Cap is maintaining its record output of the immediate past few weeks, and the management expects it to increase the output for the month of November.

JOPLIN, MISSOURI

DEEPEST MINING IS IN THE MIAMI, OKLAHOMA, DISTRICT.—IMPORTANT LEAD DEVELOPMENT AT DUENWEG, MISSOURI.—ZINC ORE PRICES WEAKEN.—SHEET-GROUND DEVELOPMENT.

The deepest mining in the Missouri-Kansas-Oklahoma zinc and lead district has been started by the T. F. Lennan Mining Co., in the North Miami, Oklahoma, field, where a pump with a capacity of 2000 gal. of water per minute has been installed at a depth of 310 ft. and will drain the ground to a depth of 320 ft. A continuous orebody, from a depth of 260 ft. down to 320 ft., will be mined. Heretofore the Company has been doing all of its work at the 260-ft. level. Both zinc and lead ores are produced. They are low grade, selling for several dollars per ton beneath the prevailing basis price; yet the richness of the ground counterbalances the low grade of the concentrate. The Company operates a concentrating plant of 500 tons capacity per shift, and for over a year has been one of the heavy producers of the Miami camp.

At Duenweg, Missouri, important development is resulting in an unusually heavy production of high-grade galena. The work is being done by the Little Bob Mining Co., and it is interesting to note, in connection with this development, that the Company was reported to be about exhausted from a producing standpoint just about a year ago. At that time the Company had been a heavy producer of lead ores for more than a year, but the ground at the immediate place of operations was exhausted, and presumably the Company had dropped out of the producing class. Drill prospecting disclosed lead ore in rich formation, about 800 ft. north of the mill. A shaft was sunk and this new ground is now being opened. Several drifts are in the ore, which is in soft ground requiring timbering, and the ore is trammed to the mill where the recovery has averaged 10.5% for the past month. The Company is now producing an average of 125,000 lb. of galena concentrate per week, although the output has run as high as 150,000 lb., and the grade of the product is nearly 84% metal, meaning a settlement of $4 in excess of the prevailing basis figure for grades carrying 80% metal, the standard of the district.

Prices for zinc ore are ranging from $36 to $43 per ton, basis of 60% metallic zinc, the lowest offerings of recent years. The greatest slump came at the close of November, when companies that had been paying $40 to $42, basis, offered no more than $36. Many companies cannot operate at these prices. For the corresponding period of 1912, zinc ore brought $54 to $58, basis, with choicer grades selling up to $61. Spelter, which is now weak at $5.15, was then firm at $7.35 per 100 lb. The district production of zinc sulphide is running close to 4800 tons per week, with shipments of about 4500 tons, meaning a gradually accumulating surplus. The Joplin field produces the heaviest tonnage of zinc ore, although Webb City occupied the leading position for many years.

Steady production is reported by the Portland Mining Co., occupying a lease of the L. P. Cunningham estate, northeast of the American Zinc, Lead & Smelting Co.'s large mines at Prosperity, Missouri. In virgin territory, the progress of this mine has been watched with much interest. The mill has a capacity of 500 tons per shift and is making a high-grade zinc sulphide, which, however, contains barely enough iron to result in penalizing. Work is conducted in a thin sheet formation found at a depth of 190 to 210 ft. Formerly the mill was operated at the Stotts City, Missouri camp, but was recently moved to its present situation.

The Underwriters Land Co., operating on the Connor estate adjoining the city limits at the west of Joplin, has sunk a new shaft to a depth of 120 ft., where sheet ore is found and where a concentrating plant will be erected. The Company is already operating the Priscilla and the Falls City mills, both of which are among the largest plants in the west Joplin field. The ore in this district carries about 3% zinc sulphide and a small per-

centage of zinc. The Company has recently acquired leases in the North Miami, Oklahoma, field and will begin drilling operations in that district.

The Picher Lead Co. has begun drill prospecting in the Tar Creek region, three miles northeast of Miami. In this new field, the pioneer plant, operated by Barnes & McConnell, is now running steadily. The ores of this region occur at depths of from 250 to 300 feet.

MELBOURNE, AUSTRALIA

SYDNEY STOCK EXCHANGE.—MINERS' CARELESSNESS.—CAPITAL FOR FOREIGN VENTURES.—CARPATHIA MINE.—VICTORIAN STATE COAL MINES.

The Sydney Stock Exchange has taken steps to put an end to cornering of stocks. Following the procedure of the London Exchange, it has enacted that "the committee may suspend, either indefinitely or for such time as they think fit, the buying in of any debentures, transfers, scrip, or other securities, when circumstances appear to make such suspension desirable. The committee may from time to time, either during its continuance or after the termination of any such suspension, remove, renew, or reimpose such suspension." The rule has been generally welcomed except by those whose operations have been unpleasantly restricted by it, and the only criticism of it has been voiced by a writer who considers that the action of the Exchange, "while doing good in the direction of checking manipulation of corners, may depreciate the value of many investments by freeing the hands of the bear." This seems a reasonable objection to take to the Exchange's legislation.

Though less than a year has elapsed since the lives of over forty men were lost as the result of a fire in the underground workings of the Mt. Lyell company's North Lyell mine, a strike is reported as having taken place at that very mine, owing to the action of the Company in dismissing a man for exposing the mine and the danger of a new disaster. The management, not anxious to have a recurrence of a disaster of such magnitude, gave instructions that no fires were to be lighted at the shaft headframe, for fear of ignition of dry woodwork. Despite these instructions, one of the shaft-tenders insisted on lighting fires there, and as he persisted in doing so after he had been remonstrated with and warned, he was dismissed. The result was that the men left work. Fortunately, however, the union officials disapproved of the men's action, and after the loss of two shifts work was resumed. But what hope is there of such men listening to reason? To down tools because the Company dismisses a man who is putting their lives in peril by his disobedience to orders argues them fools of the very first quality. [It may be explained that, at Australian mines, the head-frames are all in the open, and in winter the shaft-tender, although having a small house for shelter, gets cold, and it is customary to light small fires in cans or other apparatus for warmth.—EDITOR.]

Attention has been directed to the large amount of Australian capital that has of late years gone abroad for mining investment or speculation. Siam, the Federated Malay States, Java, and the Philippines have all benefited largely; and now there is a proposal to finance the working of an oil property in the island of Timor. It seems not unlikely that labor legislation is responsible in at least some degree. At present so much of the income of mining companies at work in Australia is eaten up in wages that profits are much smaller than they should be. In the islands of the archipelago, north of Australia, even lower-grade concerns may yield a much larger percentage of profit; and though there is always an amount of anxiety in connection with the working of a company whose scene of operation is thousands of miles away, this is nothing compared with the worry caused by constant labor troubles and the annoyance of feeling that the content of one's property is not in one's own hands.

The report of R. Logan Jack on the Carpathia, the leading mine of the new Ardlethan tinfield in New South Wales, has resulted in a collapse of the shares. This is rather on what was *not* said in the report than on what *was* said. The public, reading between the lines, realized that the mine had not yet developed any definite lode and so hastened to get out. Mr. Jack gave no estimate upon reserves, as there no ore body had been exposed on three sides; no estimate worth the name was possible.

According to the financial statement covering the operations of the Victoria State Coal Mine, placed before Parliament by the treasurer of the state, a net profit of $201,000 was made for the year ended June 30. This compares with a declared profit of $48,000 in 1911-12, and $117,000 in 1910-11. In no case was the expenditure on any such items as shaft-sinking and development charged against revenue, nor was any provision made for depreciation before arriving at the net surplus profit. Receipts, including $12,000 on sundry account, came to $1,033,000, while working expenses included $791,000 for the raising and shipping of coal, and $30,000 for interest. Receipts were $68,000 in excess of the previous year and working expenses $94,000 less than those of 1911-12. As the output of coal declined from 470,261 tons to 457,653 tons, higher prices must be credited to sales, and it would be interesting to know what the Government Railway Department paid for the 266,880 tons it used. During the year the state treasurer made an appropriation for the mine of $261,000. Increases in expenditure in capital amounted to $177,000, making the total at which works, machinery, and plant stand, at cost, at $989,000. The total net profit to date, $367,000, has been appropriated to the sinking and depreciation funds. During the year, $136,000 was expended on head-frames, machinery, rails, ropes, plant, etc., bringing the total expenditure on these items up to $445,000; but whether the extra expenditure has been accompanied by a commensurate increase in the mine's capacity is to be doubted. There is a very marked tendency on the part of the Victorian government to show that the mine is a successful venture, and its figures are regarded with some suspicion.

REPUBLIC, WASHINGTON

WORK AT THE BEN HUR, SAN POIL, SURPRISE, AND QUILP MINES.—NEW DEVELOPMENT AT SHERIDAN.—DRILLING IN THE WOLF DISTRICT.

The Ben Hur Leasing Co. is to increase ore shipments from the Ben Hur mine to the smelters to 100 tons per day. The San Poil Consolidated Co. shipped, early this week, bullion valued at about $5000, which is the approximate value of the weekly shipments from the San Poil mill. In the Surprise mine the leasing companies are operating with fair profits. The McFarland Leasing Co. has two men employed and made its initial shipment. The Sharp Leasing Co., E. J. Delbridge, manager, has increased its machine drills by adding a heavy piston sinking drill for underhand stoping a large shoot of ore on the 500-ft. level, north of the incline shaft. This ore lies north of a fault, but driving and cross-cutting on the 600-ft. level has failed to disclose it. This Company will sink on it from the 500 to the 600-ft. level. At 500 ft. it is 7 to 12 ft. wide, averaging about $14 per ton. Nine carloads of ore was shipped on November 18 from the mine, part of which was broken by the lessees and part by J. L. Harper, who holds the mine under bond. The 700-ft. level is under development by Mr. Harper. A drift south of the incline shaft has opened the No. 2 oreshoot, which extends from the 600-ft. level 300 ft. south of the main incline shaft.

A new feature in the Quilp mine is the production of a specimen of ruby silver. The Anaconda Mining & Reduction Co. contemplating the erection of a cyanide plant for treatment of ore from the Republic mine.

Ore said to be worth $182 per ton in gold, silver, and copper has been opened in the Sheridan camp, although reports are conflicting at present. Several prospectors have gone from Republic and staked claims. The camp is old and may come to the front in time. It lies partly in Okanogan and partly in Ferry county, about ten miles westward from Republic.

The Boyle Brothers Diamond Drill Contracting Co., operating a drill at Wolf camp, 7 miles northeast of Republic, has suspended work for the season, owing to frost interfering, but will resume in the spring.

General Mining News

ALASKA

Juneau

On November 29 the following dividends were paid by the companies operating on Douglas island:

Company.	Dividend No.	Per share.
Alaska Mexican	72	$0.20
Alaska Treadwell	103	1.00
Alaska United	25	0.50

ARIZONA

Cochise County

It is probable that the Shattuck company will erect a blast-furnace to treat its lead ores, and so save the freight to El Paso.

According to Walter Douglas of the Copper Queen company, plans have been completed for a pension system among the employees of this Company. The benefits of the system will be enjoyed by employees who have been 15 years or longer in the service of the Company. Pensions will be provided not only for those who shall have attained the retirement age of 70 years, but also to those who, in the opinion of the Company, have become physically or mentally disqualified and for that reason are retired by the Company. At the present time there are 113 employees who have been on the payrolls of the Company for 15 years or more and who therefore can qualify for pensions. The amount of the annual pension will be 2% of the employee's annual salary for the three years of active service immediately preceding his retirement, multiplied by the number of years' service, with a maximum of 60% of such annual wages. Pensions will be granted up to $1000 as a maximum.

Gila County

It has been practically determined to alter the first five sections of the Miami concentrator, to conform with the sixth unit which now secures a two pound per ton better extraction than the rest of the plant. The treatment of mixed sulphide and oxide ores has been puzzling, and a 20-ton experimental plant will soon be started by the Miami company upon a new process, details of which are as follows: (1) Coarse crushing and removal of fine dust; (2) rough water concentration to take out coarse sulphide matter; (3) roasting of tailing from above; (4) leaching with sulphuric acid solution; and (5) precipitation of copper by electrolysis and regeneration of solution with sulphurous acid gas, solution then being used again for leaching.

Graham County

During October the Arizona Copper Co. produced 1775 tons of copper. Considerable progress was made during the month in getting the new furnaces into operation.

CALIFORNIA

Butte County

(Special Correspondence.)—The Ophir Gold Dredging Co. has about 10 acres of ground to treat before its second boat goes out of commission. This dredge has 5-cu. ft. buckets, 22 being dumped per minute, and the motors have a total of 280 hp. The Company owns its water-supply, which is procured from two wells drilled 118 ft. each, and one 116 ft., yielding 40 miner's inches of water per day. This is pumped to the dredge pond from the wells by a 4-in. centrifugal pump, driven by a 20-hp. motor. El Oro No. 2 dredge, with 5-cu. ft. buckets, is at present working in some tight ground. The bucket-line contains 93 buckets weighing 1400 lb. each. Instead of the usual revolving trommel, this boat is fitted with two shaking-screens, which do equally as good work as the revolving aparatus. Power consumed is from 240 to 300 amp. for the whole boat. The Oro Water, Light & Power Co. has four dredges in operation. One boat was changed from 5 to 6-cu. ft. buckets, using the same hull, and the gold-saving tables were increased. This change resulted in an increase of 20% in gravel handled. Over a period of five months the boat averaged 235 cu. yd. per hour. The other three 5-cu. ft. boats are cutting into a bank from 38 to 42 ft. high, of which 22 ft. is a clay overburden. They only average about 100

NATOMAS CONSOLIDATED ROCK-CRUSHING PLANT AT OROVILLE USING DREDGE TAILING.

cu. yd. of gravel per hour. Power is obtainable for all dredges in the field at 1c. per kilowatt hour.

Oroville, November 18.

In the Emma mine, worked some time ago by the Nimshew Gold Mining Co., a piece of quartz and gold, valued at $726, was extracted by O. H. Rugh during the past week.

Imperial County

(Special Correspondence.)—The new mill of the Imperial Reduction Co. is nearing completion, and should be in operation by the beginning of next year. This Company has a capital of $250,000, with its head offices at Pasadena.

Ogilby, November 22.

Inyo County

Salt Lake City people are interested in the Cerro Gordo mine at Keeler, and results are satisfactory. An ore-shoot 4½ ft. wide, containing 70 oz. silver, 4% copper, and 10% lead has been opened on the 700-ft. level, and 15 tons daily is shipped from it. Thirty men are employed. From an old slag dump on the property, 10 tons, yielding $16 per ton net, is also being shipped. Also 10 tons of high-grade zinc carbonate ore is mined daily. Lead ore is being sent out from the Christmas mine at Darwin, while the Custer, Lucky Jim, and Domingo mines are actively worked.

Kern County

(Special Correspondence.)—Every mine in the Amelia mining district has taken a new start, new operators have taken hold and are opening the various mines, milling, and shipping ore. Not for twenty years has there been such activity in this district, and all are satisfied. The Barbara Rosa, owned by Mr. Parlow, has been sold to Mr. Carr of San Francisco, and he is treating ore at the Amelia mill, which he has leased. The Cow Boy has changed hands and the owners are shipping ore. The Gold Peak property has been acquired by new people and they are opening good ore. Mr. Wilson, who took over the McKnight property, has installed new machinery and is to begin crushing a large tonnage of ore. The Zenda Mining Co. has been negotiating to sell its property and has begun work. J. B. Ferris has been running his arrastre on molybdenite and gold ore during the past year, and proving a large body of ore. He has water-power for the plant and power costs are low. A United States Government Geologist was recently sent to examine Mr. Ferris' molybdenite ore, and seemed much surprised that such a large tonnage has been opened, and took a number of samples for testing purposes.

Caliente, November 15.

Los Angeles County

A group of Sawtelle men are engaged in prospecting along Mariposa creek where a body of deep unworked gravel is said to be present.

Placer County

(Special Correspondence.)—The dredge on the American river, 7 miles from town, is working well on the river bars, and an ultimate capacity of 130,000 cu. yd. of gravel per month is anticipated. This boat has 7½-cu. yd. capac-

ity buckets, taken from Pacific No. 1 dredge at Oroville, while a new hull to withstand river floods was constructed.

Auburn, November 20.

SHASTA COUNTY

A suit will be brought by the Shasta County Farmers' Protective Association against the Mammoth Copper Co., at Kennett, on account of alleged damage to crops by smelter fume. This Company has bought the Spread Eagle group of 21 copper claims, lying four miles northwest of Copley.

At the Baker mine the shaft is down 85 ft., and is to be continued to 200 ft. depth, where cross-cutting will be done.

SIERRA COUNTY

(Special Correspondence.)—A two-compartment shaft is down 60 ft. at the Lee mine, near Sierra City. Good ore over a great width has been opened, and a 10-stamp mill is to be erected for prospecting work. Electric power will be used. Forty men are employed, and the property is controlled by R. G. Gillespie of Pittsburgh, Pennsylvania, C. D. McGonigal being superintendent. Both the Keystone and Chips mines are closed for the winter.

Sierra City, November 22.

At a distance of 2000 ft. from the portal of the main adit of the Tightner mine, at Alleghany, and 1100 ft. below the surface of the mountain, a 500-ft. shaft is being sunk on the lode. An electric hoist and pumps are to be installed.

SISKIYOU COUNTY

Gravel property on Greenhorn creek has been bonded by the Butte Dredging Co., which has had seven men prospecting, by shaft sinking, since last April. A dredge is to be moved from Oroville next spring to treat this gravel.

TRINITY COUNTY

The 20-stamp mill for the Globe Consolidated Mining Co., near Dedrick, is nearly complete. It includes an all-sliming cyanide plant. An aerial tramway 6000 ft. long has been constructed, also 6800 ft. of flume and 3700 ft. of 20-in. steel pipe for water power. The mines have plenty of ore opened. About 100 men are employed at present.

YUBA COUNTY

The Wonder mine in the Brownsville district is being developed by H. W. A. Docker. The vein is about ten feet wide, and an ore-shoot 400 ft. long at the surface has been followed to a depth of 45 ft. on this vein.

COLORADO

CLEAR CREEK COUNTY

(Special Correspondence.)—A mineral discovery of great richness has been made at the Lucas property on Democrat mountain, that surpasses anything of recent years in that section. The orebody is 2 ft. wide and at a depth of 12 ft. from the surface assays 1000 oz. of silver per ton. The vein is the east extension of the Polar Star, one of the early-day heavy producers. L. Lucas is owner. B. O. Bonham, leasing on the Paymaster mine in East Argentine district, has uncovered an 8-in. streak of smelting ore that assays 85 oz. silver, 1.75 oz. gold, and 19% copper. Operations are being prosecuted on the 600-ft. level, and machine-drills are being installed. Shipments will be started this month. Hanson & Co., leasing on the Independence vein at the Wilcox property, are sending out carload lots of ore that bring a mill settlement of 80 oz. silver, 2.30 oz. gold, and 18% copper. The product is being consigned to the smelter at Salida. A Temple electric drill has been purchased by the Rosebud M. & M. Co., controlling a big group of claims on Democrat mountain. Cross-cutting has been started 800 ft. from the portal of the upper adit, and the north extension of the Astor vein will be reached within the next 20 ft. G. W. Teagarden is manager. The Golden Glory adit on Saxon mountain has opened a vein 1580 ft. from the portal. The ore is 7 ft. wide and from numerous assays the average value of the ore is given at $18 per ton in gold and silver. Driving east and west has been started. J. F. Puchert, of Idaho Springs, is manager. Rendahl & Co., leasing on the 500-ft. level of the Anamosa mine, made a shipment of five tons of first-class ore last week, and returns of 187 oz. silver per ton were received. These lessees are stoping on a body of ore that is 14 in. wide.

Georgetown, November 18.

EAGLE COUNTY

Frank C. Goudy, F. B. Goudy, and L. L. Twitchell, on November 19 at Denver, filed with the Secretary of State articles of incorporation for the Horse Mountain Mining Co., capitalized at $50,000. The purpose of the Company is to purchase and develop certain mining claims in Eagle county.

GILPIN COUNTY

The French Flag mine, situated on the boundary line of Gilpin and Clear Creek counties, at the head of Gilson gulch, is proving to be one of the best properties of that district at the present time, and the operators, consisting of a pool of local men and Eastern capitalists, will make good profits out of it. About $90,000 of ore has been opened between the 135 and 235-ft. levels, while other levels are showing well. Shipments are made to Idaho Springs sampling works. In the lower Russell district the Two-Forty mine is opening well; Walter Flagler is manager. Rich gold, silver, and copper ore continues to come from the Pittsburg mine. At Black Hawk, 15 stamps of the Polar Star mill are being overhauled after being out of commission for some time.

GUNNISON COUNTY

The Revenue mine and mill, on Quartz creek, has been acquired by George T. Edwards, of Salt Lake City, Utah. A cyanide plant will be added and other changes made in the mill. The Elk Mountain Mines & Tunnel Co. is driving an adit to cut the veins in the old Copper Queen property, about ten miles from Crested Butte, and expects to reach them in about 400 feet.

LAKE COUNTY (LEADVILLE)

During the winter, the Mt. Champion, Miller Gold, and Lackawanna Bell mining companies will continue development in Lackawanna gulch. The zinc carbonate opened in the New Discovery, on Fryer hill, did not continue as rich as expected, and has been temporarily abandoned, pending work in other parts of the mine. Lessees and others at the Dinero, Seneca, Dunkin, Lovejoy adit, Little Ella, Castle View, and other mines are busy.

LAS ANIMAS COUNTY

Since the inception of the coal miners' strike there have been 18 lives lost. The operators refuse to meet representatives of the union who have been mixed up in the recent strike affrays. William B. Wilson, Secretary of Labor in the United States Government, is at Denver investigating the whole trouble.

SUMMIT COUNTY

Dredging in the Breckenridge district continues to produce large quantities of placer gold. The Bucyrus boat of the Colorado Gold Dredging Co., operated in Swan valley, near Swan City, recently shipped gold valued at over $11,000. This was the result of the last ten days of dredging in October. The boat is working its way through unusually rich gravel this year and will average an output of over $1100 in each 24 hours of actual operating time. The Reliance Gold Dredging Co.'s boat is working close to the junction of French creek with the Blue river, and is in rich gravel. The Reiling boat of the French Gulch Dredging Co. is being drawn along over the surface of French gulch with wire cables toward its new pit, which is about a mile upstream from the old one, from which the boat is said to have taken out rich gravel.

TELLER COUNTY (CRIPPLE CREEK)

The 400-ft. level of the Eclipse shaft, on the southwestern slope of Battle mountain, submerged and inaccessible for the past ten years, has been recovered by the pumps of the El Oro Mining & Milling Co., operating the mine, and of more importance to the stockholders of that Company, R. G. Mullen, who entered and made a casual examination, reports ore exposed awaiting development. An 11-drill compressor has been installed. The danger of a coal shortage at the mines is being reduced by the daily arrivals of this fuel. The Christmas Gold Mining Co. has

been awarded a judgment of $4074 against John T. Milliken, of the Golden Cycle Mining Co., on account of profits made out of a lease of the Christmas mine under a certain agreement. The Vindicator company controls this property now and is using the Golden Cycle company for alleged illegal extraction of ore. The El Paso Extension Gold Mines Corporation has been incorporated with a capital of 200,000 shares of $5 each. The properties to be developed lie south of the El Paso Consolidated's mine on Beacon hill.

The Neville mill, constructed by the Free Coinage Gold Mining Co., on its Bull hill estate, on which is situated the town of Altman, at an altitude of 10,728 ft., was started on November 20. The plant is of 100-ton capacity, includes a crusher, Hardinge mill, three Deister tables, slime plant, and Oliver filter. The mine has been well developed for continuous operation.

A new tube-mill and more powerful electric motor are to be added to the plant at the Colburn mill owned and operated by the Ajax Gold Mining Co. The November production will be about 7100 tons of ore. The mine is shipping ore to both custom and its own mill for treatment. The Kavanaugh mill is treating 75 tons per day of low-grade ore from the Joe Dandy dump. Water in the Gold Coin shaft of the Granite company is now 38 ft. below the 1100-ft. level, where promising development is under way. Fifteen feet of ore is being mined in No. 2 vein of the Pharmacist mine, on Bull hill, by the lessee, B. F. Hill. Without sorting, this ore averages about $13 per ton.

GEORGIA

The Jumbo gold mine at Dahlonega is showing well as a result of the development work of the year. A 10-stamp mill is busy crushing free-milling ore. The mine is managed by M. F. Burke, who recently returned to Boston, Massachusetts.

IDAHO

Bonner County

(Special Correspondence.)—Approximately $50,000 has been expended in the last year developing the old Webber mine, 5½ miles from Pend Oreille lake, 50 miles east of Spokane, now owned by the Pend Oreille Mining & Reduction Co., a corporation consisting principally of stockholders in Chicago, Illinois, and results are so promising that plans are being prepared for a concentrator, to be erected next summer, according to S. P. Donnelly, of Lakeview, one of the heaviest individual owners of the property. The formation now exposed in the lower workings of the mine is said to be similar to that in the large silver-lead producers in the Coeur d'Alene region. Work will be continued during the winter.

Spokane, November 22.

Lemhi County

From the shipment of 11 cars of ore from the Gilmore mine, in October, the net profit was $4400. Development work on the 350-ft. level continues to open ore of a better grade than that found between the 200 and 300-ft. levels, some of which assayed up to $40 per ton. During November an adit was started at the west end of the property and will be 1000 ft. long. No. 4 raise in the Martha vein is up 105 ft. in 7 ft. of gold-bearing ore containing a high percentage of iron. The new tramway, built jointly by the Gilmore and Pittsburg-Idaho companies, was recently completed, and has been running smoothly since put into practical use about two weeks ago. The tramway is now handling ores from both properties.

Shoshone County

Rescue car No. 5, of the U. S. Bureau of Mines, which has been about two months in the Coeur d'Alene district, has gone to Butte, Montana. Over 200 men have been instructed in first aid, and several in the use of oxygen helmets. J. M. Anderson, who is in charge of the car, expressed himself as well pleased with his trip to the Coeur d'Alenes and with the interest displayed by owners and miners. He states that the big mines have installed apparatus for successfully coping with accidents.

The 300-ton mill which the Federal Mining Co. is building at the Frisco mine, at Gem, has the framing up, and 32 men are rushing the building to receive equipment before the winter sets in. Eighty men are employed at the mine.

The Hecla Mining Co., operating at Burke, paid its regular monthly dividend of $20,000 on November 20.

MICHIGAN

Houghton County

The managements of Ahmeek, Allouez, North Kearsarge, Wolverine, and Mohawk companies announce that unless there is soon a substantial increase in men returning to work, they will close down for the winter.

MINNESOTA

St. Louis County

(Special Correspondence.)—The season for shipping ore has closed, and it is estimated that movements total approximately 45,000,000 tons. The finish was marked by one of the worst disasters in the history of the Great Lakes, when a storm caused the loss of over twenty steamers and about 250 lives. The property loss is estimated at $5,000,000. It is reported that the Mesaba electric railway, operating between Hibbing and Gilbert, will be extended next season from the latter place to Aurora on the east, and probably westward from Hibbing to Grand Rapids. The Pickando-Mather company has given up its lease on the Yankey mine at Virginia, and has taken the lease formerly held by the New York Steel Co. on the Kellogg mine at Biwabik, the latter Company having become bankrupt. The Cuyuna iron range is attracting a great deal of attention just now. Last week, a party including officials of the United States Steel Corporation, Oliver Iron Co., D. M. & N., and D. & I. R. railways, visited various mines of the district. A considerable number of drills are at work, and the ore-bearing area is being proved of greater extent. Some properties are being stripped by steam-shovels, and at the Rowe the overburden is being moved by hydraulicking. The Cuyuna range lies about 160 miles west of Duluth.

Duluth, November 16.

According to the estimates of the underwriters carrying the risks of the steamers and cargoes lost in the recent storms, the total loss to cargoes and vessels was about $8,500,000. Of the total, $2,000,000 was lost on cargoes and $3,500,000 on the vessels, which amounts to the insurance. The Great Lakes Protective Association carried about 25% of the total risk, the remainder being carried by American and British marine insurance companies.

NEVADA

Esmeralda County

An interesting decision has been handed down by Judge Somers, of the District Court, regarding the suit of the Goldfield Consolidated Milling & Transportation Co. *v.* the old Sandstorm Annex Gold Mining Co., W. H. Brock, E. S. Johnson, and A. Huyser, in which the plaintiff asks for a restraining order against the defendants who are removing tailing which has flowed from the Consolidated mill on to the defendants' ground, while the latter ask to have the temporary restraining order, issued earlier, dissolved. The whole question concerns the value of the tailing, and by concentration of metal content on the surface of dumps by natural processes, a rich product, up to $135 per ton, was being scraped off by the defendants. They stated that their object was to sample the dumps. The court decided that the defendants should be restrained from removing the tailing, except such as required for actual sampling for a condemnation suit now pending.

Humboldt County

The deal to consolidate the Nenzel Crown Point Mining Co., the Rochester Mining Co., and the Rochester-Weaver Mines Co. is practically completed. It is proposed that a new company, the Rochester Consolidated Mines Co., take over the three properties and develop them. The capital of the new corporation is to be $1,500,000, it is said. Mr. Nenzel, it is understood, owns the controlling interest in all three of the mines which are to be consolidated. He states that more than $265,000 in ore al-

ready has been taken from the mines. It was affirmed that the papers would not be signed until the first of December, and that the consolidation would go into effect January 1, 1914. Salt Lake and Ogden capitalists who have been interested in the consolidation plans include Mr. Nenzel, J. F. Cowan, John Dern, M. S. Browning, and Le Roy Eccles.

LINCOLN COUNTY

The Yuba Leasing & Development Co., which is operating in the old Raymond & Ely property at Pioche, made a trial shipment of ore last week, consisting of 210 sacks, 42 of which contained gold ore from the bottom of the Greenback winze. Development work on the property is opening some good ore.

LYON COUNTY

The Mason Valley Mines Co. has taken over the Montana-Yerington property, and will be thoroughly developed. An assay office has been installed near the mine.

The Nevada Douglas Copper Co. reports as follows for October:

Ore shipped, tons	4,522
Average copper content, per cent	6.45
Copper content, pounds	583,331
Gross revenue for month	$97,708

MINERAL COUNTY

The Aurora Consolidated company's new mill is almost under cover, and according to M. P. Kirk, of Kirk & Leavell, the plant should be finished by April of next year. There are 150 men employed at the mine and mill. The main adit is in 3200 feet.

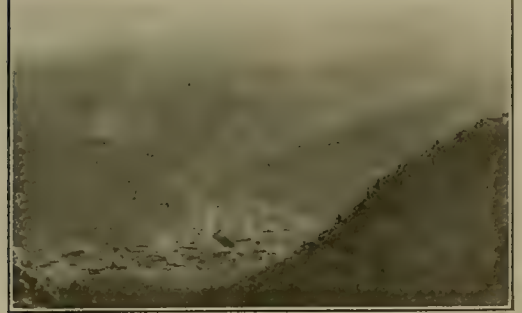
NYE COUNTY

Eleven mines at Tonopah produced 51,221 tons of ore worth $1,029,245 in October, some of the principal yields being as follows:

	Tons.	Yield.	Profit.
Belmont	15,233	$310,788	$187,333
Jim Butler	1,646	.....	6,109
Tonopah	15,043	234,475	134,100
West End	4,455	.....	40,108

WHITE PINE COUNTY

(Special Correspondence.)—A drill-hole put down recently by the Nevada Consolidated Copper Co. in the southwest part of Liberty pit, near the southwest corner of the



ELY, NEVADA.

Giroux company's Ora claim, passed through 240 ft. of overburden, then 560 ft. of ore. As there was no more casing on hand, drilling was stopped. It was supposed that there was no ore in this part, and close to the whole south end boundary of the Ora claim the Nevada Consolidated has proved ore for 500 ft. in depth. Drilling during the year is expected to show an increase of ore reserves of 10 to 20% over those of 1912. In some instances the position of the ore will necessitate the moving of dumps of overburden previously placed there.

Ely, November 19.

UTAH

JUAB COUNTY

The three-compartment shaft which is being sunk in the Eagle & Blue Bell property is progressing at the rate of about four feet per day, according to Imer Pett, general manager. The shaft when completed, will connect the 1350 and 1550-ft. levels, and will be completed before the first of the coming year.

TOOELE COUNTY

Since the announcement that a branch of the Western Pacific railway would be constructed from Wendover to the Deep Creek mining district, a distance of 40 miles, the field has become quite active. The Silver Bell mine will be developed during the winter, and the Dugway-Silver Bell has a dump of ore ready for shipment. In the Dugway district, the Dugway Bonanza Mining Co. is planning to resume work. The ore contains silver, lead, and gold.

CANADA

BRITISH COLUMBIA

On December 5 the Granby Mining, Smelting & Power Co. will pay a dividend of $1.50 per share, equal to a total of $225,000. This makes $1,000,000 for the current year, and a grand total of $4,767,043. During October the Grand Forks smelter produced 1,779,952 lb. of copper, 30,733 oz. silver, and 4108 oz. gold.

The Granby smelter treated 25,976 tons of ore during the second week of November, and shipped 436,000 lb. of blister copper.

No. 3 furnace at the British Columbia Copper Co.'s smelter at Greenwood is completed, but blowing in has been delayed through lack of coke and ore-cars. To October 1 the yield for the current year was 6,159,652 lb. copper, 89,088 oz. silver, and 18,021 oz. gold.

ONTARIO

During October the McKinley-Darragh-Savage mines produced 192,749 oz. silver from 5151 tons of ore. Vein No. 40 continues to yield rich ore, contributing 43,000 oz. to the total output. An application has been made by the Cobalt Lake Mining Co. to the mining commissioner, T. E. Godson, to fix an order for service parties to be served and time within which several defenses are to be filed for the draining of Cobalt lake. The application was filed in Toronto last week. This scheme will be far more extensive than the drainage of Kerr lake, as the town sewage and tailing from the Northern Customs, Cobalt Lake, McKinley-Darragh, and Nipissing mills flows into the lake at present. The application will probably be heard early in December.

At South Porcupine the Dome Lake mine has been sampled by two different companies during the past week. Veins on the 100 and 180-ft. levels were examined. The main shaft is down 220 ft., and is being sunk to 300 ft. It is stated that the North Thompson claim, at Porcupine, has been acquired by the Associated Gold Mines Co. of Western Australia.

YUKON

Gold production of the Canadian Klondyke company's claims during the weeks ended October 25 and November 1 was 2934 and 2879 oz., respectively.

KOREA

The October clean-up of the Oriental Consolidated produced $144,000. Details of the September report are as follows, there being 26,360 tons treated: Tabowie, $26,443; Candlestick, $5087; Candlestick cyanide, $1859; Kuk San Candlestock, $5087; Candlestick cyanide, $1859; Kuk San Dong cyanide, $6442; Kuk San Dong dump plant, $5583; Taracol tube-mill plant, $48,337; making a total of $131,834. As there have been neither summer nor fall rains this year, the country is very dry, and already there is trouble in getting sufficient water for the mills. The Nuchadagie pumping plant is working in order to furnish water for the Taracol plants. The electric power-plant is furnishing power for lights only, owing to lack of water. It was intended to start retimbering the Tabowie shaft from No. 5 to No. 7 level this month, but as the mill will have to be stopped this winter for lack of water, unless there are heavy rains soon, it has been decided to keep the mill going on the better grade of ore from the lower levels while there is still water, and the shaft will be retimbered later on. The net profit for the month was $33,110.

Personal

H. V. Winchell is in New York.

M. L. Requa has gone to New York.

P. R. Bradley was at Yuma last week.

John A. McPherson is in San Francisco.

J. A. Holmes was in New York last week.

Anthony F. Lucas was in New York last week.

A. E. Drucker is no longer with the French Concessions in Korea, and is expected in London.

Sir Robert Hadfield is on a brief visit to the United States.

R. H. Elliott has returned from the lower San Joaquin valley.

S. H. Ball expects to return to New York early in December.

Algernon Del Mar has gone to northern Ontario on business.

C. S. Herzig was in New York from Butte and has gone to Cobalt.

Willet G. Miller has been visiting New York and has returned to Toronto.

T. J. Grier is spending a holiday in the East and was in New York recently.

Alexander Adiassewich is visiting the dredging and oilfields of California.

Robert Linton was in New York last week and has returned to Los Angeles.

Carl A. Allen has been examining mines near Ely, Nevada, for the past month.

C. W. Merrill has returned to San Francisco after spending a holiday in the East.

W. H. Storms has gone to Sutter Creek for the West Eureka Mining Company.

J. W. Hutchinson was badly injured in a collision near Palisade, on November 21.

H. Foster Bain addressed the mining students at Stanford University last Tuesday.

Ernst Lichtenberg has returned to London from professional work in Nova Scotia.

Sumner S. Smith has returned to Juneau from a trip through the interior of Alaska.

D. C. Jackling is reported to be seriously ill aboard his private yacht *Cypress*, off Seattle.

A. H. Burroughs is visiting California dredging fields on his way from Nome to New York.

Frank A. Bowman has been appointed engineer for the Franklin and Kinney iron mines near Duluth, Minnesota.

Charles H. Lee has removed to 1103 Central building, Los Angeles, where he will continue his practice as a civil and hydraulic engineer.

W. O. Pray, superintendent and manager of the Lockwood-Blazing Star mines at West Point, California, was in San Francisco last week.

R. B. Lamb, of Toronto, has gone north on a professional business trip through the Cobalt and Porcupine mining districts and will return about the end of this month.

Carlo Spruyt has returned to Antwerp after an extended trip through the Western United States following the Alaskan excursion of the International Congress of Geology.

George Blanchin, of Paris, France, treasurer of the Central Eldorado Gold Mining Co., is in California on his annual inspection of the Company's properties in Eldorado county.

William J. Priestly, Jr., formerly superintendent of the Alaska Treasure mine, at Juneau, and of Rhoades-Hall mine, Fairbanks, is now in charge of the Latouche Alaska Gold Mining Co.'s property at Latouche, Alaska.

Harold D. Tompkins, formerly with the Niles-Bement-Pond Co., of Philadelphia, has accepted the position of mechanical engineer with the Smooth-On Mfg. Co., of Jersey City, New Jersey. He will have charge of the concrete water-proofing department.

Decisions Relating to Mining

Mortgagor in Possession May Work Mine

Where mining property is mortgaged to secure bonds issued by the corporation owning it, both the corporation and the lessees have the right to work the mine reasonably and properly, even though this results in its exhaustion; the rights of the parties being similar to those of a life tenant and reversioner.

Young *v.* Haviland (Massachusetts), 102 N.E., 338. May 24, 1913.

Amendment of Paragraph 89, Mining Regulations.

Paragraph 89, Mining Regulations, Department of the Interior, has been amended so as to provide that the charge for publication of notice of application for patent shall, except in Alaska, be no greater than the rate established by the laws of the several states for publication of legal notices, and shall not exceed in any event $7 for each ten lines of space in a daily publication or $5 for the same space in a weekly publication.

42 Land Decisions, 204. June 23, 1913.

Abandoned Oil Well—Failure to Plug

A person who drills an oil well and then abandons it without plugging it, so that water rises in the well, enters the oil and gas-bearing sand, and causes the gas flow from a well on adjacent land to cease, is liable to the owner of the land on which the adjacent well is situated for damages both on the common law theory that he has used his own property in such a negligent manner as to injure his neighbor, and upon the further grounds that he has violated a state statute requiring that abandoned wells be plugged.

Atkinson *v.* Virginia Oil & Gas Co. (West Virginia), 79 Southeastern, 647. Sept. 23, 1913.

Millsite—Mining or Milling Purposes

The use of a millsite as a location for a blacksmith shop and tool house, in which are stored tools, machinery, etc., necessary to run a tunnel upon the mining claim in connection with which the millsite was taken, and as a storage place for supplies needed in development work upon such mining claims, constitutes a use and occupation of the land for 'mining and milling purposes,' such as will entitle it to a millsite patent. Section 10 of the Act of May 14, 1898, reserving a 60-ft. roadway along the shore line of navigable waters in Alaska, contemplates the reservation of only an easement for highway purposes, and is no bar to the location of claims to the water's edge, subject to the roadway easement.

Alaska Mildred Gold Mining Co., 42 Land Decisions, 255. July 23, 1913.

Mining Contract—Held Not to be Option

A contract for the sale of certain mining claims provided that the first party agreed to sell and the second parties agreed to buy claims described in the agreement. Total purchase price was to be $30,000; $25,000 of which was to be paid as royalties from the output of the mines. No time was set for the commencement or prosecution of work. The second party did not go into possession, it was alleged, nor work the properties. Suit was brought for the total purchase price after lapse of a reasonable time. The court held that this was a binding agreement, not an option; that the fact that the contract called for royalties did not affect its nature as a contract of sale; that it was implied that the claims sold contained minerals, and if they did not the burden was on the purchaser to prove it as a defense; that it was understood that work must be commenced within a reasonable time by the purchaser.

Pritchard *v.* McLeod (Alaska), 205 Federal, 24. May 5, 1913.

Recent Mining and Metallurgical Patents

1,073,381.—Utilizing Fine Ores, Flue Dust, and the Like. Hartley C. Wolle and Edward F. Kenny, Westmontborough, Pennsylvania. Adjusting the moisture therein to make the material semi-coherent and then compacting same into flakes by rolling pressure.

1,073,523.—Manufacture of Sodium Alloys. Edmund Charles Rossiter, Birmingham, England, assignor to the British Cyanides Company, Ltd., London, England. Heating together a mixture of sodium hydrate, carbon and a metal, and agitating the mixture while thus heated.

1,073,461.—Process for the Separation of Lead and Zinc. Jules Babé, Honfleur, France. A process for the separation of lead and zinc contained in mixtures or combinations of salts or oxides of these metals, which consists in sulphuretting the lead in the presence of a volatile reducing agent at a temperature below that at which the zinc is affected.

1,074,999.—Method and Apparatus for Magnetic Separation. Oscar Alfred Zander, Stockholm, Sweden. Arranging ore in a series of overlapping layers or strata and traveling a magnetic field of force transversely of said series and in a direction substantially parallel to that in which the ore is fed to form the layers for separating out of the orebody the magnetic particles thereof.

1,076,397.—Ore Separator. Hiram J. Stewart and James S. Tucker, Canton, Ohio. A bottom board having its upper face flat excepting for transverse grooves cut therein, the grooves having upright front walls and beveled rear walls, and fabric strips secured across said beveled rear walls, and fabric strips secured across said beveled walls near their juncture with said flat face; and upright sides at the edges of said board.

1,078,199.—Method of Extracting Manganese from Its Ores. Friedrich Heusler, Dillenburg, Germany. A method of extracting metallic manganese from its ores which consists in first preliminarily calcining a portion of the manganese ore at a red heat, then proportionately mixing together a quantity of the calcined ore with a quantity of crude uncalcined ore, and subsequently subjecting this mixture to a reducing process.

1,076,700.—Ore Concentrator. Frank Picone, Tombstone, Arizona. A table having a plurality of parallel transversely disposed riffles upon its upper surface and a second series of riffles arranged between and extending at right angles to said first named riffles, said latter riffles projecting above the upper edges of the transverse riffles and each having one end spaced from the contiguous transverse riffle, and means for reciprocating said table.

1,077,628.—Electrolytic Condenser. Ralph D. Mershon, New York, New York. The combination with an electrolytic condenser, of a transformer connected to the condenser electrodes, means electrically connected with the transformer and the electrolyte to provide an undirectional electromotive force opposing that between the electrolyte and the transformer, and an independent source of electromotive force in parallel with said means.

1,073,432.—Process for Preparing Electrolytes for Use in the Deposition of a Metal or Metallic Alloy. Pascal Marino, London, England. First making a suitable aqueous solution containing a salt of the metal to be deposited, then adding a suitable organic reducing agent to the solution, then heating the resulting liquid and finally, when said liquid has cooled, adding to it a suitable organic reducing agent, substantially as and for the purpose described.

1,075,409.—Treatment of Ores. Nicolas Henri Marie Dekker, Paris, France. Mixing with the dry ore in a closed container, a reagent comprising a metallic sulphate and concentrated sulphuric acid, maintaining the temperature of the mixture above normal to preserve liquifaction of the reagent, agitating the mass until the non metallic ore constituents are dispelled, adding water to the residue to form a solution, and separating the metals from the solution thus formed.

1,073,462.—Process and Apparatus for Treating Sulfride Ores. Ernest Edmund Banes, Strathfield near Sydney, New South Wales, Australia. Manufacturing sublimed white lead, consisting essentially in projecting pulverized lead sulphide mixed with a substantially oxygen free, combustible hydrocarbon gas through a surrounding layer or stratum of oxygen-containing gas into a heated oxidizing atmosphere and separating the sublimate from the fume gases.

1,078,520.—Ore-Separator. Fritz Oscar Stromborg, Seattle, Washington. A dry separator consisting of the combination with a fixed horizontal case, having openings at its extremities and in its bottom, and hoppers beneath the latter, of a feeding mechanism for tossing the material to be treated into the rear end of the casing, means for adjusting the angle at which this material is delivered, and means for delivering a blast of air into the opening in the front end of the casing.

1,077,418.—Mining Machine. Edward McGowan, Mulberry, Kansas. Carrying means adapted to be freely moved forward during the operation of the machine, cutting means adapted to cut a kerf in the wall of a mine, and supporting means pivoted to the carrying means and carrying the cutting means and having a guard adapted to travel along and bear against the wall of a mine, the bearing surface of said guard being an arc the centre of which is the axis on which the supporting means swings.

1,077,297.—Mineral Separator. Marion L. Porter, Silverton, Colorado. A tank provided with an outlet at its upper edge, radially disposed supporting bars fixed at their outer ends to the wall of said tank, a spirally wound plate arranged in said tank, stirrup members depending from said bars and engaging the lower edge of said plate to support the same, and, a deflecting plate fixed to said spiral plate and to the wall of the tank to direct the mineral bearing water through the outlet of said tank.

1,073,468.—Furnace for Smelting and Refining Ores. William Martin Bowles and Charley Osker Allen, Shawnee, Oklahoma. A furnace, means for producing a series of arcs, means for introducing ore above said arcs, a tube leading from said furnace for condensing the metallic vapors, a screw conveyer for scraping the walls thereof and for forcing the condensed product out of said tube, an air jacket surrounding said screw conveyor, an opening into said air-jacket beneath said tube, and a burner disposed at the mouth of said opening for heating the air in the air jacket.

1,075,093.—Cyclic Process of Extracting Metals from Cupriferous Materials. Albert Davis, Brooklyn, New York, assignor to Midland Ores & Patents Co., New York, New York, a corporation of Maine. The cyclic process of extracting metals from cupriferous materials, which consists in leaching the material with a solution containing a ferric salt, precipitating the dissolved copper by electrolytic iron, electrolyzing the spent solution under conditions to precipitate iron in highly reactive form and to regenerate the solvent and repeating these operations with other charges of material, utilizing said regenerated solvent as leaching agent.

1,073,543.—Electric Deposition of Metals by Fusion. Arthur Percy Strohmenger, Westminster, London, England, assignor to Slaughter & Co., Ltd., London, England. A process of depositing metal by means of the electric arc, which comprised connecting the work to one pole of a source of electricity, placing above the line along which metal is to be deposited and at an agle to the work a metal electrode coated with insulating material adapted to act as a slag when fused, connecting this electrode to the other pole of the source of current, striking an arc between the work and the end of the electrode, and pressing this end of the electrode down on to the work throughout the continuance of the arc.

The Metal Markets

LOCAL METAL PRICES

San Francisco, November 26.

Antimony	10—10½c	Quicksilver (flask)	$40
Electrolytic copper	17¼—17½c	Tin	44—45½c
Pig lead	4.50—5.45c	Spelter	7—7¼c

Zinc dust, 100 kg. zinc-lined cases, 7½ to 8c. per pound.

EASTERN METAL MARKETS

(By wire from New York.)

NEW YORK, November 26.—Greater confidence is being felt in the condition of the copper market and the general feeling is that it has reached bottom and that an upward movement will follow. Copper stocks are generally low and but little trading is reported. The lead market is weak. The demand is light and prices are generally lower. The buyers are taking only small quantities for immediate delivery and the stocks in the consumers' hands are reported as low. The producers are optimistic, as there is nothing tending toward an increased output. Wet weather in the Joplin district has impeded operations to some extent.

SILVER

Below are given the average New York quotations, in cents per ounce, of fine silver.

Date.		Average week ending	
Nov.	20	Oct. 15	61.12
"	21	" 22	61.14
"	22	" 29	59.98
"	23 Sunday	Nov. 5	59.52
"	24	" 12	59.62
"	25	" 19	59.26
"	26	" 25	58.20
			58.37

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	56.25	63.01	July	60.67	58.70
Feb.	59.06	61.25	Aug.	61.32	59.32
Mch.	58.37	57.87	Sept.	62.95	60.53
Apr.	59.20	59.26	Oct.	63.16	60.88
May	60.88	60.21	Nov.	62.73	....
June	61.29	59.03	Dec.	63.38	....

The sources of silver in 1912, according to H. D. McCaskey of the U. S. Geological Survey, were as follows: Placers, 163,955 fine oz., mainly in Alaska and California, recovered by refining placer gold. The yield from dry and siliceous ores was 26,363,436 oz. Colorado, Nevada, and Utah made large increases, while there were decreases in Montana, New Mexico, and Texas. From copper ores the output was 18,744,661 oz. This is recovered from electrolytic refining of Lake and blister copper, the product of smelting. Montana, Utah, and Arizona were the largest producers. From argentiferous lead ores the yield was 16,632,377 oz., there being increases in Idaho, Utah, Colorado, and Nevada, that from Arizona showing a decrease. Argentiferous zinc ores spplied 664,421 oz., mainly from Montana and Colorado. Lead-zinc ores yielded 2,810,939 oz. from Utah, Idaho, and Colorado. Copper-lead and copper-lead-zinc ores gave 654,596 oz. from Colorado, Utah, and Montana.

COPPER

Quotations on copper as published in this column represent average wholesale transactions on the New York market and refer to electrolytic copper. Lake copper commands normally from 1-5 to 1-4c. per lb. more. Prices are in cents per pound.

Date.		Average week ending	
Nov.	20	Oct. 15	16.11
"	21	" 22	16.38
"	22	" 29	16.55
"	23 Sunday	Nov. 5	16.25
"	24	" 12	15.54
"	25	" 19	15.08
"	26	" 25	14.62
			14.60

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	14.09	16.54	July	17.19	14.21
Feb.	14.08	14.93	Aug.	17.49	15.42
Mch.	14.68	14.72	Sept.	17.56	16.23
Apr.	15.71	15.22	Oct.	17.32	16.31
May	16.03	15.42	Nov.	17.31	....
June	17.23	14.71	Dec.	17.37	....

The copper market had a steady downhill sag last week. At the beginning of the week one of the large consumers predicted that buying would soon be resumed, but not in large amounts, since consumption has in some cases shrunk 25 to 50%. The amounts sold during the week, however, were so small that by November 21 dealers were offering copper at 15c. without eliciting much buying even from abroad. The outlook for cheaper copper is very rosy—to the consumer. The strike at Rio Tinto has been settled and production in most districts in this country is at high levels. Observers of general market conditions predict that there will be no marked general advance in business prosperity until the second quarter of 1914. If this is true, copper is likely to reach considerably lower price levels. Copper exports between November 1 and 20 were 20,734 tons.

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.		Average week ending	
Nov.	20	Oct. 15	4.40
"	21	" 22	4.35
"	22	" 29	4.35
"	23 Sunday	Nov. 5	4.20
"	24	" 12	4.19
"	25	" 19	4.18
"	26	" 25	4.13
			4.13

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	4.43	4.28	July	4.71	4.35
Feb.	4.03	4.33	Aug.	4.54	4.60
Mch.	4.07	4.32	Sept.	5.00	4.70
Apr.	4.20	4.36	Oct.	5.08	4.37
May	4.20	4.34	Nov.	4.91	....
June	4.40	4.33	Dec.	4.20	....

ZINC

Zinc is quoted as spelter, standard Western brands St. Louis delivery, in cents per pound.

Date.		Average week ending	
Nov.	20	Oct. 15	5.28
"	21	" 22	5.10
"	22	" 29	5.25
"	23 Sunday	Nov. 5	5.13
"	24	" 12	5.09
"	25	" 19	5.05
"	26	" 25	5.08
			5.08

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	6.42	6.88	July	7.12	5.11
Feb.	6.50	6.13	Aug.	6.96	5.51
Mch.	6.57	5.94	Sept.	7.45	5.55
Apr.	6.63	5.52	Oct.	7.36	5.22
May	6.68	5.23	Nov.	7.23	....
June	6.88	5.00	Dec.	7.09	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California, being the largest producer The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending			Nov. 12	39.00
Oct.	29	40.00	" 19	39.00
Nov.	5	39.00	" 25	40.00

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	43.75	39.37	July	43.00	41.00
Feb.	46.00	41.00	Aug.	42.50	40.50
Mch.	46.00	40.20	Sept.	42.12	39.70
Apr.	42.25	41.00	Oct.	41.50	39.37
May	41.75	40.25	Nov.	41.50	....
June	41.30	41.00	Dec.	39.75	....

TIN

New York prices control in the American market for tin since the metal is almost entirely imported. San Francisco quotations average about 5c. per lb. higher. Below are given average monthly New York quotations, in cents per pound.

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	42.53	50.45	July	44.25	40.70
Feb.	42.96	49.07	Aug.	45.80	41.75
Mch.	42.58	46.95	Sept.	48.64	42.45
Apr.	43.92	49.00	Oct.	50.01	40.61
May	46.05	49.10	Nov.	49.92	....
June	45.76	45.10	Dec.	49.80	....

AT a recent meeting of the nitrate of soda producers held in Iquique, it was agreed to reduce the production by 19% for the next six months. The decrease in consumption which has warranted this action on the part of the nitrate producers is attributed to the Balkan war.

STATISTICS recently compiled show that during the past twenty-five years the mineral production of Canada has increased from $2.23 per capita to $18. Next to agriculture, mining is the greatest wealth producer of the Dominion.

The Stock Markets

SAN FRANCISCO STOCKS AND BONDS

(San Francisco Stock and Bond Exchange.)

BONDS

November 25.

Listed.	Bid	Ask	Unlisted.	Bid	Ask
Associated Oil 5s	——	99½	General Petroleum 6s	$——	82½
E. I. du Pont 4½s	——	84	Natomas Con. 6s	——	50
Natomas Con. 6s	——	70	Pac. Port Cement 6s	90½	——
Unlisted			Standard Cement 4½	90	——
Ass. Oil 5s	75	——	Santa Cruz Cement 6s	83	87½

STOCKS

Listed.	Bid	Ask	Unlisted.	Bid	Ask
Amalgamated Oil	77	——	Mascot Copper	——	2½
Associated Oil	38½	——	Noble Electric Steel	2½	——
Giant	86½	90	Natomas Consol	——	5½
Pac. Cst Borax, com	60	87½	Pacific Port. Cement	63½	70
Pacific Crude Oil	——	.85c	Riverside Cement	50	——
Sterling O. & D.	85c	——	Santa Cruz Cement	——	45
Union Oil	75	——			

NEVADA STOCKS

(By courtesy of San Francisco Stock Exchange.)

San Francisco, November 26.

Atlanta	$ .09	Mizpah Extension	$ .35
Belcher	.39	Montana-Tonopah	.99
Belmont	7.50	Nevada Hills	.50
Big Four	.15	North Star	.50
Cash Boy	.06	Ophir	.19
Florence	.20	Pittsburg Silver Peak	.37
Goldfield Con.	1.40	Round Mountain	.36
Goldfield Oro	.08	Sierra Nevada	.06
Halifax	1.35	Tonopah Extension	1.45
Jim Butler	.70	Tonopah Merger	.58
Jumbo Extension	.08	Tonopah of Nevada	6.00
MacNamara	.09	Union	.12
Mexican	1.20	West End	1.20
Midway	.38	Yellow Jacket	.30

COPPER SHARES—BOSTON

(By courtesy of J. C. Wilson, Mills Building.)

November 26.

	Bid	Ask		Bid	Ask
Allouez	$ 30½	31	Mohawk	$ 38½	39
Ariz. Commercial	4¼	4⅜	Nevada Con.	14⅜	14⅝
Butte & Superior	27½	27⅝	North Butte	23½	23⅝
Calumet & Arizona	61½	61⅝	Old Dominion	47	48
Calumet & Hecla	395	400	Osceola	68	70
Copper Range	33⅛	34	Quincy	54	56
Daly West	2½	2⅝	Shannon	6½	6¾
East Butte	9⅜	10	Superior & Boston	2⅜	2⅝
Franklin	2⅜	3⅛	Tamarack	26	26½
Granby	69½	70	U. S. Smelting, com.	37	37½
Greene Cananea	28	29	Utah Con.	7⅛	7⅜
Isle-Royale	16½	16¾	Winona	1⅜	1⅝
Mass Copper	2	2¼	Wolverine	40	41

NEW YORK CURB QUOTATIONS

(By courtesy of E. F. Hutton & Co. Kohl Building.)

November 26.

	Bid.	Ask.		Bid	Ask
Braden Copper	6⅝	6¾	Mason Valley	3	3½
Braden 6s	135	140	McKinley-Dar.	1¼	1⅜
B. C. Copper	2¼	2½	Mines Co. Am.	2	2¼
Davis-Daly	1½	1¾	Nipissing	7⅜	8⅛
Dolores	2	4	Ohio Copper	⅜	½
El Rayo	1	2	San Toy	15	20
Ely Con.	2	5	Sioux Con.	1	2
First Nat.	2⅛	2⅜	So. Utah	¼	⅜
Greene Can.	6	7	Tri Bullion	⅛	¼
Giroux	75c.	1.00	Tuolumne	¾	1
Iron Blossom	1⅛	1¼	United Copper	¼	¾
Kerr Lake	4½	4⅝	Wettlaufer	7	8
La Rose	1⅞	2	Yukon Gold	2	2¼

NEW YORK STOCK EXCHANGE

(By courtesy of J. C. Wilson, Mills Building.)

November 26.

	Bid	Ask		Bid	Ask
Alaska G. M.	$ 18⅞	19	Miami	21⅛	21⅜
Amalgamated	70⅜	70½	Nat. Lead	43½	44⅛
Anaconda	34	34½	Quicksilver, com.	1⅞	2
A. S. & R.	62	62½	Ray Con.	17⅜	18
Calif. Pet.	16⅜	17⅛	Tenn. Copper	28	28½
Chino	38½	38⅝	U. S. Steel, pfd.	104½	105
Guggenheim Ex.	44½	——	U. S. Steel, com.	55⅞	56
Mexican Pet	45⅜	46⅛	Utah Copper	48¼	48½

LONDON QUOTATIONS

(By cable, through the courtesy of Catlin & Powell Co., New York.)

November 26.

	£	s.	d.		£	s.	d.
Alaska Mexican	1	12	6	Kern River Oilfields	0	6	3
Alaska Treadwell	8	5	0	Mexico Mines	5	10	0
Alaska United	1	12	6	Messina	1	8	9
Arizona	1	17	6	Oroville*	0	12	6
California Amalg.	0	1	3	Pacific Oilfields	0	2	6
California Oilfields	6	0	0	Rio Tinto	71	5	0
Camp Bird	0	15	0	Santa Gertrudis	0	17	6
El Oro	0	13	9	Stratton's	0	2	6
Esperanza	1	1	3	Tanganyika	2	2	6
Granville	0	11	3	Tomboy	1	6	3

*January quarterly dividend 6d.

AUSTRALASIAN

November 26.

	£	s.	d.		£	s.	d.
British Broken Hill	1	18	9	Mount Boppy	0	16	9
Broken Hill Prop.	1	15	0	Mount Elliott	4	2	6
Golden Horse-Shoe	2	10	0	Mount Lyell	1	5	6
Great Boulder Prop.	0	18	9	Mount Morgan	3	8	0
Ivanhoe	2	16	9	Waihi	3	0	0
Kalgurli	1	10	0	Waihi Grand Junc.	1	7	6

Company Reports

NEVADA WONDER MINING COMPANY

This Company operates at Wonder, Churchill county, Nevada, and the report covers the fiscal year ended September 30, 1913. Results may be summarized as follows:

Development, feet	7,150
Total to date, feet	18,640
Material hoisted, tons	50,114
Ore milled, tons	39,118
Total value	$572,359
Extraction, per cent	93.2
Metals recovered:	
Gold, ounces	8,738
Silver, ounces	587,211
Value	$535,661

The Company controls a subsidiary concern, called the Churchill Milling Co., and the combined income account is as follows:

Nevada Wonder Mining Co.	$ 58,662
Churchill Milling Co.	175,463
Total	$234,126
Dividend of 10% paid May 20, 1913	140,669
	$ 93,457
Surplus at September 30, 1912	622,396
Total	$715,853
Depreciation	124,630
Surplus at September 30, 1913	$591,223

Of the surplus, $113,824 is in cash.

The mine superintendent, J. A. Burgess, states that the year was marked by increased development work, as well as an increase in ore sent to the mill. The main shaft was sunk three compartments wide from the 700 to 1030-ft. level, and enlarged to three compartments from former level to the surface. The shaft was timbered with 8 by 8-in. Oregon pine. The greater part of development was done on the 500, 600, and 700-ft. levels. At 800 ft. the cross-cut has been started toward the vein from the shaft, and on the 1000-ft. level the cross-cut has cut the vein and a north drift has been started. The mine generally is in good condition. Several improvements in equipment were made.

THE largest tree in the United States is said to be the 'Mother of the Forest,' a giant redwood in the Calaveras big tree grove in California. It is supposed to contain 140,619 board feet of lumber. There are, however, many claimants for the honor of being the 'largest tree' and the 'oldest tree,' and these claims, according to foresters, cannot always be verified.

Concentrates

Most of these are in reply to questions received by mail. Our readers are invited to ask questions and give information dealing with the practice of mining, milling, and smelting.

FRUE VANNERS make from 180 to 200 strokes per minute, and the belt travel is from 2 to 6 ft. per minute.

FUME from smelting furnaces will not attack the tubes of waste-heat boilers built in flues, unless the temperature drops very low.

TIMBER MEMBERS of a dredge, which are subjected, alternately to wet and dry, should be sheathed with light sheet iron to prevent this occurring, which results in rotting.

UPPER YUKON steamers carried 1935 passengers from Dawson to White Horse this season. The low rates obtaining led many people to 'come out' this fall who had been in the interior since the discovery of gold.

FRESHLY SLAKED LIME has a much better action on colloidal matter in ores than lime which has been atmospherically slaked over a long period of time, or which has been artificially slaked some time before.

AEROLITES are defined as masses falling to the earth from celestial space. During their flight through the sky such bodies are called meteors and the pieces which fall are meteorites or aerolites (air-stones) or uranoliths (heaven stones).

MOUNT KATAHDIN, in Piscataquis county, Maine, has an elevation of 5200 ft., and is the highest mountain in the state, according to the United States Geological Survey. The average or mean elevation of the entire state of Maine is 600 ft. above sea-level.

OLD IRON RAILS may be used to advantage to protect the sides and bottom ore-bins, where the ore is dumped in from a skip a considerable height above down a chute. Iron or steel plates cut through fairly fast from such impact; but the rails have a long life.

ACID MINE WATER, containing copper, readily attacks rails, bolts, water-tanks, and other things made of iron, which should be kept painted by some acid-resisting paint. The well known P. & B. paint has been very satisfactory for this purpose at the Penn mine, California.

ANNOUNCEMENT has been made at Washington that hereafter certificates will be issued upon final proof in the case of application for patent on mineral claims. This will relieve the applicant from doing assessment work during the time that the Field Division is examining the ground.

SAMPLING ORE from a rock-crusher may be simply and satisfactorily done by punching a few 1½-in. holes at one place in a conveyor-belt which is carrying the ore to bins. The sample falls into a chute, and is further automatically cut down as it falls over several grids as used in an assay office.

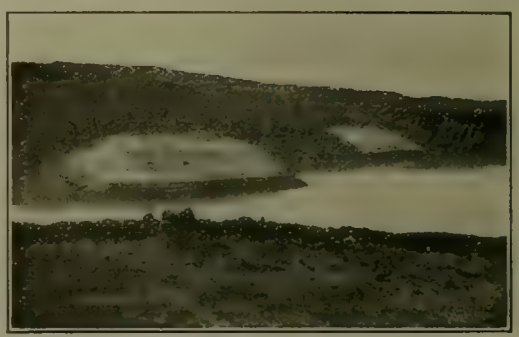
SINCE mining began in Alaska in 1880 the gold placers of the territory have yielded 7,488,491 fine ounces of gold, valued at $154,800,875. These mines have also produced 1,652,016 fine ounces of silver, with a commercial value of $960,743, according to A. H. Brooks, of the United States Geological Survey.

CONCENTRATE in the collecting boxes in front of vanners, at some mills on the Mother Lode of California, is drained or settled by an attachment to the vanners, which by a few levers, knocks the side of the box or trough for a few minutes. The water collects at one end and is then bailed out, and the hammer taken to another machine.

THIRTY-EIGHT gold dredges were operated in Alaska in 1912, compared with 27 in 1911, according to the United States Geological Survey. In addition to these, a dozen or more were in various stages of construction. It is estimated that these dredges handled between 3,200,000 and 3,600,000 cu. yd. of material, recovering gold to the value of about $2,200,000.

LOUISIANA is an important producer of rock salt, in which it ranks second among the states. The salt mines underlie so-called islands, which are really mounds rising above the marsh lands along the Gulf shore in Iberia Parish. The Petite Anse mines, on Avery island, were operated during the Civil War, having been developed in a small way in 1862. These mines were flooded twice, and a new shaft was sunk in 1899. Mining on Weeks island began in 1902. In the value of the total production of salt, which includes the product evaporated from brine, Louisiana ranks sixth among the states.

DISPOSAL of gravel, soil, and sand from a dredge usually results in the gravel being on top as in the half-tone. This is the reverse of what is wanted for resoiling dredged land, the gravel should be on the bottom and the soil on the top, so that it could be easily spread over the gravel.



A PARTLY DRAINED DREDGE POND, SHOWING HOW THE STACKER LEAVES THE FINE AND COARSE TAILING.

FATALITY RATES among coal mines in a number of foreign countries covering a period of ten years, 1901 to 1910 inclusive, are as follows, according to figures collected by F. W. Horton, for the U. S. Bureau of Mines: Great Britain, 1.36 per 1000 men employed; Germany, 2.11; France, 1.69; Belgium, 1.02; Japan, 2.92; Austria, 1.04; India, 0.96; New South Wales, 1.74; Nova Scotia, 2.65; while the rate for the United States was 3.74. The low fatality rates in the foreign countries is accounted for largely by reason of the fact that coal-mine inspection has been in operation much longer than in the United States. In Great Britain the coal mine accident statistics have been collected, published, and studied since 1851. France, 1853; Austria, 1875; Germany, 1852; and Belgium, 1831.

MILL improvements at the Tomboy mine, Colorado, during the year ended June 30, 1913, consisted in substituting another Wilfley table for a Deister slimer in the grading plant, and moving the latter table to the main concentrator floor; the 12 Frue vanners being at work since 1902 were worn out, and replaced by a similar number of Deister No. 3 slimers; and coarser screens were fitted to the batteries. That portion of the coarse pulp that is sent to the middling plant is reground by two Hardinge conical mills, but this has had a tendency to decrease rather than improve the recovery of free gold by amalgamation. To maintain and perhaps raise the present high capacity of the mill, and secure the best results from amalgamation and concentration due to finer crushing, an installation of two additional Hardinge mills below the batteries is contemplated. Recent experiments, by flotation and electrostatic processes, promise higher recoveries and higher prices for the zinc-middling product. The dewatering plant did good work, and the Dorr settling tanks are fitted with a device, consisting of an additional set of blades and a false bottom, which almost doubles the capacity of each tank. This is to be tried at an early date.

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EDITORIAL

NOVEMBER copper production of the Anaconda company is announced as 25,250,000 pounds, the largest since May. The Phelps-Dodge output was 12,556,000 pounds, a slight decrease from the average for recent months.

COLUMBIA UNIVERSITY is to go into mining as well as training miners, having leased a property near Roxbury Station, Connecticut. As the rental is placed at $1 per year, we suspect that more notes than ore will come up from the shaft.

FILING of a suit against the Golden Cycle Mining Company, by Mr. Charles Butters, with a demand for damages for infringement of filter patents, illustrates the complicated nature of filter-patent litigation at present. The Golden Cycle company recently settled with the Moore Filter Company and now must meet the claims of Mr. Butters. The whole situation illustrates again the unsatisfactory condition of our patent laws.

DECISION by the United States Supreme Court to the effect that in calculating the amount of the corporation tax no deduction should be made for depreciation resulting from mining ore, applies only to the old act. The new income tax, levied in connection with the revision of the tariff law, allows a deduction for depreciation in the case of mining companies of "a reasonable amount not exceeding 5 per cent." Those interested will find details under sub-sections A_2 and G_4 of the tariff law. Further details regarding the judgment just rendered will appear in our decisions department in due course.

ENGINEERS, who are often forced at best to take long chances with their health and with that of their men, are beginning to recognize that it is wise to employ professional soldiers against disease. As a matter of dollars and cents it is cheaper, on work of any scale, to protect the lives and health of the men than to suffer delays and to run the risks incident to amateur sanitation. We print this week an account, written for the layman, of malaria, the common and most annoying disease of new countries. It has been prepared by Dr. H. G. F. Spurrell, medical officer for the Anglo Colombian Development Company, and comes to us from Buenaventura. Dr. Spurrell's papers on the 'Habits of Mosquitos,' that our readers will recall with pleasure, were prepared in the midst of the swamps of West Africa. His knowledge comes thus from first-hand observation and he is of the brotherhood that is making glad the waste places of the earth.

THE magnitude of the business of government in the world as a whole, is shown in the statistics compiled by the Bureau of Foreign and Domestic Commerce. The total annual revenue is stated at $12,179,000,000 and the annual expenditure at $12,308,000,000. With this rate of receipt and expenditure and an aggregate national indebtedness of the world of $42,000,000,000, it would seem that the business of government was on an unsound financial basis.

ANNOUNCEMENT has been made of the details of the transaction whereby the General Petroleum Company is to pass into the control of a British syndicate headed by Mr. Andrew Weir. According to Mr. John Barneson, who with Mr. Eugene de Sabla recently made the arrangements for the exchange of General Petroleum securities for securities in the new corporation, the new Company will be capitalized for $75,000,000 and will have headquarters in London. The advent of these interests into the California oilfields creates a new and formidable rival to the Standard Oil Company and the Royal Dutch-Shell syndicate. Further details are given in our London letter.

EXPRESSION of sentiment by the 'Citizens Alliance' in the Lake Superior region as embodied in the principles of the organization which are set forth in the pledge of membership, if indicative of the *vox populi*, warrant little optimism on the part of strikers. It is the belief of the members of this alliance that the Western Federation is opposed to good government, good citizenship, and the welfare of the district; that its scurrilous attacks upon the people, its poisonous propaganda of destructive socialism and violence must be brought to an end: that the presence of the Western Federation of Miners is a menace to the future welfare and prosperity of the district; that in the interest of law and order it must go; and that it is the duty of each citizen to exert himself in an effort to bring about an end to the present strike. The unfairness of the demands of the strikers, together with their methods in handling the situation, has apparently incurred the ill-will of the law abiding citizens in the Lake Superior district as in Colorado, and without popular support, unionism cannot expect success.

NATOMAS affairs are treated briefly in our London letter this week and in greater detail in the editorial pages of *The Mining Magazine* for November, just arrived. As is true of many another enterprise, Natomas Consolidated is suffering just now from lack of ready money for completion of projects under way. This would not be matter for especial comment were it not that reports recently made to the bondholders indicate that serious miscalculations as to cost and yield have been made. The former is easily explained by the general and sharp advance throughout the United States in the last few years, and the estimate of yield which now proves seriously at fault, $3,033,025 as against $5,139,092, was made, it is to be noted, not by engineers of the staff, but by a consulting engineer chosen by the London bondholders. It is also fair to recall that the money furnished to the company was $2,000,000 less than Mr. E. J. de Sabla asked. There has been no criticism of the engineering work and in gold dredging practice Natomas is admitted to be a standard maker. The difficulties in which the enterprise is involved seem the natural results of attempting too big a job with too little money. Possibly the bondholders have been over anxious to deceive themselves and have been allowed to have their own way. Certainly there has been a misunderstanding as to the existence of a prior lien on the property and certainly the consulting engineer who reported to the bondholders with such precision the value of the gold-dredging areas, did not have as full knowledge of the situation as he should. For engineers the lesson would seem to be not to attempt too much in a far country and a specialized industry without abundant local aid. To Mr. F. W. Griffin, the manager, and his excellent staff, we extend hearty sympathy and the hope that the financial skies may soon clear.

Yard Decision Reversed

The famous Yard decision has been overruled, and the Department of Interior has retreated from its position that in advance of patent mineral claims could be declared void by administrative process. This marks another step into the twilight zone that lies between the domains of state and national jurisdiction.

The Yard decision was one of the more famous of the rulings that marked the change in the attitude of the United States government toward the public lands, which followed inception of the conservation movement. It upset many precedents, and its effect was felt in many directions. The decision, made, as was also that which now reverses it, by the First Assistant Secretary of the Department of the Interior, covered a number of points. We discussed it in detail in our issue of July 31, 1909, and also printed, September 11, an illuminating letter by Mr. W. E. Colby in which the bearing of the decision on practice in the oilfields was pointed out. It will be recalled that within the limits of the Plumas National Forest 11,000 acres of land had been located as mineral claims and transferred prior to discovery to Mr. H. H. Yard and the North California Mining Company. The lands were shown to be covered by timber worth $320,000, and to have yielded gold worth $3; a mountain pass, now used by the Western Pacific railroad was concerned; and the method of taking the land was one which, by clouding the title, permitted the obtaining of the timber at subsequent sale, at a nominal price. There was much popular feeling that this was a typical case of land-grabbing through taking advantage of technicalities of the law. It was maintained, on the other hand, that the decision operated, as Mr. Stewart White has phrased it, to "change the rules during progress of the game," and public sentiment is sharply against that.

Passing other points concerned, one vital feature of the decision was the assumption by the Department of power to cancel claims prior to patent. It is to be remembered that when a claim is located no notice to any United States officer is required. The mineral

lands have been thrown open to location and entry and anyone, including aliens, may go upon the land and locate claims, without formality so far as the United States is concerned. As between the Government and the individual, no questions arise until application for patent is made. Prior to that date locators must rely upon state courts for protection, though there is a shadowy right of the Government involved in protection of the public domain from trespass. In the Yard decision it was held that for good and sufficient reasons, mainly fraud or plain intent of fraud, the Department might cancel claims even during this probationary period. The same question has come up in other cases. Attempts have been made to hold the Bright Angel trail at the Grand Cañon, by means of a string of mineral locations, and for the apparent purpose of charging toll to visitors. There are many situations where the integrity of a mineral claim is similarly open to question.

We are among those who believe the United States should have power to raise this question; otherwise by doing continual assessment work lands may be held in perpetuity on location only; no application for patent having been made. There are many objections to a general system of such titles, and much may be said for a law requiring notice to the United States government and a system of federal records of locations. However, it is one thing to believe there should be such power of cancellation, and another to hold that it exists. The Supreme Court of California, in the case of Miller *v.* Chrisman, has taken strong ground as to the rights of locators before patent, and even before discovery, and while the Supreme Court of the United States did not comment on that particular phase of the case, it did affirm the decision of the California court.

In the case just decided, that of J. P. Nichols and Cy Smith before the Land Department, certain placer locations on unsurveyed lands in the Wallowa National Forest were held by the local officers and the General Land Office to be null and void, after hearing held upon charges by the Forest Service that there were no discoveries of mineral, and that the claims were not held in good faith for mining purposes, but for speculation. On appeal, the First Assistant Secretary ruled that so long as these parties had not filed mineral applications the Department had no jurisdiction over their locations; that the proper forum for the determination of the validity of the mining locations is the courts; and he said that the decision rendered in 1909 in the Yard case "is entirely indefensible, whether viewed from an administrative or legal standpoint"; and that to the extent that such decision might mislead citizens or officers of the government "into an unwarranted invasion of private rights, it would be repugnant to good administration as subversive of law." The Yard case and all others of like tenor were therefore overruled, and the Government resumes the position it had always held prior to that decision. This places matters in the shape that we urged they should assume, in our editorial comment at the time the original decision was rendered; namely, that decision of such matters, involving the good faith of the applicant, are better made in open court than before an administrative bureau. It is to be noted that this does not touch such a case as that involved in the Cunningham decision where patent was refused. Apparently, however, the Cunningham claimants, if content to go without patent, could have continued to hold their claims by doing annual assessment work, and relying on the courts for protection against trespassers. The ambiguity of such a situation is but another argument for general revision of the mining law. Why be content with uncertain titles, and why face litigation when Congress has both the right and the duty to enact explicit statutes covering all such matters?

Large Scale Gold Mining

Juneau is fast becoming one of the great mining centres of the world. Across Gastineau channel the Treadwell group of mines has long been famous for the low grade of the ore and the great scale of the operations. The new central shaft is equipped for handling 5000 tons per day from a depth of 3000 feet, and even more extensive operations may be expected. This, however, is about to be surpassed on the main land. In Silver Bow basin immediately back of Juneau is a great gold-bearing lode that has been worked on a small scale for a number of years. Last year Mr. D. C. Jackling and the late A. F. Holden became interested in the Alaska Perseverance mines at the south end of the lode and the Alaska Gold Mines Company was organized to finance large scale operations. Through its subsidiary company, the Alaska Gastineau, a 6000-ton mill is now being built and the mine is being rapidly prepared to furnish ore for this plant. Probable extensions are already forecasted. The central portion of the lode is owned by the Alaska Juneau Gold Mining Company, in which Mr. F. W. Bradley and associates have a controlling interest. We gave some account of this property in our issue of May 31 and have the pleasure of printing this week an authoritative statement as to the mining problems involved, written by Mr. Bradley. He tells much of technical interest and gives an insight into the conditions that permit planning work on the basis of milling 12,000 tons per day for 100 years. Truly such gold mining is of a new order. North of the Juneau is the Ebner property which, after numerous vicissitudes, has now been brought into some semblance of order as regards titles, and is under option in the interest of the United States Smelting, Refining & Mining Company. The ground is to be tested by a long deep-level adit, such as has been driven at the Juneau and the Perseverance, and, if development is favorable, another great producing unit may be expected. According to present plans, a total daily production of more than 20,000 tons may be expected at Juneau within the next four years. This will furnish work for something more than 30,000 men and will require a generation of 40,000 horse-power, besides furnishing a market for machinery and supplies of the first order. All this may not be so romantic as "finding another Cripple Creek," but the establishment of a practically permanent industry of this order in Alaska means more for that territory.

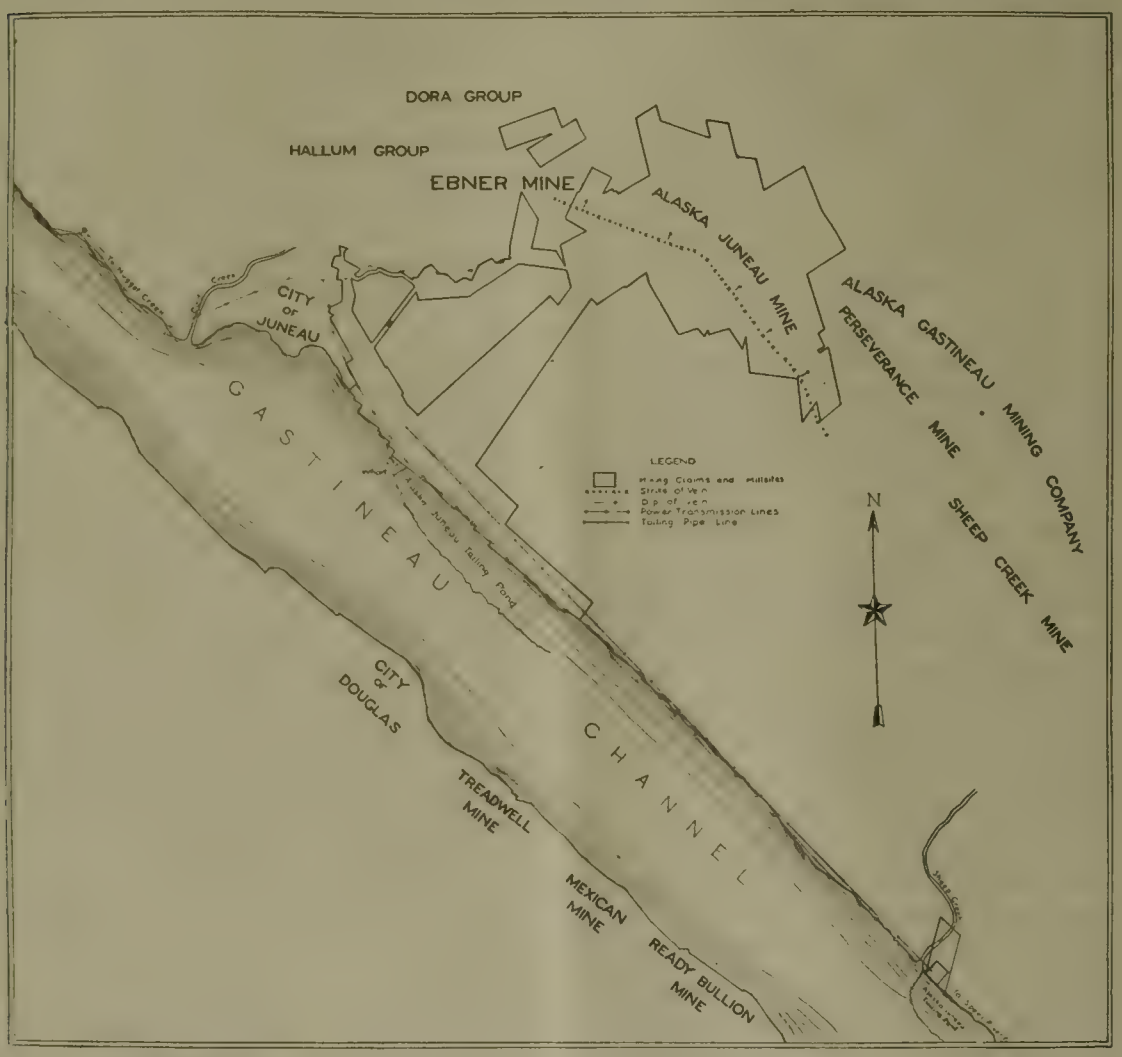
Plans of the Alaska Juneau Gold Mining Company

By F. W. Bradley

The development and equipment plans of the Alaska Juneau Gold Mining Co. now under execution, and which involve mining and milling a gold ore considered at one time to be worth no more than $1.25 per ton, are the result of several years study of peculiar local conditions and problems. It was evident from the beginning that a tremendous tonnage of proved value would have to be developed, as to bring the operation to a successful climax involved the mining of a very large daily tonnage and treatment in mills placed at salt water. Milling operations the year round in Silver Bow basin (an elevation 1200 ft. above sea-level, being the lowest building spot on the Company's mining claims) are impractical even on a small scale, because of climatic conditions, and on the scale commercially demanded are out of the question for reasons entirely aside from climate. The very first proposal involved the deep development of the vein by running a cross-cut from a point on Gold creek about two miles back from the town of Juneau and at an elevation of 420 ft. above sea-level; which work was originally planned in 1899, started in 1909, but was not definitely arranged for until 1910.

This main cross-cut has now been advanced for a distance of 6538 ft. to a point where a raise is now being driven to reach the surface in the shortest possible distance. This raise will be about 800 ft. long to the floor of Silver Bow basin on the hanging wall side of the vein; while if driven in the vein to the apex of the latter at the surface, the raise would be more than 2000 ft. long.

By the time the raise is completed, 30 stamps of the first mill unit will be ready to begin milling the best available ore (selected from a comparatively high-grade streak in the vein) in order to make the mine help pay for its further development. At the same time, 10 additional stamps (arranged accord-



MAP OF A PORTION OF THE MINING CLAIMS, MILLSITES, AND OTHER PROPERTY OF THE ALASKA JUNEAU COMPANY.

ing to the flow-sheet hereinafter referred to) will begin test crushings to determine the accuracy of the sampling and assaying of the ore already exposed by the cross-cut, to prove the value of any ore that may be exposed by the raise, and to discover

mill working five months each year for the past 15 years on ore mined by open-pit work along the croppings of the Alaska Juneau vein. Confidence in the persistence of the vein and its value is also based on milling results obtained by the small Ebner mill on

MILLSITES OF THE ALASKA JUNEAU GOLD MINING CO.

1, Private trail to mine; 2, change-house; 3, adit No. 3; 4, flume and tram line; 5 main working or sea-level adit; 6, incline tram from main adit; 7, rock-house No. 2; 8, ore-bin; 9, first mill unit; 10, second mill unit; 11, third mill unit; 12, fourth mill unit; 13, tailing pipe-line; 14, slime and cyanide plant; 15, tailing pond; 16, office; 17, cottages; 18, private road to mills, extension of Gold street; 19, picked waste dump; 20, sluice-box to convey waste to barges; 21, waste barges; 22, waste barge wharf; 23, lines of snow and rock slides; 24, sawmill reservation; 25 and 26, gridirons; 27 and 28, incline tramways; 29 and 30, hoists; 31, fresh-water pipe-line; 32, salt-water pipe-line; 33, power-house; 34, coal wharf and bunkers; 35, fuel-oil tank; 36, power-transmission lines; 37, boat-float; 38, salt-water pump-float; 39, fresh-water tank for Juneau fire protection; 40 salt-water pipe connection for city of Juneau; 41, main wharf; 42, barn; 43, wood shop; 44, machine shop; 45, 46, and 47, warehouses; 48, gasoline storage; 49, circulating water tank; 50, industrial tracks; 51, powder adit; 52, powder house; 53, coal conveyor; 54, oil pipe-lines; 55, transformers; 56, compressor.

what defects, if any, exist in the present adopted flow-sheet.

The Vein

The vein where cut by the main adit has a right angle thickness of about 500 ft. with an average assay value of about $2 per ton. Although this is better than any of the surface developments, it is believed that this width and value will persist for considerable distances both longitudinally and vertically. This belief is based upon the results of a 30-stamp

the continuation of the vein westerly into the adjoining Ebner property, and by the milling results obtained by the old 100-stamp Perseverance mill on the continuation of the vein easterly into the adjoining Perseverance property. In 1910 when the active development of the Alaska Juneau property was undertaken, extensive open-pit mining was planned for summer work, and for winter work reliance was placed upon finding comparatively narrow widths in the vein that would yield by selective underground stoping $1.45 per ton; but as the vein where exposed

by the cross-cut should yield $1.70 per ton, it is now expected that an average recovery of $1.45 per ton will be obtained from the entire vein when mining underground 6000 tons per day. This can be done at a total cost of not to exceed 80c. per ton, which cost per ton will be somewhat reduced when eventually winning 12,000 tons per day.

Mining

Mining will be done under a combination of the Douglas Island methods with the caving system developed in the adjoining Perseverance mine by the former superintendent, J. R. Mitchell, with the expectation of securing at least 100 tons of broken ore per machine-drill shift, as against an average of 31 (29 to 34) tons in the Douglas Island mines. This difference in duty per machine-drill shift is due entirely to the difference in composition of the two veins; the Alaska Juneau being a slate vein with loose or free quartz stringers and some metagabbro dikes between a greenstone foot-wall and a schist hanging wall, while the Douglas Island vein is a solid, hard, tough dike of diorite with frozen quartz stringers without parting or selvage between the quartz and the enclosing rock as in the Alaska Juneau slate vein. The Alaska Juneau ore is very much easier to drill than Douglas Island ore and will break with a less consumption of powder per ton. Also when blasted or caved, the Alaska Juneau ore in the bottom of a stope will in time, because of air slaking and the superimposed weight of additional ore broken or caved from the back of the stope, crumble and crush into pieces small enough to go through chutes into ore cars; whereas, the Douglas Island ore after being blasted from the back of a stope has to be both bulldozed and broken by sledges in order to pass similar openings.

Haulage System

The trolley haulage system to be eventually installed in the present cross-cut and over the tramway from it to the millsite will handle 6000 tons per day. In order to handle a total of 12,000 tons and over per day, a sea-level adit is now being driven. This, starting immediately from the millsite on the shore of Gastineau channel (an arm of the Ocean), will be 9500 ft. long to reach the vein at a point 400 ft. vertically below its development by the present cross-cut. For this winter's milling work, the ore hauling will be done by a gasoline locomotive.

Milling

Although the slate and the metagabbro each carry gold to the amount of from 25 to 85c. per ton, practically all the easily recoverable gold is in the quartz stringers which are worth about $6 per ton. Experimental work has demonstrated that the mill feed can be profitably enriched by sorting out and roughing out the waste, even though there is some loss in the gold contained by the waste, plus that contained by some ore thus discarded. In the rock-crushing house, it is expected that about 20% of the waste will be trommeled off with very little handling. This is because the quartz occurring as loose or free stringers is more friable than the slate and will break into smaller pieces when going through a rock-crusher with consequently more waste than ore passing over the end of the trommel; and a very little hand-sorting work on a waste stacking belt at the end of the trommel, will prevent the loss of any substantial amount of ore.

The milling proper may eventually be done in four units of 150 stamps each and to build each unit and to prepare the mine for supplying each mill unit with 3000 tons of ore per day would require at least a year's time, or at least four years' time for the four units having a total capacity of 12,000 tons per day. Of the 40 stamps of the first unit to begin dropping this winter, 10 will be used as a pilot plant. Each stamp of the pilot plant will crush about 17 tons through a ¼-in. mesh screen and 3 tons will be by-passed each stamp, thus making a total duty per stamp per day of 20 tons. The pilot stamps will be followed by two Wilfley roughers, one Chilean mill, amalgamating plates, and two Wilfley concentrators. From the 200 tons of crushed and by-passed material from the 10 stamps, there should be eliminated about 30 tons of slime, then the two Wilfley roughers should eliminate about 40 tons of waste, leaving 130 tons for the Chilean mill. The crushed product from the Chilean mill will be classified and each class (70 tons of slime being eliminated) will go direct to its own amalgamating plates from which it will go over its own Wilfley concentrators which will remove the sulphides. All slime and all sulphides will go direct to the cyanide plant—the slime for direct treatment and the sulphides to be tube-milled and then treated.

The principal value in the ore is due to free gold, there being less than 2% of sulphides, which have an assay value of less than $30 per ton. This is practically all gold, but includes some silver, lead, and copper value. Consequently the concentrates will not be so easy to treat as are the straight iron pyrite concentrates of the Douglas Island mines.

The situation demands and requires wholesale mining methods to secure low costs per ton, but as to milling methods, it may be more profitable to do selective work than wholesale. That is, it may be more profitable to do very much more sorting at the rock-crushing house than is now contemplated. The operation of the pilot portion of the first unit on ore from the deep mining to be begun this winter, will determine definitely whether the milling is to be wholesale or selective, and this in turn will determine just how the remaining portion of the first unit should be completed.

To provide for the very large tonnage that must be handled in order to earn a satisfactory profit, wharves and slips have been arranged for waste barges which can take out and discharge in the ocean any large quantities of waste that may be sorted out of the mill feed, providing selective milling is decided upon. If, on the other hand, wholesale milling is decided upon, then the resulting fine tailing will have to be deposited locally to the extent of the available storage space and eventually they will have to be piped to storage space farther out in Gastineau channel beyond Sheep creek, as shown by the map. The tailing will be discharged from the mill at an elevation of 170 ft. above sea-level, which elevation affords ample grade for carrying it long distances in each direction along Gastineau channel.

Mining and Milling Costs

Below is a comparison between the ascertained average costs per ton in the four Douglas Island mines and the estimated costs per ton at the Alaska Juneau when the latter is working on the same scale as the combined Douglas Island mines.

	Douglas Island.		Alaska Juneau.	
Mining:				
Development, stoping, and general	$0.72		$0.24	
Underground and surface tramming, hoisting, and pumping	0.23		0.16	
Total mining		$0.95		$0.40
Milling:				
Labor	0.09		0.06	
Supplies	0.04		0.04	
Power	0.04		0.05	
Miscellaneous and general	0.08		0.05	
Total milling		0.25		0.20
Concentrate treatment		0.08		0.07
Plant construction and other costs.		0.12		0.13
Grand totals		$1.40		$0.80

Battery water and water for some power will be carried from Gold creek to the millsite in a flume that parallels the Gold creek adit tramway line. Any small deficiency of battery water during extreme cold spells in the winter season will be made up by pumping salt water. For the present any deficiency in the Gold creek water supply for power purposes will be made up by an auxiliary steam plant; but eventually, hydro-electric power will be transmitted from Nugget creek, about 15 miles distant. Also, it may be necessary to eventually transmit hydro-electric power from Speel river, about 45 miles distant.

No provision whatever has been made for housing or boarding employees (who will total about 400 for each mill unit or eventually about 1600 in all), because the tramway adit immediately behind the city of Juneau practically brings the mouth of the mine within the city limits, where, no doubt, ample and suitable accommodations will be forthcoming as required. It has been found at the Bunker Hill & Sullivan mine in Idaho, the feeling of loyalty of employees to the Company is much improved by in no way infringing upon their absolute right and freedom to use their own time and money as they please. Besides, a contract has been entered into between the Alaska Juneau company and the city of Juneau whereby the Company is freed from city taxation on its plant within the city limits in consideration of its furnishing a supply of both fresh and salt water for fire protection. This contract is further reinforced by the moral obligation that the Company will not go into either the boarding house or store business to the extent of endeavoring to force its employees to discriminate against similar establishments in the city of Juneau. The importance of this feature of the matter arises from the fact that it is expected that operations on this mine will continue for a hundred years or more.

Phosphate rock has been opened near Abingdon and Marion, in Washington and Smyth counties of Virginia.

Consolidated Gold Fields of South Africa

In the report for the year that ended on July 31, the following general statements are made: "In the report of last year it was pointed out that, taking the gold-mining industry of the Witwatersrand as a whole, the recovery per ton crushed has of late shown comparatively little variation from year to year, so that any increase in the average rate of profit earned must generally be derived from reduction of working costs. This view is borne out by the results obtained during the year that ended July 31, 1913. The total output of the Witwatersrand gold mines was 8,698,681 fine ounces of gold, representing an estimated profit of £12,750,000, as compared with 8,432,379 fine ounces and an estimated profit of £12,200,000 for the preceding year. But for the effect of the recent strike the results of the year under review would have been better. These results were obtained by crushing 26,333,530 tons of ore giving an average recovery value (on the basis of 84s. per fine ounce) of 27s. 9d. per ton, with average working costs of 18s. 1d. per ton (or, excluding Gold Fields companies, 18s. 11d. per ton), leaving an average profit of about 9s. 8d., the figures for the last three years being:

For year ended	Recovery.	Working costs.	Profit.
July 31, 1911	27s. 10d.	17s. 10d.	10s. 0d.
July 31, 1912	28s. 1d.	18s. 5d.	9s. 8d.
July 31, 1913	27s. 9d.	18s. 1d.	9s. 8d.

"In the case of the mines of the Gold Fields group, it is to be noted that in four of the crushing mines the grade of the ore encountered has fallen during the year, and that, though every effort has been made to counterbalance this by cheaper working, the reduction made in working costs, though substantial, has not been sufficient to maintain the average profit per ton at the rate shown twelve months ago; the average working profit for the group having been 5s. 10.574d., as against 7s. 2.550d. last year."

The following figures show the essentials of the year's work both for the Rand as a whole and for the Gold Fields mines:

TRANSVAAL

	For year ended July 31, 1912.	For year ended July 31, 1913.
Total gold output, fine oz	8,857,398	9,114,219
Value output at £4.24773 per fine oz.	£37,623,834	£38,714,742
Tons of ore crushed (including tons treated by direct cyaniding)	26,157,972	27,260,951
Estimated mining profits from gold.	£12,523,000	£13,165,000

CONSOLIDATED GOLD FIELDS GROUP

	For year ended July 31, 1912.	For year ended July 31, 1913.
Actual total gold output, fine oz	946,520.181	936,022.616
Value of output as shown in companies' books	£3,975,167	£3,936,596
Value output at £4.24773 per fine oz.	£4,020,562	£3,975,971
Tons of ore crushed	3,616,330	3,978,882
Mining profits from gold (excluding expenditure on machinery renewals and replacements)	£1,304,143	£1,170,019
Total profits (including sundry revenue and revenue from accumulated slimes)	£1,384,566	£1,265,428

Malaria—Its Effect on Work and Workmen

By H. G. F. Spurrell

It is my intention in this paper to discuss malaria as a disease. That is to say, I mean to deal with various aspects of a disorder in the health of the human being, not with the microscopic animal which causes that disorder, nor with the mosquito which transfers it from one man to another.

There is such a high probability that a mosquito will sooner or later transmit the parasite, which causes malaria, to every white, who spends any length of time in the tropics, that, whenever malaria is a subject of general conversation, the interest centres mainly around the measures for suppressing mosquitoes or escaping their bites. Yet, after all, it is the results, which follow the introduction of the parasite, which are really important; and now that the part played by the mosquito in transmission is established, and its importance never again likely to be neglected, I think it would be well if a little more thought were given to the disease itself. Malaria is not the only or the most deadly disease of tropical lands. A man who goes to tropical America may get yellow fever, and if he does he is quite likely to die within the week. A man who goes to the East may get Kala-azar, and if he does he will certainly die within a few months. But there is hardly anywhere in the tropics where a white man can stay for any length of time without being able to count with practical certainty upon contracting malaria and suffering more or less severely from its effects. Malaria, although it is not the most spectacular of tropical diseases, is probably the one which most hinders the development of the richest parts of the world.

Influence of Malaria

Malaria means different things to different people, but it always means something very bad to everyone connected with a mining company. To the company's employees who work the mine it means shifts missed, pay lost, and a probable curtailment of their working lives. To the mine manager it means the presence of a medical officer who is an expensive infliction and is continually saying that employees and sometimes the manager himself are not fit to work when their services are most required and often when to his untrained eye there is no obvious reason why they should not make an effort to do at least something. Not content with this the medical nuisance has a way of insisting upon vexatious regulations, which upset the harmony of life, and of requiring alterations in the housing of the staff which make the costs mount up. To the medical officer, malaria means not only work, he is there for that, but constant strife and anxiety. To the shareholders it means a drain of endless expense and a periodic recurrence of mysterious disasters.

The layman who is wise does not endeavor to close with his enemy himself; he allows his professional soldier, in this case the medical officer to do this for him; but he may have his interest aroused in the cause of his misfortunes to the extent of wishing to understand something of its working. If he goes to medical text-books he finds that previous medical knowledge is necessary to grapple with this particular problem, while if he consults a medical man he is liable to lose patience: the fellow so often appears to be contradicting himself. It is therefore no easy task that I have the temerity to undertake.

First, malaria is not one disease: it is at least three. Secondly, though each of these diseases depends on a very definite sequence of events, the circumstances in which these events take place may produce a bewildering variety of manifestations. I will endeavor to describe the base essentials first, in their simplest circumstances.

Suppose you go, if I may put the matter personally, to visit or work in a mine in a malarious country. I am assuming here that you have never been in a malarious district before. The mine may be one where every recommendation of the company's medical advisors has been acted upon. The staff is housed in mosquito-proof buildings, the native dwellings are kept at a proper distance from the camp, quinine and good advice are given free. You think that on such a property you will be safe. Unfortunately to get there you may have to pass through dangerous country which is not under the company's control. You have to stop at hotels, travel by boats, and hang about customs houses where every sanitary rule is ignored. If you are new to the country and language, the native servants who take you through the bush may, probably will, by their management of your camp equipment and food, endeavor to ascertain by experiment the limits of your patience. What they actually prove is the extent to which you are susceptible to the insect and waterborne diseases of the country.

Symptoms

If this part of your journey does not take more than a day or two, you may, after you have been a week on the property, flatter yourself that either the things which bit you were not infective mosquitoes, or else that your powers of resistance are high. But at the end of a week or thereabout there comes a day which begins with a feeling of uneasiness. You cannot say you feel ill, but it is much as if you were being dragged out by misguided friends to go skating after you have lived for many years in a place where the winters are too mild for the ice to bear. You feel unsteady, you are sure you will not enjoy yourself, and you wish the treat were safely over; but you are determined to get through the day without disgracing yourself. You next feel as though the ice had given way under you and after total immersion in freezing water you had scrambled out and were being struck at short intervals by gusts of a bitter wind. There is no question of resistance now; teeth chatter loudly, your limbs shake violently, and you feel desperately ill. Your friends hurriedly put you to bed and pile blankets

on you. If you have a kick left in you, you ask for more blankets, and, notwithstanding, your shivering fits shake the whole bed. Yet cold though you feel yourself, if anyone else took your temperature he would find that it had run up to 104°F. or 105°F. You, however, have other things to engage your attention. You remember how, the day before, you saw a negro trying to split a log of wood. He stood over it and swinging his axe aloft burried the blade in the end of the log with a resounding thump. Then he tugged and shook at the handle of his axe to get it free for another blow. You feel now just as though the devil himself were trying to split your head in the same way. Then comes a change: the shivering ceases and you feel overpoweringly hot and fling off the blankets for which you clamored before. Finally a profuse perspiration breaks out all over your skin, which hitherto had felt about as dry and harsh as a hot brick. The sweat pours off you in streams and soaks your blankets and mattress through; but in yourself you feel wonderfully better and very likely soon to drop off to sleep.

Next day you feel almost yourself again and quite able to go about your work as usual. But on the following day at about the same hour another attack like the first comes on you and runs the same course. This continues. On alternate days the same series of events, the preliminary malaise, the cold stage, the hot stage, and the sweating stage occur in regular order taking from first to last about eight hours to run their course; and after a week or two of this you are an anemic wreck.

Protection Against Malaria

For the purpose of giving a clear picture of the disease, not of frightening anyone who may be going to a malarious country, I have described an untreated case of malaria. If effective protection against mosquitoes can be secured it is not necessary to get malaria at all. If a daily dose of quinine is taken as a prophylactic the malaria parasites which are introduced into the blood may die before they have time to give rise to symptoms of disease, or, if some of them do survive, the malady they produce is the ineffective work of debilitated cripples. But what surprises the victim of such an attack as I have described is to hear, when a medical man arrives to diagnose his case, that he has been suffering from the form of malaria known as 'benign tertian.' "Tertian perhaps," he says: "the second attack came on the third day from the first, the third attack on the third day from the second, and so on." Call a disease which affects you on alternate days "tertian" if you like, but why "benign"? What other forms of malaria are there which are not "benign" and how can they be worse?

'Benign tertian malaria' has not, however, been misnamed. Its name distinguishes it from the two other kinds of malaria, one of which is called 'quartan malaria' because the second attack comes on the fourth, not the third, day from the first; the other is called sometimes 'subtertian malaria' because its periodicity is less clearly marked than that of benign tertian, sometimes 'malignant tertian' because it is infinitely more dangerous to life. I shall endeavor to show that these distinctions indicate differences which really exist, and are of practical as well as scientific interest.

It will be well to establish at first the points which the three diseases have in common. All three are due to the activity of animal parasites, not to bacteria, which are vegetables. It is not necessary to my purpose to describe the structure or development of the malaria parasites, but it will be as well to say here that they can easily be recognized under the microscope in specimens of a patient's blood, and that in this method of examination the species causing the three different diseases can be distinguished from one another by any observer of ordinary skill. But it will be worth while before discussing the symptoms of malaria further, to describe how the microscopic animal causes the disease. I should like to attempt this by means of a homely illustration. Suppose you took half a dozen mice, and, having corked up each one tightly in a bottle, with a piece of cheese and enough water and oxygen to keep it alive for 48 hours, arrange the six bottles on a shelf in your room with an automatic contrivance for breaking them simultaneously at the expiration of that time. Until the moment arrived when the bottles were broken you might live within a yard of them and forget their existence. But all this while within the closed spaces the mice would be converting the oxygen and water and cheese into new and malodorous compounds; and when the bottles were suddenly broken and mice careered wildly around your room looking for fresh hiding places, you would be sickened by the overpowering stench of their accumulated products. It would require some hours for cleaning and airing before the room would be habitable again. This is the kind of a way in which the malaria parasites produce the symptoms of disease. Each young malaria parasite enters and establishes itself in a red blood corpuscle. This minute body with its minute inhabitant circulates in the blood together with the other unaffected corpuscles; but all the time it is degenerating, for the parasite is digesting its substance until nothing is left of it but a containing membrane. As a consequence of feeding on the interior of the corpuscle the parasite grows till it is many times its original size. It attains maturity assuming something of the shape of a raspberry, and, when finally the corpuscle bursts and it is turned adrift in the blood stream, the segments of the microscopic raspberry separate and each as a young parasite enters a different corpuscle to start a fresh life cycle. The young parasites do not cause the attack of fever directly: the symptoms I described above are due to the waste products of their growth, while feeding within the corpuscle, being suddenly released into the blood stream from their containing envelope. This has been proved by taking blood from a patient during an attack of fever, and, after filtering it through porcelain to get rid of parasites and all solid constituents, injecting it into the veins of a healthy man. He suffers at once from a single attack of fever, but does not contract malaria.

Various Forms of Malaria

The particular features of the different kinds of malaria depend upon the specific characters of dif-

ferent parasites. The one which causes benign tertian malaria completes its life cycle with a blood corpuscle in 48 hours, so the attacks of fever occur approximately at the same time on alternate days. That causing quartan malaria requires 72 hours and accordingly the attacks recur with intervals of two days between. These two diseases, however, have an important feature in common due to the fact that all the parasites in the body reach maturity at about the same time and consequently the fever, which marks the liberation of their waste products, takes the form of well defined attacks with a sharp onset and definite duration. The parasites of subtertian malaria on the other hand, though their life-cycle takes about or a little under 48 hours, are far less uniform in their growth and do not reach maturity simultaneously. Hence the attacks of fever are not so well marked, but usually last longer. A man with subtertian malaria usually has a definite rise of temperature on alternate days; but the degree of fever reached is not as a rule so high as in benign tertian, while on the intervening days the temperature, though it usually falls considerably, often does not quite come down to normal. In technical language, subtertian malaria tends to be a remittent fever, while benign tertian and quartan are intermittent.

The reader may still be wondering why the disease in which the most spectacular paroxysms of fever occur should be called 'benign.' The name in a comparative sense, however, is well deserved. This type of malaria in spite of its sensational manifestations rarely endangers life, at any rate in its early stages, and it yields, as a rule, quickly and easily to treatment. Much the same may be said of quartan malaria except that it yields less readily to treatment, is harder to shake off, leaves greater debility behind, and is a serious complication where any other disease is also present. Subtertian malaria, on the contrary, is a dangerous disease which is liable to take a 'malignant' form, when it may prove fatal, if not immediately and effectively treated. Even when it does not develop 'pernicious' characters and endanger life, its effects are often grave and far reaching.

Subtertian Malaria

Subtertian malaria has two aspects, both of which it is particularly important to keep in mind. I have already mentioned that the parasites which cause this disease are less regular and uniform in their habits than those of the benign tertian, and that the patient, accordingly, often appears less acutely, but more continuously ill. Their other peculiarity is that they render the corpuscles in which they develop, adhesive, and liable to stick to the walls of blood-vessels instead of flowing on with the blood stream. As they approach maturity, they most of them get anchored in the deeper parts of the body. This sometimes occurs very locally when it may cause more or less complete obstruction of the circulation in particular organs, and give rise to effects varying according to the organ. Where the organ is healthy it is bad enough. A sound intestine, for instance, may be sufficiently weakened in this way for other germs, hitherto powerless, to start an attack of dysentery. But where the efficiency of the organ is already impaired, as in a heart hampered in its action by the effects of previous valvular disease, comparatively slight interference with the blood supply may precipitate a disaster. All too frequently the obstruction occurs in the smaller bloodvessels of the brain. People notice that a man is stupid and becoming incoherent, and they charitably suppose that he is drunk. They then find he gets drowsy and looses consciousness, and conclude that he is sleeping off his intoxication. On the following day they are horrified to find that he is dead. At the post-mortem it is demonstrated, by means of the microscope, that the smaller bloodvessels of his brain are full of malaria parasites and the pigmented debris of broken-down corpuscles.

Mild Forms

One might well suppose that the comparatively mild form, which subtertian malaria not infrequently takes, was of importance chiefly because the disease might on that account remain unidentified and untreated until there occurred some such catastrophe as I have described. This of course is true, but it is not all. A man acknowledged to be suffering from subtertian malaria may feel not too ill to struggle on with work in which he is deeply interested; and unfortunately he may also appear to others capable of doing it satisfactorily. A greater mistake is hardly possible than to entrust important work to a man who has not completely recovered from subtertian malaria. Although such people may not seem to have their faculties impaired, they are peculiarly liable to commit errors of judgment, and naturally the more responsible the position they hold and the more deservedly they are trusted, the greater the harm they may do. Many tactical errors, shipping disasters, extraordinary mistakes in estimates, and apparently unaccountable suicides have been due to men in charge of affairs refusing to admit that they were too ill to carry on their duties and continuing to struggle with facts whose bearings they could no longer recognize clearly. Apiece with this blunting of the critical faculty is a tendency to be unreasonable and cantankerous. The patient refuses to admit that he feels ill, and is fractious under treatment, particularly when the treatment urged is rest. Where he is in subordinate position this is bad enough, though then he can be ordered to rest, or, if he is obliged to work, what he does can possibly be checked afterward either by someone else or by himself later when he is recovered. But it is a very serious matter when the head of affairs becomes unreliable without being aware of it, especially when his subordinates do not recognize that the firmness of character, which perhaps has hitherto been regarded as one of his most useful qualities, has been replaced by pig-headed stupidity.

From the description I have given, malaria, in whichever form it may be present, might appear to be an easy disease to recognize, and it might be supposed that no one who had any experience of it, could very well be afflicted without knowing it. Yet though this is true of a typical case, there is no other disease which shows a regular tertian or quartan periodicity—it is quite the reverse with many of the

cases which one actually meets. For instance, the patient may have been infected twice and having two stocks of parasites in his blood, each maturing independently on alternate days, have an attack of fever every day. If one stock is a tertian and the other a quartan, every other attack of fever will be repeated on three successive days. When a man is infected with both benign tertian and subtertian parasites there is considerable danger of the subtertian element being overlooked and the case regarded as one of the less serious disease. These difficulties can all be cleared up, the kind of parasite identified, and the different stocks in their different stages of development sorted out, by means of the microscope. But the patient often makes this difficult by taking a dose of quinine before he goes to a medical man, and, though malaria is not cured so easily, this will probably make the parasites disappear from the superficial circulation, for a time, and delay the possibility of accurate diagnosis, though not the need for immediate treatment.

Susceptibility to Poisoning

Then some people, particularly those who are having their first attack, are more susceptible than others to the malarial poison. The microscope may show that they are infested with a single stock of benign tertian parasites, which are maturing regularly on alternate days, yet the constitutional disturbance caused at each attack of fever be so severe that it has not passed off before the next arrives, and the patient is continuously ill. On the other hand, the microscope may show that a man has the parasites in his blood running their usual course, but not present in sufficient numbers to cause attacks of fever. Such a man may appear to be merely anemic and gradually declining in health, and the medical man who diagnoses malaria is met with the incredulous question, "Is it possible to have 'fever' without a temperature?" While some people are inclined to attribute most of the misfortunes of life to malaria, others see in the manifestations of this disease the effects of all manner of unlikely causes. The man who loves his whisky believes his symptoms are due to his not drinking enough of it, while his counterpart, the rabid teetotaler, sees in everyone else's ailments the effects of alcohol. Many an attack of malaria has been taken for sunstroke, and obscure cases of ill-health often become the starting point of dietetic faddism when their cause could have been found with the microscope. Consequently malaria in its comparatively less serious forms may steadily undermine the health of a community without being recognized. The occasional cases with well marked attacks of periodic fever, are believed to be the only instances of the occurrence of malaria, and the anemia, sleeplessness, general debility, and depression of vitality are attributed to other causes, usually that vague abstraction, 'climate,' and not treated. While in this way the indefiniteness of the disease may lower the working efficiency of a community and lead to the wastage of constant invaliding, a similar indefiniteness, in the more serious cases, may lead to mistakes in diagnosis, which, by delaying treatment, endanger valuable lives. I have taken care to emphasize the milder, less definite aspects of subtertian malaria because it is so important not to overlook them, but it must not be forgotten that this disease has its severe forms in which high temperatures and bilious vomiting make up a picture remarkably like that of yellow fever. When special malignant features are produced by large quantities of the affected corpuscles lodging in particular organs, a number of serious conditions may be simulated: pneumonia, dysentery, and apoplexy are only a few of them.

Complicated with Other Diseases

Yet here another point must be emphasized, namely, that malaria may complicate other diseases as well as simulate them. It does not exclude other diseases, and it stands to reason that if malaria is bad by itself it is no better when associated with some already grave condition. The man with tuberculosis of the lungs or a defective heart, has no vitality to spare for coping with malaria as well, and should not be exposed to the risk. Should such a man get malaria into his system he may be sure that whenever either his original trouble or his added malaria becomes active, the other disease will take advantage of his depression to light up afresh. A man who has left a malarious country for some time and believes either that he has shaken off the disease or possibly that he has never contracted it, is very liable to develop a sharp attack should he meet with some accident or require a surgical operation of any kind. In fact, whenever a man who has been exposed to the infection, suffers from any derangement of health, it is always as well to examine his blood, with the microscope, in order to make sure that his present illness is not complicated by a recrudescence of malaria. There is, of course, the converse of all this. In every place where a great reduction of malaria is effected, the death-rate from other diseases is reduced. One disease in particular deserves special mention here. Blackwater fever is no longer believed to be a form of malaria; but though acknowledged to be a separate and well defined disease, there are few who will deny that the vast majority of cases, if not all, occur in people who have lived for some time in a malarious country neglecting precautions against malaria and not being sufficiently treated for the attacks.

After Effects

And now may I be permitted to use, once again, the personal method? I have described how bad you can feel in an attack of benign tertian malaria; I want next to consider what may happen to you after it. If you are treated properly you will speedily gain relief from your symptoms, and, if the treatment is thorough, you will have no more trouble unless you are reinfected. As a matter of fact, people who go from a temperate climate to the tropics often do not become entirely free from infection for a year or so after returning home. After all symptoms of malarial fever are gone a few parasites continue to lurk in the system, and whenever the vitality is lowered by such accidents as another illness, overwork causing severe fatigue, exposure to bad weather, privations, or indiscretions of diet, or even mental worry and anxiety, they seize the opportunity

your lowered powers of resistance offer, to increase and multiply with deleterious effects to your health. These may take the form either of a succession of attacks of fever on alternate days similar to, though not usually so severe as, your first experience, or, if the parasites do not at once gain the upper hand, of progressive anemia, sleeplessness, irritability of temper, and general wretchedness. How far either may go depends on how soon your condition is recognized and treated. I may here give a word of practical warning. When you return home from the tropics you almost inevitably make a considerable change in your way of living. You may land back in winter and meet with cold weather to which you have become unaccustomed. This, besides being bad in itself, necessitates your wearing thick clothes which also feel unfamiliar and oppress you by their weight. You probably, without any intemperance, relax your care in the matter of diet. And almost certainly you have a good deal of business, both your own and your company's, to transact, which involves much traveling about and fatigue. It is remarkable how many people, who have shown no signs of malaria during the latter part, perhaps even the whole of their stay in the tropics, have a bad bout almost as soon as they reach home. Yet after you leave the tropics you will lose your malaria. With treatment you lose it quickly, but even without treatment malaria tends in most cases to die out in the course of two or three years, though there are people who, having once been in the tropics, attribute to malaria every ailment that troubles them for the rest of their lives.

Power of Resistance

With almost all diseases, it is noticeable that some individuals have naturally higher and some lower powers of resistance than those of the average man, and that these powers of resistance vary at different periods of life. The negroes who live, without medical interference, in an African swamp, have, so to speak, come to terms with the malaria parasite of their district. Their children are all innoculated by mosquitoes at an early age. Those whose tolerance of the poison is low die, and do not transmit their susceptibility to the next generation: there are not many of these, as in the course of ages the stocks with low resistance have died out. In a certain small percentage of the children the parasite cannot be found, and it is possible that these have such high powers of resistance that the parasite cannot survive in them: there are not many of these, either, as the advantages of immunity over tolerance are not great. The average child harbors the parasites for a few years; but its tolerance is great, and its health is not much disturbed. By the time it is about ten years old it has in most cases developed such a degree of immunity that the parasites cannot live in its blood. But should the children of any of those negroes who have removed to a non-malarious country, be exposed to infection when adult, they prove susceptible. There is no complete racial immunity. In South America, for instance, some negroes spend most of their lives in high, well drained country, where they run little risk of infection, and others reside in towns in which sanitation is more or less defective. In addition, many dose themselves intermittently with quinine. Consequently here malaria is not uncommon with a black skin, for early innoculation is not universal nor is the disease always neglected till immunity is acquired. Where negroes suffer from malaria the mortality, especially among their children, is high.

Susceptibility of White Races

Among white races of northern origin the susceptibility is great, particularly in childhood. The unstable nervous system of the child is peculiarly liable to be attacked by subtertian malaria, when convulsions and all too often death result. Yet one, not infrequently, may still meet in the tropics with elderly men who went to the country before the proper way to guard against the disease was known, and who now take no precautions against malaria. Yet they enjoy robust health, and may even tell you that they never have suffered from fever, though they have buried many men who did. One sometimes finds them men of high character and ability; but one is more likely to notice the cases in which their way of life is reckless, to put it mildly, and their capabilities seem so limited that one wonders how they ever attained the responsible positions they hold. These are the men of high resistance. Of the many men who go to tropical climates, some are invalided and some die; others, either by care or good powers of resistance, last their time, but nevertheless are glad to return to life in temperate latitudes after a while. Others again seem to come to no harm whatever they do, and prefer to live out their lives in an easy-going land. In the old days men of this last type rose to be managers of the concerns in which they were employed, by sheer staying power. Other employees and other managers came and went, or came and died, but they lived on. In course of time, not only did they get to know the business and the country and the people, but both at home and on the spot it was realized that they could be regarded as permanent; and some of these old reprobates are there at the head of affairs to this day. They have seen many men die, and when young men, newly out, take them for their models and aspire to attain a like eminence by drinking level with them, they see them die, too; though often not from want of good advice from the very men who do not find it necessary themselves to practice what they preach. This individual difference in powers of withstanding disease is a factor which employers, who need a white staff in malarious lands, cannot afford to neglect until they have brought the malaria under control. Every man's first visit to a malarious country is an experiment. It may prove that he can live and work where others cannot, in which case he can command his price in future: it may end in his being sent home again before he has paid for his passage out.

But the question of susceptibility in malaria is not a question of malaria alone. It is also a question of tolerance of quinine. The man who professes scepticism of the efficacy of quinine merely reveals his ignorance of established facts. But

there are individuals who suffer from most unpleasant symptoms whenever they take even a small dose of quinine. People who cannot take quinine should not attempt to live in the tropics. It is also well to bear in mind that there are times when women stand quinine very badly.

Treatment

Mention of quinine brings me to the subject of treatment, in which it plays an important part. All I intend to say here about treatment is that when properly carried out it is wonderfully effective. In this short paper I have touched the fringe only of a very big subject. My object has been to show that, on the one hand, malaria is a perfectly definite thing, on the other hand, its manifestations are so varied that only a trained observer provided with the proper appliances can be sure of recognizing it behind all its effects. I have also tried to show that malaria is capable of impairing the working efficiency of a community in all manner of ways, which range from causing what is almost sudden death and acute illness to chronic ill health and progressive decline. I would again emphasize by separate mention that malaria may be responsible for impaired judgment in individuals which may result in anything between slight inaccuracy in office work and a terrible disaster. I have also endeavored to show how malaria, where neglected, is liable, as a complication, greatly to increase the seriousness of other diseases and of injuries due to accidents. If my endeavors have been successful, I think my contention will be conceded that the prevalence of malaria is one of the greatest obstacles that can stand in the way of a country's development. The moral is surely that all matters connected with the detection, prevention, and cure of malaria should be placed in competent hands, and that those hands should not be restrained by mistaken ideas of economy or hampered by the interference of uninformed people.

Before an individual travels, or goes to live beyond the reach of medical assistance, he can obtain much useful information regarding the care of his health from anyone competent to instruct him, and should not neglect to do so. But where a community has to live in the tropics, where a white staff has to be maintained to supervise native labor, it is a fatal mistake to economize in sanitary organization and to allow cases of sickness to be dealt with as they arise by a plebiscitum of amateurs. Malaria is not the only cause of fever in the tropics, and early recognition and correct treatment are quite as important in other diseases as in malaria. Moreover, malaria, even when diagnosed correctly by a layman, is often difficult for him to treat successfully; while many of the worst cases simulate other conditions so closely that he is not likely to recognize and treat them as malaria at all. One of the results of this is waste of money. It is true that the sanitation and medical supervision required by a white community in the tropics may seem expensive, especially if the numbers are small, but the saving in reduction of time lost through acute illness, the gain in increased individual efficiency through improved health, fewer invalidings, and greater continuity of work, and the advantage of being able to employ a larger proportion of whites to supervise the native labor, may not only mean a gain in money, but actually make possible an enterprise which would not otherwise be practicable at all. This can no longer be disputed now that we have before us the impressive object-lesson of Panama. When the real lesson of Panama dawns on the civilized world, we may see an exploitation of the tropics by the people of temperate climes comparable in its far-reaching results with the occupation of the New World by the peoples of Europe.

Retardation Phenomena in the Solution of Gold and Silver in Aqueous Cyanide Solutions

According to I. I. Andreev in a recent number of *Zeitschrift fur Elektrochemie*, the solubility velocity, AG, for gold divided by the percentage of KCN concentration is fairly constant at very low KCN concentration and reaches a maximum at 0.25% KCN concentration. In 1 to 50% KCN solutions the solubility velocity is proportional to the concentration of the O_2 present. Weakly ozonized O_2 has an accelerating effect on the solubility velocity for Au. If the O_3 content exceeds 4%, only a temporary acceleration occurs; the surface of Au becomes brick red, due to oxide formation, and a definite retardation in the solubility velocity follows. H_2O_2 has an identical effect, very slight amounts accelerate, increasing quantity retarding. Some visible oxide formation with accompanying retardation takes place in air under certain conditions even in KCN solutions of 0.01 to 0.05% concentration. This phase is being further investigated: PbO_2 and MnO_2 individually and alone have no effect on the solubility velocity of Au in KCN, but in the presence of H_2O_2 or O_3, O_2 is given off and marked acceleration of the solubility velocity takes place. No Au oxide layer was observed. Analogous experiments were carried out with silver. Increasing amounts of H_2O_2 or O_3 give accelerating effects in much greater degree than with gold and the solubility velocity diminishes only with comparatively high O content. Combination of O_3 and H_2O_2 increases the solubility velocity 25-fold.

Shipments of ore from the Missouri-Kansas-Oklahoma field for the forty-four weeks ended Saturday, November 8, represent a total value of $13,166,684. The estimated value of the ore in the bins is $1,000,000, making more than $14,000,000 worth of ore produced from the zinc, lead, and calamine mines during the year to date. In the production of zinc sulphides, Webb City is first, Joplin second, and Miami third. Webb City also is first in lead, Miami second, Joplin third. For calamine, Granby is first and Duenweg second, with Spring City third.

North Dakota lays no claim to importance as a mineral producer, yet the state's output of minerals in 1912 was valued at more than $1,000,000. The yield of lignite was 499,480 short tons, valued at $765,105. Clay products were valued at $231,245.

Geologic Work on the Mother Lode

A petition was recently addressed to George Otis Smith, director of the U. S. Geological Survey, asking that a re-study of the district be made by the Survey. It was signed by many of the prominent operators and engineers. In the course of his reply, Mr. Smith said:

"As you doubtless know, the Survey has in the past carried out extensive geological investigation in the Mother Lode region, resulting in the publication of geologic folios covering the lode for most of its length, together with much of the country on either side. It has always been intended to complete and round off this work on its economic side by the preparation of a comprehensive monograph on the gold veins of the Sierra Nevada, particularly those of the Mother Lode. This project has been deferred because the part of the Survey's appropriation available for work in metalliferous regions has never sufficed to meet all demands, and it has been necessary to confine activities to those districts in which work was most urgently needed and most heartily appreciated. An important factor in determining the relative urgency of various proposed projects is the disposition of the mining men in a district toward geologic work. Fifteen years ago, when the work for the Mother Lode folio was done, the attitude of mining men along the Mother Lode was not generally favorable to scientific study, or was at best apathetic. In some mines the geologist was welcomed, in others he was tolerated, in a few he was hampered by unnecessary restrictions, and to one important mine, entrance was refused to the federal geologist. As the best results are possible only where the mine owners coöperate fully with the geologists, it is not surprising that during the past few years other important districts, in which the work of the Survey was earnestly desired by the local men, and where it was apparent that every facility would be given to the visiting geologist to do his work well, should have been given precedence over the Mother Lode of California. I am pleased to see from the names appended to your letter that the general spirit toward scientific study is so favorable, although I miss from your list the original Amador Mines Co., the Keystone Consolidated Mining Co., the Argonaut Gold Mining Co., the Kennedy Mining & Milling Co., the Oneida Gold Mining & Milling Co., the Zeila Mining Co., the Lightner Mining Co., the Gwin Mine Development Co., the Melones Mining Co., the Harvard Mines (Buckminster), the Rawhide Gold Mining Co., the App Mining Co., the Dutch Gold Mining Co., the Jumper Gold Syndicate, and a number of other companies, all of which are or have been important producers. If the companies mentioned are also in favor of the proposed work, such fact will go far to insure its successful completion, and the Geological Survey will undertake the investigation as soon as funds are available for it, and will carry it to completion as fast as is consistent with sound scientific work.

"In conclusion, I wish to express my satisfaction that prominent men practically interested in the Mother Lode, desire its investigation under the direction of the Geological Survey, and to say that, if the desire is shared by most of the important companies not represented in your letter, or if at least they will not withhold from the geologist who may be assigned to the work free entrance to their mines and such data as he may require, I shall be pleased to detail one or more of the regular Survey staff to investigate the veins of the Mother Lode as soon as money can be set aside for that purpose."

[A number of companies referred to by the Director as not signing the petition were represented on it by the personal signatures of officers.—EDITOR.]

The production of tungsten ore in the United States during 1912 was equivalent to about 1330 short tons carrying 60% of tungsten trioxide, valued at $502,158. The output for 1912 was larger than that for 1911, when 1139 tons, valued at $407,985, was produced. The total amount of tungsten produced in the world in 1912 was 9115 short tons.

The Talisman mine, New Zealand, produced $106,000 from 4400 tons of ore during October. A strike of coal miners has cut off the fuel supply for the mine and mill.

Dredges operating on the Gold Coast of West Africa, treated 2,204,501 cu. yd. of gravel in 1912, yielding 12,478 oz. gold, equal to nearly 10c. per yard.

Melting Points of Copper Alloys

The U. S. Bureau of Mines has recently studied the melting point of commercial alloys and the determinations below were obtained by A. B. Norton, with aid from S. J. Popoff, at Cornell University, under the direction of W. D. Bancroft, of Cornell University, and of H. W. Gillett, of the Bureau of Mines. A brief report upon the work has been published as Technical Paper 60 of the Bureau.

	Composition desired.				Composition by analysis.				Number of duplicate determinations.	Melting point (liquidus)	
Alloy.	Cu %	Zn %	Sn %	Pb %	Cu %	Zn %	Sn %	Pb %		°C.	°F.
Gun metal	88	2	10	..	...	..	..	..	4	995	1825
Leaded gun metal	85½	2	9½	3	85.4	1.9	9.7	3.0	6	980	1795
Red brass	85	5	5	5	...	..	..	..	*8	970	1780
Low-grade red brass	82	10	3	5	81.5	10.4	3.1	5.0	4	980	1795
Leaded bronze	80	..	10	10	...	..	..	..	3	945	1735
Bronze with zinc	85	5	10	..	84.6	5.0	10.4	..	4	980	1795
Half yellow, half red	75	20	2	3	75.0	20.0	2.0	3.0	3	920	1690
Cast yellow brass	67	31	..	2	66.9	30.8	..	2.3	4	895	1645
Naval brass	61½	37	1½	..	61.7	36.9	1.4	..	5	855	1570
Manganese bronze	..	..	..	..	...	..	..	..	6	870	1600

*Two samples.

Mining in Algeria

By An Occasional Contributor

Algeria, France's premier colony, although not her oldest, is rich in the various minerals, notably phosphates, iron, zinc, lead, copper, antimony, and quicksilver. In a report recently issued on the mineral wealth of the country and the stage of its development and exploitation, it is stated that 68 concessions have been given for the exploitation of these minerals. It is known that there are large deposits of iron in this country, but particular attention is given to the more valuable metals. The output of zinc, for example, with a tonnage of one-tenth that of iron, is worth more, and its production is constantly increasing. In the case of lead, the production remains practically stationary, while copper is produced only to a very limited extent.

In the department of Oran are situated the mines of Fillaoucen Gar-Ronban (argentiferous lead) and Hassi-ben Hendjir (copper); none of these mines, however, are being worked at the present time. Zinc and lead deposits which are rich in calamine are being worked at Djebel Masser. At Mazis the calamine passes into blende at depth. These deposits are all being worked by one company and have a good record as producers.

Province of Algiers

Of the 14 mines in the province of Algiers, only 4 are being worked at the present time, namely, the Djahamama, Gerrouma, Ouarsenis, and the Sakamody mines. Considerable exploration work has been done and a large territory has been prospected with divers results. At Guerrouma, which is 50 gm. from Algiers, the blende and galena are found mixed with the Senonian marls. The mineral sulphides mined by the Bou-Mebran company in this locality in 1912 amounted to 2308 tons. The calamine deposits at Djahamama are found in ferruginous sands between the Lias limestone and the Silurian sandstone. The company working these deposits has obtained but little ore from them to date. The most important mining work being done in the region is at Ouarsenis. The concessions for this work, which cover an area of 2558 hectares, were granted in 1890. The calamine is found deposited in the upper beds of the Liassic period. These deposits have been worked at four different places, known as the Grand Pic, Abd-el-Kedn, Bell Kairet, and Rokka-el-Etba. Wherever these deposits have been found they have been in the form of pockets. At the Grand Pic property, work is being done on five rich pockets at the present time. These deposits are about a half metre wide and vary in length from 40 to 90 m. At Abd-el-Kedn there are two deposits of calamine which are strongly impregnated with baryta. Another deposit 30 m. long and 5 m. wide carries baryta blende. The Bell Kairet and the Rokka-el-Etba deposits are unimportant.

The Ouarsenis deposit is particularly rich in smithsonite, which is found mixed with oxide of iron; it has also yielded argentiferous galena with a little blende. The mineral content, after calcination, varies from 34 to 55% zinc. The galena ore of the Grand Pic contains 64% lead and 900 gm. silver per ton. At the Tarat-el-Ref, the galena carries 72% lead and 663 gm. silver. The mineral is transported from the mines in carts to Orleansville. During the year of 1912 there was produced 7118 tons.

Constantine

The ore deposits are more numerous in the province of Constantine than in any other province of Algeria. There are more than 80 known deposits in this province. Concessions have been granted for working 50 of these. One of the principal exploiting companies is the Guergour, which holds concessions for working the Ain-Roua, Kef Semmah, Djebel-Anini, and Baukedema deposits. The minerals exploited by this company between the towns of Setif and Bougie are silicates and carbonates of zinc, carrying some sulphur. They appear in the form of accumulations in two deposits and in the form of veins in the others. Mining is done either by pits or stopes, the deepest of the pits being 80 m. The mineral that is mined is shipped to Bougie or Tixter-Tocqueville. This company employs 200 men at the mines. The equipment includes a large washing plant and a dam is now being constructed to insure a supply of water for hydro-electric power.

The Ain-Aiko company is exploiting a splendid deposit of calamine at its property, 20 km. from Oued-Zenati station, on the Guelma-Constantine railway. The ore assays from 40 to 45% zinc, and the calamine carries about 58% zinc. Large ore reserves have been blocked out at the Amarko mine. The calamine is shipped by rail to the village of Montcalm, 8 km. distant, and is then wheeled in barrows to Oued-Zenati. The equipment includes four 60-ton and four 12-ton furnaces, the latter for treating the high-grade ore and concentrates. There are also a washing plant, workshops, and a central power station, equipped with a 280-kw. generator driven by producer gas-engines of 115 hp. The washing plant is equipped with two plunger pumps which are driven by electricity. There are from 400 to 500 workmen employed by the Ain-Aiko company, for whom living quarters are provided by the company. The usual conveniences requisite to the comfort of a small town have also been provided, together with railroad communication with the outside world.

Vieille-Montagne Company

The Vieille-Montagne company, between the years of 1872 and 1878, acquired the deposits of Hammam-N'Bails, called the Nador. This property is situated on the right bank of the Seybousse river, south of the Gwelma-Constantine railway. The Nador calamine deposit is at least 10 m. wide, and is interstratified with beds of limestone. At depth, and particularly toward the eastern extremity of the property, antimoniate of iron takes the place of

the nadorite which constitutes the gangue of the calamine. The calamine ore when calcined yields from 30 to 35% zinc. The antimoniate of iron contains 40% antimony, and the nadorite yields from 40 to 60% of lead and antimony. Mining is being done here in two pits at a depth of 70 m. The Company has two calcining furnaces on the ground. The mineral is taken by carts to the station at Nador, 16 km. distant, from which point it is sent by rail to Bone. In 1912 the Company shipped a large amount of antimony to Antwerp, but since that time it is being practically all shipped to France and Belgium.

The deposits of Djebel-Soubella or Bou-Thaleb are fast becoming exhausted, which was to be expected, as they consisted of narrow veins in the Jurassic limestone. Lead is found at Bou-Thaleb in the form of galena and carbonate. The property is equipped with four crucible furnaces and one reverberatory in addition to a washing plant. The mineral is carried from the property to Melsong, on the Alger-Setif railway, which is 55 km. distant.

The Société du Djendi

The Société du Djendi, like the Vieille-Montagne company, is exploiting carbonate of zinc deposits in the Djendi Guesta district. Near the village of Ampere, south of Setif, there are six parallel calamine deposits in the marl and limestones of the Upper Cretaceous period. The calamine here is of uniform quality and contains, after calcination, 50% zinc. Great hopes are entertained as to the future of the Oued-Bou-Doucka deposits, which are situated west of Philippeville, where the mineral is said to contain from 40 to 50% zinc. Work on these deposits has been recently started.

The Ouasta Mesloula company is operating in the country near Tunis. The ores here contain calamine and lead carbonate. At Mesloula the accumulations of calamine are associated with lead and copper. The mineral is sorted and washed at Claire Fontaine and sent to Bone by rail. The output of Oueste is carried in carts 30 km. to Souk-Ahras and sent by way of Bone to Antwerp. The products of Mesloula supply the works of Couéron (Loir-Inferieure), France.

There is only one copper concession that is being worked at the present time, which is at Tadergount, 34 km. southeast of Bougie. The mineral is found here in three veins and the metal content varies from 15 to 25%. Only a small force of men is employed at these properties. At Heliopolis Guelma there was a concession of 1160 hectares granted in 1905 for ground reported to carry 35% silver. This ground will be exploited in the near future. Near the Jemmapes, between Bone and Philippeville, a concession has been granted for 1336 hectares of ground carrying pulverulent cinnabar. This property yielded nothing in 1912. A mercury furnace was recently erected, and it is expected that the property will develop into a producer.

Mining is being actively conducted in the province of Constantine. There are about 15 applications for concessions before the authorities at the present time, and a number of applications for permits to prospect have also been asked for.

The concessions given for zinc deposits and the like are of considerable extent, and some of them date as far back as 1872, as the N'Bail-Kef-Semma, which had a production last year of 10,238 tons. Some concessions have been given since 1900, most of them being granted in the year 1908.

As there are no reduction works in Algiers, the minerals have to be exported in a crude or semi-crude condition. Belgium takes five-sixths of the calamine exported, and Great Britain and Germany share the balance. All of the lead is shipped either to France or to Belgium. There is no mineral fuel in the district of any importance. There are two lignite concessions, which to date have not been exploited. This does not mean that the field is hopeless, for petroleum has been found within the confines of the country, notably at Dahra, east of Mostaganem and near Claire Fontaine and Constantine. Permits and concessions have been given, notably to an English group, for the prospecting and production of petroleum. The Olan Oil Co., Ltd., has sunk wells as deep as 475 m. and found a permeable base at 416 m., indicating petroleum. It is stated that another well has encountered a petroleum formation at 83 m. depth. It is not necessary to state that, in the event of petroleum being found in the country in any quantity, there is no reason why a metal manufacturing industry could not be established here. This, however, is a matter of the future.

Costs at the Yuanmi Mine

This gold mine is in Western Australia, and during the past fiscal year a total of 64,350 tons was mined and treated at the following cost:

	Per ton.
Ore extraction:	
Breaking ore, including ore from development	$0.90
Filling stopes	0.13
Tramming and raising	0.72
Total	$1.75
Ore treatment:	
Crushing	$0.09
Ore transport	0.06
Milling	0.50
Treatment by vacuum-filter	0.58
Fine grinding sand	0.72
Precipitation and melting	0.13
Disposal of residue	0.05
Total	$2.13
Realization of bullion	0.11
Grand total	$3.99

Gold Yield of West African Mines

In October the principal outputs were as follows:

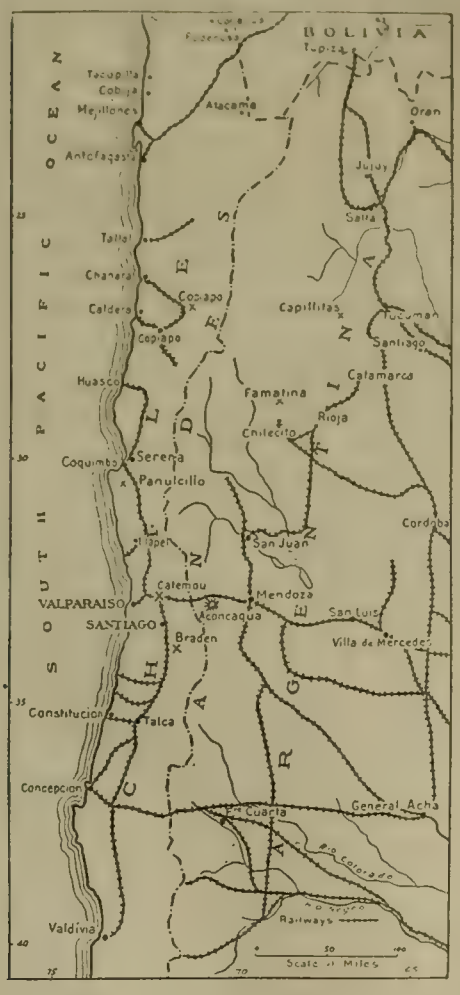
	Tons.	Value.	Profit.
Abasso	8,600	$72,000	$9,700
Ashanti	11,119	177,000	.....
Broomassie	2,400	65,000	5,000
Tarquah	5,160	71,000	14,000

Gravel washed at the Lena Goldfields property, Siberia, from October 1, 1912, to September 30, 1913, totaled 850,500 cu. yd. The gold yield was 335,348 oz., valued at $6,000,000.

Iron Ore Deposits of Chile

By Carlos Vattier

*In my publications on the subject of iron mining and metallurgy, which have been presented to the public during the past two years, especially those papers presented at the meeting of the Iron and Steel Institute at London and Leeds, in October of last year, the richness of the Chilean deposits was discussed. However, in my last expedition, accompanied by Nicomedes Echegarai, I have, through the courtesy of the mine owners, been able to make a more thorough study of conditions and the possibilities of these deposits. I might add that my opinion, previously expressed, regarding the classification and formation of these deposits has been confirmed.



MAP OF CHILE.

It is evident that many of the iron deposits of Chile were at one time under the sea and were afterward raised into what now is known as the Cordilleras and with the decomposition of these first deposits there have been formed beds, pockets, stockworks, and surface deposits which can be seen on the declivities and summits of the mountains. In the Department of Chañaral at an altitude of over 600 metres above sea-level, there are to be found maritime deposits of recent geologic age. The iron deposits here, as a result of the violent upheaval, are seen in various forms. In some places they appear as true stratified deposits dipping into the mountains, and in others as massive deposits lying on the barren granite or porphyry. The depth to which these deposits extend can only be determined by drilling. The large superficial showings of oxidized ore which are accompanied by smaller ones intimately associated with them, are evidences of the existence of bedded and blanket deposits at depth. In some localities bedded and vein deposits of great length and richness are to be seen. This class of deposit is found to consist of a pure oxide of iron to great depths. There is always the probability that these oxides of iron are a cap which covers deposits of copper minerals.

Copper-Iron Minerals

Copper minerals in association with iron manifest themselves in various forms. Sometimes at a few metres from the surface, the iron mineral will carry two, three, or even a greater percentage of copper (as is the case at Pueblo Hundido, Carmen, and other localities), and such an ore carrying considerable copper will extend to great depths. At other places are found fissures and small veins of high-grade copper in the main body of the iron oxide or in that zone lying between the vein or bed proper and the wall rock, but without extending into the deposit proper. One can be certain of not finding copper mineral in the iron ore in these occurrences. Copper is also found as phosphate and sulphate in certain zones of a deposit, but will disappear as length or depth is attained. These variations in the quantity and quality of the iron minerals in the various deposits make it necessary to prospect the property thoroughly before it is possible to make an absolute statement as to their value as deposits of commercial importance. In special reports on the geology of the country in which these deposits are found, it is possible to find some information as to their prospective importance and the best means of exploiting them.

Geographical Position

A study, which is as yet not completed, of the iron deposits of Chile, makes it possible to a certain degree to establish a general rule correlating the importance of these deposits from a commercial, industrial, and metallurgical standpoint with their situation in different parts of the Republic. Up to the present time there has not been found any deposits of high-grade iron ore in the southern provinces of Chile. Only low-grade limonite has been found in that region. The deposits of importance begin to appear at Parral in the province of Linares and ex-

*Translated from *Boletin de la Sociedad Nacional de Minera.*

tend north from this point. In the provinces of the central part of the Republic, are deposits of a good grade of iron ore, but these are generally not very extensive, and their position is so far distant from the coast that for the present at least, they cannot be exploited at a profit for the export trade. The deposits of greatest importance are situated in the provinces of Coquimbo, Atacama, and in the southern part of the province of Antofagasta. From this southern zone of the province of Antofagasta to the north, little is known at the present time. However, there are known to exist some deposits (as at Mejillones) of iron ore, which always contain copper or other metals.

The most important result of the latest studies has been to permit correlations of great precision between these deposits and to arrive at conclusions as to their general trend. The general course of the deposits is north and south, and these lie at somewhat fixed distances from the coast. Three systems of veins have been recognized to date. Naturally, the respective distances of the orebodies from the coast vary with the irregularities of the coast line and the conditions under which the particular part of the mountains containing the deposit was elevated. In a general way it may be stated that the first system of veins, which are found beginning at the sea shore on the west coast, extend to the east a distance of from 10 to 12 kilometres. The deposits at Tofo, Juan Soldado, Romeral, Huachalalume, Cifunchos, Cachina, Potrero (Taltal), Mejillones (Cobrizos), and others may be mentioned as belonging to this system. The second system is from 20 to 80 kilometres to the east and embraces the following deposits: Infiernillos, Dorado, Tunillas, Cristales, Algarrobo, Yeso, Depositos de Bodegas i Chamonate (department of Copiapó), Varillas, Sierra Aspera, and others. The third zone is from 100 to 150 kilometres to the east and includes the following deposits; those of the provincia de Santiago, Yacimientos de Illapel i Combarbalá, San Marco (departamento de Elqui), Potrero Seco (departamento de Copiapó), Púquios, and others. It will be interesting to connect these various deposits with lines on a geological map.

Domuño Deposits

Before speaking of the important deposits in general, I will give a brief description of the deposits at Domuño, which is near the port of Quintero in the department of Valparaiso and which was recently studied. On the side of the mountains at an elevation of 400 metres above sea-level and eight kilometres from the coast, in the argillaceous schists there appear some veins from 0.4 to 0.2 metres in width of specular and micaceous oxide of iron. On this vein there was sunk a small shaft to a depth of two metres and lower down an adit was driven into the deposit a distance of 12 metres. It was found that with a little depth the iron disappeared and in its place were found high-grade copper ores.

In the province of Coquimbo and the department of Serena may be mentioned the following mines which are of importance: the Tofo, Cristales, Juan Soldado, and Romeral. Recent developments at the Tofo property have confirmed the views set forth at the convention at Leeds, namely, that the deposit would become of increased importance as depth is attained. An adit which has opened the deposit at a depth of 180 metres has revealed a large deposit of ore of the same nature as that at the surface. The ore which is at present in sight in this deposit may be safely estimated at 150,000,000 tons. Recently the Bethlehem Steel Company of North America has made a contract with the Sociedad Altos Hornos to buy ore from this property for a term of 15 years with the privilege of extending this time, at the rate of over one million tons of ore per year. This production will in no way interfere with the supply necessary for the Corral company. The work will be conducted under American supervision. The Bethlehem company is going to spend $8,000,000 in preparation for this work. The plans include the construction of vessels for the special purpose of transporting the ore from Chile to the United States.

The mines of the Cristales district have not been developed to sufficient extent to date to ascertain the exact extent of the orebodies, but there is reason to believe that these orebodies will lead to deposits of importance. It is believed that it will be a comparatively easy matter to transport the minerals of this district to the coast, as a railroad is to be constructed which will supply an outlet. It is also proposed that government engineers will explore this country by means of drills. Various samples, which have been taken, show 60% Fe and some have a high copper content, but the copper is usually independent of the amount of the iron.

Mines of the Juan Soldado District

In former discussions of this district I have presented the information which has been obtained from engineers who have made a special study of the region and have thoroughly prospected it. Some of the prospects, particularly those which have been discovered in the Chacay district and farther south in the Jardin (Quebrada Honda) country, have been proved to be superficial. Trenches, which were cut, went to the barren rock. On the slopes of the mountains in the southern part are to be seen some outcrops from two to three metres wide, which are of interest. A vein one metre wide is also known in the Portezuelo district, but has not been prospected. Many veins are to be seen in a ravine which traverses the district in a north and south direction. The principal vein-system is cut at right angles by another system. Little, however, is known of these deposits. To the south of Romeral, passing down the valley to the Triga district, there are veins which do not outcrop, but which are covered with earthy material. Some of these veins are from 10 to 12 metres wide and appear to constitute good deposits. Between Romeral and Juan Soldado, is the Cepo valley, and the Rincon de las Minas, with numerous outcrops of veins from two to three metres wide and containing a good grade of iron ore with no copper. While the mineral deposits of this region are numerous it would be difficult to work them at a profit. The principal difficulty would be in the mining, which through the nature of the deposits would make exploitation expensive.

The Romeral deposits are situated three kilometres

to the south of Juan Soldado and fifteen kilometres to the east of Punta Teatinos. The superficial deposit of oxidized ore has a general width of 250 metres and a length of about a kilometre. The deposit may be considered as being divided into two parts. In the prospecting work which has been done in the district some good deposits of oxidized ore have been found. It would be well to prospect the ground with drills in order to determine more regarding the extent of these deposits, which are most attractive from the standpoint of quantity and quality of the ore and the ease and economy with which the deposits may be exploited. With the work which has been done to date it may be said that there is at present in sight 15,000,000 tons of good iron ore. The nearest port would be Punta Teatinos; this, however, is an exceedingly poor one and a large amount of work would be necessary to protect it from the south winds. At the present time the only port available is Coquimbo.

Mines of the Department of Ovalle

As one leaves Ovalle in the direction of Punitaqui, at a distance from the city of 15 kilometres, after passing a narrow pass called Cruz Colorada, the sides and tops of the mountains to the west of the wagon road, particularly at a point called Piedra Rodada, show interesting deposits of iron oxides which have a southeast and northwest trend. A railroad has been proposed which will connect Punitaqui with Ovalle and which will pass at the foot of these hills. I have seen large masses of good oxide of iron and also large quantities of mineral, which was not in place, in the district. On the other side of the mountains are to be found the copper mines. To the north are found deposits of iron ore carrying some copper. One of these copper deposits has been prospected to a depth of 15 metres. The principal iron outcrops are to the south of the district.

A shaft was sunk to a depth of 60 metres on the Dorado property and is reported as being in a pure oxide of iron. Mr. Echegarai has made an examination of this deposit and has found some indications of copper and a four-metre vein of good iron ore. With these proofs of a deposit whose apex is high above the plain and which is known to continue in depth, it can be stated that there are many millions of tons of iron ore in it. At the foot of the hill and four kilometres to the south a prospect shaft was sunk four metres and is in good iron oxide. It is planned to continue this shaft to a greater depth. The freight rate from Dorado to Tongoi is about $1.80 per ton, but this figure could undoubtedly be reduced to less than $1.50.

At a distance of 33 kilometres from the city of Coquimbo, near Islon, in what is known as a copper country, are to be found good indications of iron. In many deposits the copper is found intermixed with iron and the ore is very silicious. It would be interesting to investigate these deposits at depth. In the same province at a short distance from the railway, which runs from Serena to Vicuña, in that locality in which ferro-manganese mines were formerly worked by Joaquin Naranjo, it would be interesting to make a further investigation of the manganese iron deposits.

Department of Atacama

At Yeso, in the department of Atacama, pockets of a black oxide of iron, which do not outcrop at the surface, have been found. These deposits are also to be found in the neighboring hills, but there has not been enough exploration to determine their importance. At Huanteme there are two deposits of iron oxide. The largest has a width of 60 metres and a length of 100; the smaller is 80 metres long and 15 wide. It is probable that these deposits are superficial. The deposits are composed of a dull gray hematite with some magnetite. The Mantos group gives promise of some importance. The last claim, the Beatriz, is 200 metres from the Coquimbana and is 12 kilometres from the mine of that name. This vein has the characteristics of the Coquimbana vein and might be a branch of it. The minerals of this deposit should carry manganese. The vein is two or more kilometres long and five metres wide. The ore is a gray hematite. The Chañar Quemado mines are the most interesting of the department. The principal orebody is 100 metres long and 40 metres wide. The ore is a magnetite. There is a surface deposit of about 40,000 tons of a good oxide of iron. Not enough work has been done on any of these groups to permit an opinion as to their future possibilities. The Santa Lucia deposits lie to the north and show some evidence of mineralization. The principal deposit is 80 metres long and 20 metres wide. The formation is irregular and there is no ore on the surface. The Los Colorados deposits appear to be the most extensive of the entire region.

Speaking of the deposits in general, I do not think they are, for the present, of economic importance because of the grade of the ore and the high cost of transportation. To work the properties, expensive railroad construction and aerial tramways would be necessary. As exceptions, however, might be mentioned the Mantos, Chañar Quemado, and Los Colorados deposits, concerning which it is impossible to give an exact opinion through ignorance as to the quantity and quality of the ore at depth.

Department of Copiapo

In the department of Copiapó iron deposits are in evidence in many localities. The Potrero Seco deposits are 123 kilometres from the port of Caldera. The deposits are irregular and occur at an altitude of about 720 metres above sea-level. The ore appears as outcrops of magnetic oxide of iron, specular hematite, and pyrite. The owners of these properties plan to make a thorough investigation of the deposits. As it is, nothing definite may be said as to their importance.

In the Copiapó district, four kilometres from a little station named Carpa IV, there is a deposit known as the Chamonate. This deposit outcrops with a width of two and a half metres in the form of a dike which has a general north and south trend. Farther to the north there are other outcrops of iron oxide three and a half metres wide, some of which contain manganese.

Seventy-five kilometres from the port of Caldera and four and a half kilometres southeast of Bodegas there is situated a group of iron deposits known as the Bodegas deposits. The outcrops have been very

much decomposed and the mineral occurs as a pure magnetite. In the neighborhood there are copper deposits which have been formed in a carbonate of lime formation. The first of the iron deposits is 60 metres long and 25 wide; the second, which is to the south, is 100 by 50 metres, and a third deposit is of the same size, but broken in formation. These deposits are 280 metres above the valley and it would be possible to transport the ore from the mine by means of an aerial tramway. Other deposits than those mentioned are known in the district. It would be very commendable if the government would undertake drilling operations in one of these localities, such as the Chamonate, in order to ascertain something as to the nature of the deposits at depth and also to learn if water is to be had by sinking.

Chañaral Deposits

The Granate deposits are in the Sierra del Buitre in the Tierra Amarilla district about four and a half kilometres from the railway. One of the veins here is three metres in width and can be traced for a distance of 400 metres. In some parts of the vein there are copper-bearing minerals. In the Sierra de Gallegüillos, at a distance of 30 kilometres from Copiapó and at a distance of about 30 kilometres from the bay of Obispito are situated the Portezuelo Negro deposits. Here are known to exist a number of veins of about four metres in width. It would be interesting to prospect this district at depth and ascertain if the many veins united at depth to form one large orebody. The iron occurs as oxide.

The deposits in the department of Chañaral at Varilla are large and important. These orebodies, which have been known for a comparatively short time, are situated at a distance of nine kilometres from Vetado, on the railway from Chañaral to Pueblo Hundido. The station is 13 kilometres from the port of Chañaral. The general strike of the veins of the district is north and south. The outcrop is well pronounced and forms a dike of iron oxide which is about two and a half kilometres long. The width of the dike and its branches vary from 10 to 60 metres. The ore which is on the surface amounts to over 500,000 tons. It would be an easy matter to construct an aerial tramway from these deposits to the station at Vetado, a distance of about nine kilometres, from which the ore could be transported to tidewater at Chañaral. It is possible to transport the ore the entire distance to the port by means of an aerial tramway, which would be about 22 kilometres in length. I have been told by a reputable French hydraulic engineer that it would be easy and cheap to construct a breakwater at the railroad terminal as a protection against the south winds and a pier where it would be possible for large boats to dock. At a distance of 12 kilometres to the west of Pueblo Hundido and at a short distance from the railway, concessions have been asked for the exploitation of iron deposits of an exceedingly good quality.

In the department of Taltal in the province of Antofagasta there are numerous deposits of iron ore. The Cifunchos deposits are situated at a distance of about 12 kilometres from the bay of Cifunchos and at a height of 100 metres above sea-level. Five distinct veins are to be seen here about 2 metres wide, which extend in a north and south direction for a distance of 2000 metres. Samples which have been taken, indicate a good oxide of iron. To the north of these deposits there is a deposit known as El Vetado, which has a width of from 1½ to 2 metres. Both timber and water are to be had for mines in this district.

The Cachina deposit is situated at a distance of about 7 kilometres to the east of the port of Taltal in a claim known as Miramar at an altitude of 600 metres. The general direction of the strike is northwest and southeast. In an open cut on the claim known as the Salvadora, the vein is about three metres wide. It is not known as yet what the size of this deposit will develop into. The ore is a good grade of red hematite. To the north of this deposit are the Esplotadora, Miramar, and Valparaiso, and to the south the California and Mexico deposits, which have a length of three kilometres. Throughout this entire length, but with interruptions, are to be seen beautiful outcrops of iron oxide. The deposits could be worked by open-cut methods.

The Potrero deposits are of great interest. The Vencedora, Chile, and La Norte Magnética may be of importance. In an open cut in the Alemania claim good iron ore has been exposed. Four metres of good oxide has been opened in the Vencedora claim. There are many faults through the district and the veins which are exposed at the surface may be the branches of a large formation which would be found in depth. Between the larger veins are numerous smaller deposits varying in width from a half to two metres. Sometimes these veins contain copper minerals. The Palermo vein is three metres in width. The strike of the vein is east and west with a dip to the south. Preparations are being made for the prospecting of deposits which are known to exist in the desert to the north and at a little distance from the coast.

There is still much to be learned concerning the iron deposits of Chile, not so much in the south as in the north, but before becoming too much occupied with the deposits that remain to be discovered it would be more profitable to devote more attention to the known deposits and learn something further as to their real value.

The report of the Aramayo Francke Mines, Ltd., operating in Bolivia, shows the following results:

Ore treated, tons	37,660
Black tin output, tons	3,694
Black tin sold, tons	3,353
Wolfram sold, tons	281
Revenue from metals	$1 720,000
Dividends paid	432,000
Debentures redeemed	192,000

The properties are at an elevation of 12,000 to 16,000 ft. above sea-level. Facilities for transport are being improved by the completion of a railway line from Uyuni to Atocha. Mining prospects continue to be satisfactory, but labor is troublesome. A tramway, 1800 ft. long, constructed under great difficulties, was finished. The concentration plant will be enlarged, also a plant to treat low-grade silver ores may be erected, while the smelting of bismuth will be continued.

Smelting at Campo Seco, California

By M. W. von Bernewitz

In a hilly and somewhat rough district, although only at an altitude of a trifle over 300 ft. on the Calaveras county side of the Mokelumne river, is the property of the Penn Mining Company. The mine has been opened to a depth of 1400 ft. by the main incline shaft, while below this a winze has been sunk another 300 ft. The country rock may be described generally as a greenstone, and the ore has the following average analysis, gold and silver content being $1 per ton:

	Per cent.		Per cent.
Silica	23.0	Magnesium	2.0
Lime	1.5	Barium	4.5
Iron	22.0	Copper	5.0
Zinc	6.0	Sulphur	26.0
Aluminum	8.0	Moisture	1.0

This, it will be admitted, looks like a fairly complex smelting problem, but as is shown by the following description of the process, the ore is not troublesome.

From the main and No. 2 shafts the daily tonnage hoisted is 100 and 40 tons, respectively, that from the latter being higher in silica than from the main part of the mine. All over the surface of the property are tracks laid for the Vulcan steam locomotive, which hauls the ore in Weiner side-dumping 5-ton capacity cars to a 90-ton storage bin. From this the coarse ore is fed to a Gates No. 3 D-type crusher, and the fine passes through a grizzly. All of the crushed material and that from the grizzly is taken by an elevator to a trommel having ⅝-in. holes. The undersize from this goes direct to a conveyor-belt, while the oversize passes through a McFarland 16 by 36-in. set of rolls, then on to the belt with the undersize. An improvement is to be effected here before long in that the roll product will go through a second trommel with ⅝-in. holes, the oversize to be fed to a pair of 12 by 24-in. rolls. Roll shells last three months. All the ore is next conveyed to bedding bins having a total storage of 2100 tons, of which 700 tons constitutes one lot, which is independently sampled. The simple sampling device was described on the 'Concentrates' page of this journal of November 29.

Cars holding 1.3 tons of the bedded ore take it to the 8 McDougall roasting furnaces of the Pacific Foundry type. These are 11½ ft. diameter and have 7 hearths and a drying floor on top. Originally they had only 6 hearths, but the addition of another, and the drying floor, increased each furnace's capacity by about 20%. Rabbles are air cooled by induced draft, and if necessary, air may be forced through the reverse way. The speed is one revolution in 65 seconds, with worm drive, no fuel is used, and the sulphur is reduced from 26 to 8%. Dust losses are 1½% of the crude ore, but a fair quantity of this is saved in the 10 by 10-ft. flue, leading to the 6 by 85-ft. steel stack, which also serves the smelting furnace, being 125 ft. above it. A 15-hp. motor drives the roasting furnaces. The roasted ore is trammed to the charging hoppers over the reverberatory furnace after being weighed.

Anaconda Type Furnace

The reverberatory is of Anaconda type, 20 by 56 ft., of 788 sq. ft. effective hearth area, the roof and sides tapering toward the firing end. The roof has a rise of 20 in. at the centre, while the bottom is of fused silica of local quartz, and the sides of silica brick, then magnesite brick on the slag line, the thickness originally being 27 in. The furnace is oil fired, there being three burners of local make, oil being delivered at 80 lb. and steam for atomizing at 100 lb. pressure. Over a period of nine months the oil consumption averaged 43 gal. per ton of ore smelted, this costing $1.15 per barrel delivered at the works. Charging the furnace with ore is done about six times per 8-hour shift, each charge being 6 tons. During this work, the oil blast is shut off. Ordinary charge holes in the top of a reverberatory burn out in 6 to 8 weeks, but the water-cooled cast iron holes have been in 10 months. Slag is drawn off about every five hours into 25 cars holding 2000 lb. of this material, and the matte is drawn off once or twice daily, the same cars holding 2700 lb. of this product. The cars are taken to the slag or matte dumps as desired, by an electric locomotive. There is a concentration of 10 into 1, and the matte averages 55% copper, an dis crushed, sampled, sacked, and shipped to the American Metal Co. of New York for refining. There is also $20 per ton in gold and silver in the matte. Copper content of the slag is 0.5%, and

THE PENN CO.'S SMELTER AT CAMPO SECO.

with 45% matte it decreases to 0.4%. It will be seen that with no fluxes and at one operation this complex ore is reduced with no trouble, giving an unusually high-grade matte and low slag.

In the flue from this furnace, which has been in successful operation since February last, is a 250-hp. Stirling waste-heat boiler which generates enough steam to drive a Buckeye 150-hp. cross-compound engine, which is belted to a 120-kw., alternating-current, 440-volt generator, also a small direct-current generator, these supplying the power for the whole plant.

A new reverberatory furnace is being constructed near the one described and will be blown in early next year. It will have a similar roof, but the walls will be of 9-in. brick only, of silica and magnesite as usual, 19 by 60-ft. hearth area, and double ended, the fires to be reversed after every charge. This system is hoped to give good results.

During 1912 the Penn mine produced 51,162 tons of ore yielding 6,058,449 lb. of copper, 112,020 oz. silver, and 2867 oz. gold. A. P. Bussey is superintendent of this interesting property, with D. C. Smith as metallurgist.

Mineral Production in Virginia in 1912

By Thomas L. Watson

The value of the mineral production of the Virginia mines and quarries in 1912, as reported by the Virginia Geological Survey in coöperation with the U. S. Geological Survey, is shown in the accompanying table, together with the corresponding information for 1911. The total value of the production of minerals in the state in 1912 amounted to $21,276,157, as compared with $19,314,567 in 1911, an increase of $1,961,590, or slightly over 9 per cent.

Coal is much the most valuable product from an industrial standpoint. The quantity and value of coal mined in Virginia in 1912 exceeded by nearly a million tons in quantity and more than $1,250,000 in value the production of any previous year. The figures were 7,846,638 short tons, valued at $7,518,576, an increase of 981,971 short tons in quantity and $1,263,772 in value over 1911. The coal areas of the state which have produced or are producing are: (1) the Richmond coal basin in the eastern border of the Piedmont Plateau, and the only area of free burning coal in the Eastern part of the United States that is immediately adjacent to tidewater; and (2) the Appalachian region west of the Blue Ridge, which comprises a number of separate areas extending entirely across the state from Frederick City on the north to the Tennessee boundary on the south. New developments are in progress which will lead to an advance in coal-mining in Virginia in the near future.

Clay and clay products, derived from Tidewater, Virginia, showed a substantial growth in 1912, increasing from $1,743,007 in 1911 to $1,884,743 in 1912. Improved conditions in road making and the building trades in general brought about an increased production of quarry materials, such as granite, limestone, slate, etc., which amounted to $1,072,382 in 1912, as against $1,010,606 in 1911.

Many other products showed a substantial increase in 1912 over 1911, chief among which are mineral waters, talc, and soapstone, pyrite, millstones, etc. A noticeable decrease was shown in iron ores, and to a less extent in some of the lesser products, which is considered to be temporary only.

Virginia Mineral Output in 1911 and 1912[1]

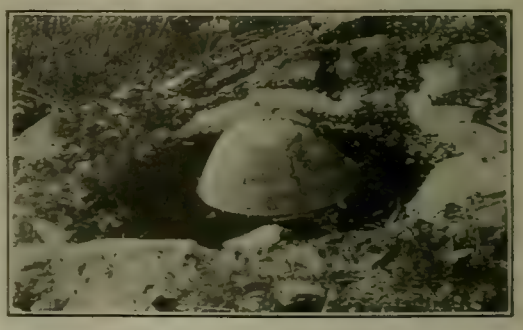
	1911.	1912.	Increase or decrease.
Clay products	$ 1,743,007	$ 1,884,743	+$ 141,736
Coal	6,254,804	7,518,576	+ 1,263,772
Coke	1,615,609	1,815,975	+ 200,366
Granite	420,611	470,657	+ 50,046
Iron ores	1,146,188	903,130	— 243,058
Iron, pig	3,898,285	4,364,708	+ 466,423
Lime	483,016	488,628	+ 5,612
Limestone	369,872	403,063	+ 33,191
Manganese ores	24,546	14,881	— 9,665
Metals (gold, silver, copper, lead, and zinc)	169,394	74,855	— 94,539
Millstones	17,635	25,866	+ 8,231
Mineral waters	298,701	349,255	+ 50,554
Pyrite	558,494	621,219	+ 62,725
Sandstone	31,315	4,020	— 27,295
Sand and gravel	204,170	291,773	+ 87,603
Slate	188,808	195,392	+ 6,584
Talc and soapstone	660,926	576,473	— 84,453
*Other products	1,229,186	1,272,943	+ 43,757
Totals	$19,314,567	$21,276,157	$1,961,590

*Includes asbestos, barytes, cement (portland), feldspar, ferro-alloys, gypsum, infusorial earth, manganiferous ore, mica, ochre, and salt in 1911, and barytes, cement (portland), feldspar, ferro-alloys, fuel briquettes, gems and precious stones, gypsum, infusorial earth, manganiferous ore, metallic paint, ochre, rutile, and salt in 1912.

[1]These figures are published in more elaborate form in Bulletin VIII of the Virginia Geological Survey.

An Old Arrastre

The accompanying half-tone shows one of these old machines at Blewett, Chelan county, Washington. It is especially interesting, as it was hewn out of the solid bedrock of the creek. The rock is dark



ARRASTRE CUT OUT OF SERPENTINE.

green and compact and composed principally of hornblende, with white streaks of quartz and feldspar and is finely polished. It was hewn by a half-breed Indian named Culver about twenty-five years ago, and it is said that he extracted a small fortune with it from free-milling surface ore found in this district.

Taiwan, in the first six months of 1913, yielded: gold, $400,485; copper, $257,788; coal, $251,094; sulphur, $14,053; silver, $17,222; petroleum, $24,534.

Discussion

Readers of the Mining and Scientific Press are invited to use its columns for the discussion of technical and other matters pertaining to mining and metallurgy. The best way to express one's views on any topic is by offering that careful criticism which is more valuable than general compliment. The importance of any contribution is determined by its probable interest to the readers of this journal.

The Rand Banket

The Editor:

Sir—The above scholarly paper will doubtless be criticized at length by the distinguished geologists and engineers mentioned in Mr. Rickard's introduction, but the matter discussed is of great interest to all who take more than a mere monetary interest in their profession. Besides, we must not lose sight of the fact that as, judging from the introduction and the undoubted high status of the author, this paper is likely to settle definitely the dispute about the origin of the gold in the Rand banket. There is danger that in the future the views of the author are liable to be accepted as authoritative and final; therefore, as I believe that I have evidence contravening some of the statements about pyritic pebbles in general, I offer it forthwith, notwithstanding that we in England have so far received only the first installment of the paper.

In December 1911, while exploring and examining some mining permits in a remote part of the Natal district on the west coast of Sumatra, I came across some conglomerate of the Cretaceous period *on* which I found gold. I may add, by the way, that so far as my observations indicated, there was no gold actually *in* the conglomerate, or, at any rate, none similar to the gold that was receiving my attention at the time.

During the course of my work, as recorded in my diary, I found in the conglomerate a piece of vein-quartz, banded black and white, weighing about a kilogram. This, on crushing and panning, yielded pyrite, but no gold. I believe, and hope, that I saved a piece of this vein-quartz, but if so it is stored with goods where I cannot get at it at present. However, I have at hand some of the pyrite as washed out, and have forwarded it to C. B. Horwood in case it may be of interest. I, too, have seen mine-water and other surface-water heavily charged with iron sulphate owing to the decomposition of the pyrite, but surely this is no argument against the possibility of pyritic 'pebbles' occurring in a conglomerate of the pre-Cambrian period, such as the Rand banket, because many of us suppose, as we think, reasonably, that the atmosphere of pre-Cambrian days differed greatly in composition from that of the present (or Rio Tinto) day; in fact, we believe that in composition it approached very nearly to the original atmosphere, that is, carbonic acid, nitrogen, and aqueous vapor.

My pebble from a Cretaceous conglomerate was rather large. Still, from a general recollection of the surroundings and of the appearance of the pebble, I can recall no reason why smaller pyritic pebbles should not have occurred among other smaller pebbles. While in an inert (so far as oxidation atmosphere, such as I assume that of the pre-Cambrian period to have been, I see no reason why, provided they escaped destruction by attrition, even single grains of pyrite should not survive. Notwithstanding my remarks, which must be distinctly understood to combat only the idea concerning the impossibility of pyrite pebbles occurring in a pre-Cambrian conglomerate, I look forward to the details of Mr. Horwood's proof that the pyrite forming the Rand pebbles is secondary and was introduced long after the formation of the banket. I hope, too, that in one of the future installments we may be given an analysis of the Crown Reef dike where it is most and least altered, or an analysis of at least one of the typical dikes that occur so frequently in the mines of the Rand. In the latter remark I know that I am anticipating, but it so happens that I was searching for information on a similar point only the day before I received my copy of the *Mining and Scientific Press.*

STEPHEN J. LETT.

London, October 26.

The Editor:

Sir—In the installment of 'The Rand Banket' by C. B. Horwood, Part III (*Mining and Scientific Press*, November 1, 1913), the author displays a singular misunderstanding of Van Hise's rule for the change in volume accompanying metasomatic replacement, which he dismisses (page 676) in the following terms: "Moreover, in this example the two parts of his formula contradict one another; as according to the first part of it the volume occupied by the pyrite should be greater than that previously occupied by the replaced substance; and the second portion of his supposition requires that the pyrite should fill less space than was filled by the material replaced. Thus no great importance need be attached to his statement as a whole."

Van Hise's rule as stated in his 'Treatise on Metamorphism,' page 209, is as follows: "The volume of the original compound is to the volume of the compound produced directly as their molecular weights and indirectly as their specific gravities." Herein the author reads two separate and mutually contradictory principles instead of, as is obvious, a coherent formula expressed in words rather than symbols. Applied to the phenomenon under consideration, that is, the metasomatic substitution of pyrite for a quartz pebble in the conglomerate, it is only necessary to introduce the corresponding quantities, letting V_1 represent the volume of the original quartz and V_2 the volume of the substituted mineral, pyrite, thus:

$$V_1 : V_2 = \frac{60.4}{5.0} : \frac{120.0}{2.7}$$
$$= 302.0 : 324.0$$
$$= 1.0 : 1.07$$

It follows therefore according to Van Hise that pyrite, completely replacing a quartz pebble, would occupy a volume 7% greater than the latter. The accuracy of this figure, however, is conditioned by the exactitude of the specific gravities, respectively 5 and 2.7, stated by the author. As an example, if the specific gravity of the pyrite were as high as

5.2 and that of the quartz 2.6, it would be found that, instead of an increased volume, the pyrite would occupy a slightly smaller space (a fraction of 1%) than the replaced silica, which is more in accord with the author's observations.

HENRY H. KNOX.

New York, November 10.

Are there Jobs Enough to go Around?

The Editor:

Sir—On page 11 of the pamphlet issued by the sixteenth session of the American Mining Congress, I note the following paragraph of unknown authorship: "With the growth of the mining industry comes an increased demand for men with the technical training which is necessary to this highly specialized business. The growth of mining schools under state control furnishes indisputable evidence of this demand. Agricultural schools fostered by the federal government have been fully justified by results. Mining needs *more* greatly and is equally entitled to federal aid in the making of experts capable of dealing with its many times more difficult scientific problems."

I think these statements are misleading to the young and innocent: They do not express the true idea. There has been an increased demand numerically for technically trained men, but the supply has increased faster than the demand, so that the ratio of demand to supply is smaller today than it ever has been. The price of technical service is cheaper than ever before, remembering that this question is not concerned with the exceptionally talented man, but with the average intelligent technical graduate.

The ideas quoted above have been responsible for the flooding of the field with mining engineers. Literature of this kind has done the profession a great deal of harm, though it has benefited the industry by giving it greater competition among engineers and therefore cheaper service.

The growth of mining schools cited above as an example of this indisputable evidence, etc., has not been a healthy one. Probably 50 per cent of the graduates of these schools are out of a job. A great many have been crowded into some strictly commercial field which they entered as a last resource.

An advertisement in one of our journals for a technical man or a perusal of the application files of a big corporation will soon show the surprising number of men who are on the market, and who through the severe competition are compelled to take anything to keep going. Technical men had better opportunities twenty years ago than they have today.

The mining industry has benefited by getting technical men to do the work that was formerly done by untrained men and not paying any more for the improved service. The industry is getting better surveys, ore samples, assays, maps, models, reports, etc., than formerly, and is actually paying less for it.

Is it proper to deceive our high-school boys by telling them that the future mining industry will give them more openings, or a wider market for their services? Why not tell them the truth and say that there are more applicants for every technical position in the industry than there is in any other industry, and that the profession is as overcrowded as that of law or medicine?

There is always room at the top for the right men, but let there be no delusions as to the severity of competition in getting there, nor as to the future expansions of the mining engineer's field. There is already too much ignorance on the part of technical students concerning what is required of them in the profession. There are too many men in the field who by constitution are ill adapted to the all-round requirements of the profession.

Some of our universities are recognizing the conditions and are trying to raise the standard of scholarship in their graduates by making their course post-graduate. This again misleads the student into believing that scholarship is the thing, whereas the solution lies in wider experience with severe practical work of all kinds under actual money-making conditions. The severe practical work would act like a cathartic on the large classes that are drawing sheepskins every year. The process of elimination had better go on at that stage than afterward, because it is going to come sooner or later. A whole year's practical work between sophomore and junior years for one of the big operating companies for the usual wages, bunkhouses, and grub would change the ambitions of many who never realized that these conditions are any item in the business. It would be an act of charity to many who learn it only in time to become salesmen for a machinery or powder house. It would also make the quotation of engineer's degrees go up some in the labor market, and incidentally give our college instructors the rare treat of talking to men who had learned what a college could do for a man and what it could not do.

To come back to our article, let us recognize that new mining engineers are entering a crowded profession that has fewer openings now, relatively speaking, than it used to have; that there is no indication of a runaway market in sight in the future; and that a high standing in scholarship is no measure of their character, personality, tact, originality, courage, and nerve, and a whole host of qualifications which are in reality the determining factors of success.

F. SOMMER SCHMIDT.

Salt Lake City, October 28.

Grinding-Pan Practice

The Editor:

Sir—The article on 'Grinding Pans at Kalgoorlie,' by M. W. von Bernewitz, in the *Mining and Scientific Press* of May 17, and the subsequent discussion, was particularly interesting to me, because at the mill with which I am connected, grinding pans are run as slimers in closed circuit with mechanical classifiers, and are giving excellent results.

According to the description of pan practice at Kalgoorlie, the discharge lip of the pan is used as a return classifier for sand which requires further comminution. This should give similar results as

arranging the pan in closed circuit with a separate classifier. But if in the latter system an efficient classifier is used, it has the advantage of exclusively returning to the pan the material that needs finer grinding. On the contrary, the discharge-lip classifier, working under free settling conditions, must give an underflow with considerable slime, thereby diminishing the capacity of the pan. The high duty of 30 tons per 24 hours ground through 200 mesh by a 5-ft. pan, obtained at our mill, may be partly

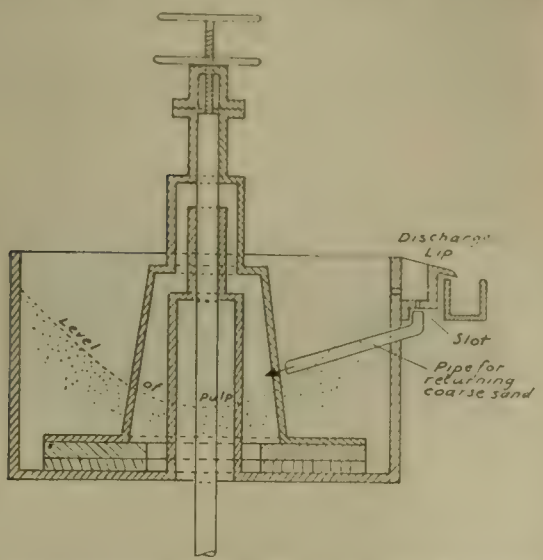


DIAGRAM SHOWING ASSUMED LEVEL OF PULP IN GRINDING PAN.

ascribed to the fact that the classifiers keep all slime out of the feed. The capacity is also favorably influenced by directly discharging the pulp, after it has once passed underneath the muller, without returning it to the centre of the pan by deflectors. Thus the pulp, which is fed at the centre, comes between shoes and dies entirely free from slime. An advantage of having the classification done by the slotted-discharge lip is that an elevator or pump is not needed, which is indispensable for returning the discharge pulp of the pan if a separate classifier is used.

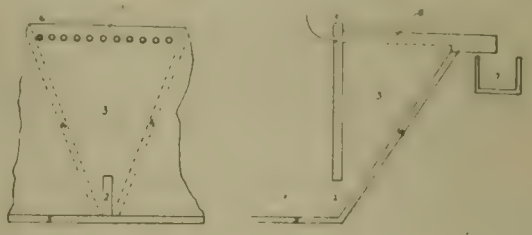
Mr. von Bernewitz does not explain how the underflow of the discharge lip is again fed to the pan. The pulp takes a paraboloidical shape with the apex in the centre of the pan; the elevation of the pulp at the periphery above the level in the centre is proportional to the number of revolutions of the muller and amounts to at least 12 in. when the muller revolves at 50 r.p.m., or more. Therefore it would seem feasible to convey the returning pulp to the centre of the pan by a pipe passing through the body of the pan, as shown in the accompanying sketch. I do not know if this is the way in which the return of coarse pulp is effected at Kalgoorlie, and should feel obliged to Mr. von Bernewitz if he would elucidate this point.

M. G. F. SÖHNLEIN.

Ingenio de Machacamarca, Bolivia,
September 17.

The Editor:

Sir—I am pleased to know that my notes on this subject have been well received in far-off Bolivia, and think that Mr. Söhnlein's pan results are interesting. As I said in my reply to Mr. Randall in the *Mining and Scientific Press* of November 8, a properly devised overflow lip classifies to a large extent, but a separate classifier in closed circuit with a pan would probably do better work. The coarse pulp is not returned to the pan as in Mr. Söhnlein's sketch, and at 50 r.p.m. the pulp does not assume the shape shown, but keeps level. Referring to my original article of May 17, 1913, on page 735 is a description of the flow of pulp in a pan. The discharge lip of a 5-ft. pan is about 18 in. long, 24 in. wide, and the same depth as the pan, being bolted on to it. About 2 in. from the top of the pan, on the lip side, are a number of 1-in. holes made during casting the pan, through which the pulp flows to



FRONT AND SIDE VIEW OF DISCHARGE LIP.

the lip, and on the lip side of the pan, close to the bottom, is a slot about 1¼ by 6 in., through which the coarse sand is drawn into the pan from the lip by the suction of the revolving muller. A lip holds about 20 gal. of pulp, and is always full, as is true of the pan. On the outside of the lip is a launder to carry off the slime overflowing. This is so in a sliming pan, but in one used for stage crushing, such as the Freeman or Cobbe, the pulp assumes a shape somewhat similar to that in Mr. Söhnlein's sketch, as the overflow devices are quite different.

M. W. VON BERNEWITZ.

San Francisco, November 1.

The following rules relative to underground timbering are selected from certain regulations used by iron-ore mining companies in the Lake Superior district: Timber must not be hoisted or lowered through a shaft, compartment, or raise that contains a ladder. In drifts and openings, timbering shall follow as close to the breast as is practicable; in soft ground sets must be placed as soon as there is room, and the roof must be secured by poles resting on the cap and set into holes at the top of the breast, these poles to remain as lagging; loose dirt on back and sides must be carefully trimmed. When timbering is being done on a stope or a raise, special care must be given to platforms and staging; stage poles shall be put about 2½ ft. apart when raising. No spikes or nails shall project from timbers or boards placed where the nails may be stepped on or may tear flesh.

Coal exports from Newcastle, New South Wales, during the first nine months of 1913 amounted to 3,786,432 tons, valued at $9,645,727. This fuel is sent to other Australian states, New Zealand, islands in the Pacific ocean, and the west coast of North and South America.

Concentrates

Most of these are in reply to questions received by mail. Our readers are invited to ask questions and give information dealing with the practice of mining, milling and smelting.

Filling stopes with sand at the Simmer & Jack mines, on the Rand, costs 6.8c. per ton lowered, on the surface, and 13.2c. underground, a total of 20c. per ton sent below.

Deister No. 3 slime tables should be run forward, at a speed of 265 to 300 r.p.m., with an average stroke of $^{7}/_{16}$ in. On light copper sulphide ores a speed of 265, and for zinc-lead separations a speed of 300 r.p.m. will give good results.

Shaft sinking at the Nevada Wonder mine during the past fiscal year averaged $34.26 per foot. This included the cost of enlarging and fitting up the 700-ft. station for an electric sinking hoist, and cutting stations on the 800, 900, and 1000-ft. levels.

Announcement has been made at Washington that hereafter certificates will be issued upon final proof in the case of application for patent on mineral claims. This will relieve the applicant from doing assessment work during the time that the Field Division is examining the ground.

Free determination of mineral specimens is made by many state's institutions. Samples addressed to the California State Mineralogist, Ferry building, San Francisco, will receive attention. There must not be more than three sent at one time, and they must come from places within this state only.

Prospecting gravel for future dredging operations is done by drilling or sinking small pits or shafts. From the latter, the whole of the gravel removed is washed and averages calculated. This is a good system when the gravel is dry; but where there is a large quantity of water to contend with in the pit, and pumps must be used, results are very apt to be misleading. In this case the drill is more suitable, although even then great care must be taken, and the personal element of the man in charge has to be considered.

Means of locomotion by mining engineers, geologists, and others in the field is of importance. Considerable time is generally lost in getting from camp or hotel to the point where work begins, in returning at night, and in moving headquarters. It is important that the geologist should travel quickly and arrive at his work fresh and full of energy, according to Joseph Barrell. This is the first point in geologic methods on which the efficiency engineer would probably put his finger. The motorcycle could without doubt be made of large use in this respect. With it the worker could reach distances of twenty miles in the same time he would walk three. From one base 1600 square miles could be reached with the same facility as 100 square miles by walking.

Disposal of residue at Kalgoorlie is done by the following methods: tramming with horses on the Associated Northern; cars drawn by electric locomotives at the Ivanhoe and Perseverance; belt-conveyors at the Horse-Shoe; and sluicing or pumping at the Associated, Boulder, Kalgurli, Lake View, Oroya-Links, and South Kalgurli; belt-conveyors for this purpose have been practically discarded in favor of the pumping system. The old dumps were becoming a nuisance in many ways, and are slowly disappearing by being re-treated or used for underground filling. For the pumping system the government sells water at 36c. per 1000 gal., but none from the ponds can be returned. At the Boulder, Lake View, and Oroya-Links vacuum plants, the residue drops into mixers or very strong agitators, where it is mixed with water and pumped away. At the Kalgurli the residue is taken from the presses to a mixer

A SLIME DUMP AT KALGOORLIE FORMED BY PUMPING.

by cars. At the Associated and Lake View the press residue drops onto belts and is discharged into a vortex mixer, and pumped away to ponds on their own leases. At the South Kalgurli, the press residue drops to sloping floors and slips down into a mixer, then to two agitators large enough to hold the residue from an eight-hour mill run, from which it is pumped away from the mine, twice a day, the pipe is afterward washed with clean water. The vortex mixers are driven at 150 r.p.m. by gearing or quarter-turn belts, the latter being a good method and eliminating all noise. At the Associated, the cheap water is used in addition to all the salt water from the mine, change-room discharge, boiler blow-off, and general catchment. A motor-driven geared mixer uses 6 hp. The amount of water used varies, but in addition to 20% moisture left in the press-cakes, there is required about 140 gal. per short ton. In vacuum plants a smaller amount is required. Pumps used have two or three slow-speed plungers, packed with greasy hemp or a graphite composition, and also clean-water jets to prevent their cutting out. It was noticed that when this pumping method was first used, the pipes gradually filled up. The practice is now to make sure that the pipe is discharging at full capacity all the time, and when pumping is finished the pipes are washed out with clean water, thus preventing their choking. In laying a pipe-line, care should be exercised that there be no depressions in the line where settlement will take place. Costs are as follows: tramming by horses, 10c.; by belt-conveyors, 10c.; by electric locomotives, power at 5c. per kilowatt, 12c.; and by sluicing or pumping, 7 to 12c. per ton of dry ore treated. The accompanying half-tone shows how slime dumps or ponds are formed on level ground, the mill residue being pumped to them and then gradually built up of this material.

Special Correspondence

TORONTO, CANADA

COBALT ORES AGAIN BEING SHIPPED IN LARGE TONNAGES.—LA ROSE AND SENECA SUPERIOR. INVESTIGATIONS INTO COBALT ORES.—DOME LAKE, TECK-HUGHES, AND JUPITER.—OIL IN ALBERTA.

The difficulty which was experienced some weeks ago in marketing Cobalt ores appears to have been satisfactorily overcome, as the weekly shipments have been heavy of late. The statement of the La Rose Consolidated for October shows an output of 203,454 oz. silver and profits of $67,927. The surplus on hand was $1,709,579. The extension of the Seneca Superior vein on the Gould Consolidated property adjoining, has pinched out after being followed for 30 ft. The Seneca Superior has cut its main vein on the 100-ft. level, where it contains about 6 in. of 1000-oz. ore. It is wider, but not so rich as on the lower levels. The Mines Branch of the Canadian Department of Mines is promoting an investigation which promises to have important results for the Cobalt silver industry. Hitherto the shippers of Cobalt ore have had little advantage from the cobalt content of their consignments for which the smelters, as a rule, make no returns, so the Mines Branch has engaged H. T. Kalmus, of Boston, to conduct a series of experiments at Queen's University, Kingston, to devise a process for the economic reduction of cobalt from the ore, and the production of alloys from the metal. In a preliminary report, Mr. Kalmus states that so far he has met with encouraging results, and ascertained that the method of preparation by direct reduction with carbon can be done commercially at low cost. The pure carbon produced, he claims, has a tensile and compressive strength higher than any of the ordinary pure metals, and can readily be electroplated. As regards alloys with which he has experimented, he finds them considerably harder than the best tool steel, with both elastic limit and tensile strength as high as the standard specifications for structural nickel steel. The specific object of his researches is to produce an alloy combining lightness and strength suitable for the manufacture of automobile parts. It is estimated that, since Cobalt began producing, about 7000 tons of cobalt has been shipped in silver ores, for which mine owners have only received $566,000, in place of $10,000,000 which this content should have been worth to them.

The control of the Dome Lake has passed to interests associated with the Temiskaming & Hudson Bay of Cobalt. The shareholders on November 27 authorized the sale of 205,000 treasury shares at 17½c. per share to Thomas Reid. The Company will realize about $35,000, which will enable it to pay off liabilities and proceed with development. The Teck-Hughes, of Kirkland Lake, has also changed owners, Harry Cecil, representing an English syndicate, having purchased from the Great Northern a three-fourths interest. A large outlay will be made for development. The shareholders of the Jupiter, at a meeting held in Montreal on November 24, have authorized the issue of $50,000 in 6% bonds, running for eight months, to be offered to shareholders pro rata at 80 per cent.

The oil discovery at Black Diamond, near Okotoks, Alberta, which has been the cause of the flotation of a number of companies, despite the warning issued by the Calgary Board of Trade, which pointed out that the value of the deposit was exaggerated, has been followed by another oil boom near Athabasca Landing in the same province. A reported find in that locality resulted in a rush to take up claims, and four whole townships comprising over 70,000 acres were taken up in about two hours. No definite information as to the latter discovery is available, but the first is verified by the Geological Survey as far as it goes. The sample of oil forwarded was pronounced to be a 'white oil,' extremely light for a natural oil, and consisting largely of gasoline. Such oil is rarely found in quantity, but the officials of the Survey think it may be an important indication of petroleum in large quantities in the vicinity.

NEW YORK

FLOTATION LITIGATION AND POSSIBLE RESULTS.—DEVELOPMENTS AT THE CHUQUICAMATA AND BRADEN MINES IN CHILE.—CALUMET & ARIZONA AND SHANNON

Interest is keen here in the progress of the infringement suit of the Minerals Separation, Ltd., against the Butte & Superior. The first suit was against James W. Hyde, who claimed improvements on the Froment process then in use in the Butte & Superior mill, and was concluded by a sweeping decision for the plaintiff. As a matter of fact, the defense of the suit was decidedly weak, and the Butte & Superior can hardly have held a very strong hope that it could make good its contention that the Minerals Separation patent was anticipated by the Froment patent, because if Froment had tried to operate his process he would have found it necessary to modify it until it would have been substantially that of the Minerals Separation. As Mr. Hyde is no longer in the employ of the Butte & Superior, it was necessary to bring a second suit against that Company. To this suit the defense was made that Mr. Hyde was not the agent of the Butte & Superior and that the process now in use there was devised by F. G. Janney. The judge held that the Butte & Superior was now infringing the patent of the Minerals Separation, but refused to grant an injunction against the operation of the plant on the ground that 900 men would thereby be thrown out of employment, without sufficient compensating advantage to the plaintiff. The Butte & Superior was therefore directed to file a bond for $75,000 and to report its output to the court each month. It may be expected that the suit will be fought to the uttermost limit of legal ingenuity, for the process in suit is practically identical with that of the Minerals Separation, and if the latter loses this suit all hopes of profit in this country will be practically swept away. The stake for the Butte & Superior is also large, since the claim is for $3,000,000 damages and $1.25 per ton royalty for subsequent use of the process. The main stake is even larger than this, for the dominant interests in the Butte & Superior are the chief factors in Utah Copper, Ray, Chino, and Nevada Consolidated, which have a combined yearly output of 400,000,000 lb. of copper and which are now only saving about 66% of the copper in their ores. If by any means they can obtain the right to use a flotation process on these without the payment of a royalty, the gain will be tremendous, and the cost of fighting the suit to a finish is a 'good spec.' The royalty demanded is, of course, high, being on the basis of the claim allowed by law in case of willful infringement, and probably also to allow latitude for compromise in a final settlement. It is understood that the royalty to be paid by the Elm Orlu is about 25c. per ton, and that some copper companies have concluded contracts at about half that figure, since the royalty is based on the amount of mineral recovered rather than on the tonnage milled. The Inspiration expects to have its mill in operation in a few weeks, and the 250-ton plant of the Consolidated Arizona should be ready soon after the first of the year.

The ore reserves in the new Guggenheim property in Chile, at Chuquicamata, were already so large that the recent announcement that 100,000,000 tons have been added to them does not create even a ripple. Even the 200,000,000 tons of 2.5% ore now do not exhaust the possibilities of the property, for the outer boundaries of the orebodies have not been found in many directions. The first 10,000-ton unit of the leaching plant is planned and construction is about to begin. Word comes also that the reserves at Braden have been largely increased through the connection of the Fortuna and Teniente adits. S. S. Sorensen is now in charge and Pope Yeatman is also at the property, where he intends to stay until it is put in shape. The mill will be doubled in size, increasing it to 6000 tons capacity, and it is stated that the increase will only cost $500,000, as compared with the $2,500,000 spent on the first mill. Nothing recent has been given out in regard to the leaching plant at the Braden, as the attention of everyone there seems to have been concentrated on the more insistent difficulties.

Speaking of leaching, 'everybody's doin' it,' and the

Wagner Azurite Copper Co., at Luning, Arizona, has contracted for a 100-ton plant to be erected by the people who built the Butte & Duluth plant. The Kelvin-Sultana is also considering a 60-ton leaching plant, and nearly everyone is looking into the matter. The Calumet & Arizona smelter made an output of 4,500,000 lb. of copper in October, an increase of 500,000 lb. over the preceding month. The Shannon has made its quarterly report, showing an output of 3,362,157 lb. copper at an average cost for the quarter of 13.83c., the yield per ton being 44 lb. copper from the Shannon ore. The Shannon is one of the properties which operates at a cost so close to the selling price of copper that a decline in the price of the metal, such as the present market is showing, puts it into a bad condition.

An amusing rumor is in circulation that the Inspiration is about to take over the Mines Company of America, based on the fact that Charles Biesel and W. B. Thompson had a conference at El Paso recently. As a matter of fact, W. B. Thompson and W. H. Aldridge are already the chief moving spirits in the Mines Company, as John Lambert, W. E. Ries, and A. T. Black, who control the Company are not gold and silver mining men, and are doubtless glad to have the assistance of such competent *confreres*. In speaking of copper companies, it is interesting to notice that the convertible bond issue of the Chino has nearly all been converted, that Company now only having about $250,000 in bonds outstanding. The Nevada Consolidated only has $500 of its bonds still out. The Nevada Consolidated declared an extra dividend of 50c. per share, payable December 31, in addition to its regular quarterly dividend. This was a great surprise, as it had been said that the Nevada Consolidated would proceed to build up a big surplus. As a matter of fact, this payment will make the year's dividends exceed earnings by nearly $1,300,000 and correspondingly reduce the present surplus.

The outlook for the Ohio Copper Co. is considerably improved by the appointment of George F. Waddell as mill superintendent. Mr. Waddell is an old Butte man who has been mill superintendent for the Nevada Consolidated for several years, and his extended experience should benefit Ohio.

The Temiskaming & Hudson Bay Mining Co. has taken over 205,000 shares of the Dome Lake at 17½c. per share. This, added to the 200,000 shares acquired a short while since, gives it control of the Dome Lake. This property covers 120 acres in Tisdale township and has a 10-stamp mill erected. Recently about 1000 tons of $9 ore per month has been milled. The 'upset' price of the stock is a sad decline from last March, when it reached $3 per share. M. A. Teague found the property in 1911, but it proved a failure, and the stock in the $2,500,000 Company declined to 6c. per share. Early this year the capitalization was cut to $500,000, and this furnished the ammunition for a new market campaign which carried it back to $3. Under the new management the hopes for eventual success are much brighter.

Charles Butters has obtained patent No. 1,078,994, covering a modified filter now in use at the Tonopah Belmont mill and designed to overcome claims of infringement on the part of the Moore Filter Company.

GENERAL VIEW OF MOLINO, CHILE, SHOWING BRADEN CONCENTRATORS.

LONDON

MOVING PICTURES AND MINES.—TOMBOY SHOWS GOOD RESULTS. — GENERAL PETROLEUM FINANCED. — NATOMAS CONSOLIDATED NEEDS NEW CAPITAL.

The cinematograph has recently been used in London on several occasions for enlightening shareholders and the public as to the nature of mining operations. For instance, at the meeting of bondholders in the Natomas Consolidated an exhibition was given of the work of the gold-dredges. One of the London firms of film-makers has been taking views of Cornish mines, at the suggestion of Oliver Wethered, a London promoter, who has been instrumental in introducing outside capital into Cornwall. Nearly twenty years ago he found the greater part of the new funds required for rehabilitating Dolcoath after the severe effects of the great slump in the price of tin. One of his latest ventures is the reclamation of tin sand from Gwithian beach at the mouth of the Red river. At Mr. Wethered's invitation, a large audience assembled at one of the West End picture palaces the other morning. The series of pictures at Dolcoath were excellent, and included pay-day, ambulance practice, rock-drilling, the air-compressor, revolving roasting-furnace, dispatch of concentrate in bags

to the smelter, etc. Views were also given of the Geevor mine, and of Gwithian sands. Hitherto promoters and directors have only shown plans and specimens of ore, neither of which convey much idea to the layman shareholder. The pictures should help in reviving interest in mining among the public. The technical men present at the demonstration were pleasurably affected by the show.

The last year or two has been a dull time in mining in all parts of the world, and the press and the societies are discussing the reason. By many it is said that the public stand aside because they do not get a chance against the director and other inside speculators. That this is often, and even usually, the case, is only too true. For that reason, when we come across a company run for the benefit of the shareholders, we feel a gladness of heart, and its reports and the chairman's speeches act as an inspiring tonic. Such a company is the Tomboy, which owns property in Savage basin, Colorado. This is one of the Exploration Company's group. Ever since R. T. Bayliss assumed control, the Exploration Company has been noted for its thought of the shareholder and its contempt for private use of inside information. The Tomboy company was formed in 1899, and two years later, on it becoming apparent that the deposit did not persist in depth, John Herron, the manager, acquired the adjoining Argentine property. It was only a prospect at that time, and the price in cash was insignificant, but those who knew the geology of the ore deposits of the district were confident that the acquisition of the property was an excellent stroke of business. This view has been upheld by subsequent events, for dividends approximating £450,000 have been distributed on the output of a property that only cost about £15,000. Two years ago the Argentine orebody began to show less promising results of development, so again the Company sought for other property in the neighborhood. Eventually the Montana group of claims, forming the southern portion of the Revenue Tunnel company's property, was acquired for £80,000 cash. This sum was provided partly out of reserve and partly from profits. The ore extracted has already nearly recouped the cost. Development during the past year was satisfactory in spite of one or two disappointments owing to the veins being not as wide as expected. The reserve on June 30 was approximately 160,000 tons, averaging over 9 dwt. gold and 4 oz. silver. In the Argentine the reserve is 260,000 tons. Little exploration has been done at the latter lately, as it was deemed better to push the development at the Montana property. A glance through the quotations of Tomboy shares shows their steadiness at an uninflated level, contrasting in a wholesome manner with the absurd quotations and violent fluctuations characteristic of the Rhodesian market. The metallurgical problem at the Tomboy is of unusual interest, owing to the nature of the concentrate obtained and the various base metals in the ore. Gelasio Caetani and W. K. Betty have done excellent work, in consulting capacity, with regard to the recovery of the metals, in conjunction with D. A. Herron, the present manager. No doubt an exhaustive article on the subject will be published ere long, when the present modifications are completed.

Two important Californian enterprises are about to be re-organized, with a view to raising further capital in London. I refer to the Natomas Consolidated and the General Petroleum, both of which are American companies, but are now to be registered under English law. Among the sponsors for the General Petroleum are Andrew Weir, Arthur M. Grenfell, and H. C. Hoover; this is a strong combination. The Company is in an excellent position, and presents a contrast to the Natomas Consolidated. The latter is in a bad way, owing to serious miscalculations with regard to both finance and engineering. Not only do the bondholders suffer, but also E. J. de Sabla, the promoter. The engineering data and the financial requirements were stated plainly at the time of flotation, and it is no secret that Mr. de Sabla asked for $2,000,000 more than the estimate of working capital put forward, namely, $10,000,000 instead of $8,000,000. The estimate of yield and cost of plant, made by C. M. Rolker, has proved to be a long way out. During three years of dredging, the yield was $3,000,000, as compared with $5,000,000 estimated, and his estimate of cost of plant was too low by $800,000. In view of these figures, Mr Rolker's estimate of the gold content to four places of decimals of a cent provokes a cynical smile. It is practically certain that the new capital required will be forthcoming in London, and, if so, it will have an excellent effect in strengthening the financial position in California, recently shocked by the failure of the F. M. Smith enterprises.

JOHANNESBURG, TRANSVAAL

Deep Mining on the Rand and the Jupiter Property.

The prospects of deep mining on the Rand have not been improved by the recent closing down of the Jupiter mine. Of the three deepest mines on the Rand, namely, the Cinderella Deep, Simmer Deep, and Jupiter, the last has led the way, and the lowest point reached is over 5000 ft. below the shaft collar. Of the other deep mines, it has also been deemed advisable to suspend operations at the Cinderella Deep, while at the Simmer Deep, despite the fact that very large sums of money have been spent in its equipment, the results obtained are far from satisfactory.

It will be remembered that six months ago, at the last meeting of the shareholders of the Jupiter mine, the situation of the property was carefully explained, and it was announced that the board of directors was considering the advisability of increasing the capacity of the ore-reduction plant from 40,000 to 60,000 tons per month, and so enable the mine to earn increased profits with ore of a mine grade of $4.10 per ton. This scheme was decided upon, and every arrangement made necessary for the successful carrying out of the enlarged scale of operations, even to the raising of the necessary capital, but the strike disturbances in July, and the consequent exodus of native labor, made it necessary that the board of directors should reconsider the position. Without an adequate supply of native labor, some doubt was expressed as to the possibility of carrying on profitable operations at the Jupiter mine on an enlarged scale, for it cannot be said that the natives are in any way fond of working in the deepest mines of the Rand, when, as a rule, only an ample supply of labor can be obtained when the outcrop or shallower mines have plenty of help. Under these circumstances, two working policies presented themselves to the directors, the first being to mill on a reduced scale and adopt an ultra-selective mining policy, and the second being to suspend milling operations for the present and proceed with shaft-sinking into the still deeper areas of the mine, in the hope of finding ore of a higher grade. If the advisability of carrying out either of these working policies failed, the only alternative would be to close down all operations at the mine and so conserve the cash resources of the Company until a suitable opportunity and time arrives for working the mine on an enlarged scale, and increasing the capacities of the ore-reduction plant to 60,000 tons per month. After mature consideration it was not considered a sound mining policy to adopt a strict selective-mining method, whereby most if not the whole of the best ore reserves would be depleted in quite a short time, leaving a balance of such poor ore as to render its profitable extraction an impossibility in the future. To stop milling operations temporarily, and expend the cash resources of the Company in prospecting by shaft-sinking the still deeper unproved areas, did not offer much attraction, for it seemed doubtful whether the deeper areas would, if proved, contain ore of a higher average value than $4 per ton, even if these operations were confined to the Howard or richest part of the mine. It was therefore decided that, with the present paucity of native labor, the continuance of milling operations was impracticable, that the present cash in hand was not sufficient to put the mine and mill into a condition to produce and treat 60,000 tons per month, and that under the circumstances it was deemed best to suspend all work at the present and await the arrival of a period, accompanied by conditions as to native labor and otherwise, when it will seem possible to place the mine in a permanently satisfactory position.

General Mining News

ALASKA

Fairbanks

According to figures prepared by Frank Cook, agent at Fairbanks for the Wells Fargo & Co.'s Express, the output of the Fairbanks district for the year 1913 will be practically a million dollars less than for the previous year. The causes for this are various and hard to be determined, but many of the prominent men of the district attribute it in great part to the shortage of water during the past summer. The following is a list of shipments of bullion for the year 1913:

Fairbanks district	$3,469,321
Hot Springs district	215,579
Ruby district	70,585
Total	$3,755,485

The output of the Tanana valley since its discovery in 1903 is approximately $63,460,000.

Juneau

The Alaska Treadwell Mining Co. reports as follows for October:

Development, feet	356
Stock of broken ore decreased, tons	33,674
No. 1 mill, 240 stamps worked, days	29.90
No. 2 mill, 300 stamps worked, days	30.45
Total ore crushed	79,961
Gold by amalgamation	$125,237
Gold by cyanidation of 1705 tons of concentrate	110,526
Realizable value	233,406
Net profit	135,005

On account of ore from the 1320 and 1460-ft. levels being low grade, and because of the caving of the hanging wall, ore from the upper levels has not kept up its grade, the Alaska Mexican company lost $3262 in October. The 120-stamp mill worked 30.6 days and crushed 18,606 tons of ore, yielding $24,651. Operating expenses were $23,267 and construction $4646. The ore averaged $1.34 per ton.

Suit has been entered in the Superior Court of California, for the county of Alameda, by F. L. Morris and H. H. Patterson against B. L. Thane, for an accounting and further share of the commission received in connection with the sale to the Alaska Gold Mines Co. of the Sheep Creek, Ground Hog, and Silver Bow mining claims, and the Salmon creek and Granite creek water rights, including the 300 hp. of developed hydro-electric power. These properties were owned jointly by Messrs. Morris, Patterson, Thane, and J. R. Whipple, and, according to the papers in the case, Mr. Thane was authorized to sell them, it being agreed that the proceeds should be divided equally among the four. He received 9000 shares in the Alaska Gold Mines Co., which were duly divided. However, he also received a contract as manager at a salary of $10,000 per year and 12,000 shares to be transferred in installments in the course of three years. It is claimed that these 12,000 shares were not in fact salary but part of the consideration for the property and as such properly subject to division among the parties in interest.

ARIZONA

Gila County

(Special Correspondence).—At the Arizona Commercial, cutting the station at the 1300-ft. level is almost completed and the shaft is rapidly nearing a depth of 1400 ft., at which point sinking will be temporarily suspended. At the Superior & Boston the vein on the No. 6 level, which was sharply cut off by a mass of diabase, has been re-discovered through the aid of the diamond-drill hole which was started some time ago under the direction of E. Sweeney. At the Black Warrior, which is under lease to Snell & Fiske, operations were temporarily suspended because of the impassable condition of the roads. During the first 15 days of November about 650 tons of ore was shipped to the El Paso smelter, averaging 6.2% copper. Under normal conditions 54 men are employed, the daily output averaging 44 tons. The Gibson lessees are shipping 200 tons of copper ore to the Old Dominion smelter.

Miami, November 26.

Mohave County

The Tom Reed mine produced gold worth $110,000 during the past month. From the Gold Ore mine, regular shipments are being made by auto-truck to the Gold Road mill. The ore averages $11.50 per ton. A hoist is being erected at the Cone Mining & Milling Co.'s claim, west of the Boundary Cone and southwest of the Tom Reed. Rich ore has been cut at a depth of 95 ft. At the Golconda, the shaft is to be sunk from 495 to 700 ft. This mine yields zinc ores. The molybdenite deposits in Copper cañon have been inspected by F. W. Horton of the U. S. Bureau of Mines. Sixteen miles from Kingman is the C. O. D. mine, which produces gold, silver, and lead ores, and recently it was optioned to Qualey Bros. of New York.

Pinal County

The Gunn-Thompson interests have decided to erect a 500-ton concentrating plant on their property, the Magna, at Superior. The Calumet & Arizona Copper Co. is employing a large force of men in its mines there.

CALIFORNIA

October's oil operations showed a decline in production and an increase in consumption, details being as follows:

New rigs	27
Wells drilling, active	310
Wells drilling, idle	388
Producers, active	5,675
Producers, idle	1,250
Abandoned wells	15
Production from 16 fields, barrels	7,839,917
Decrease against September, barrels	416,793
Total stocks on hand, barrels	49,309,700

Monterey County

(Special Correspondence.)—At Parkfield, the Kings Quicksilver Mining Co., a Canadian corporation, has opened a body of low-grade cinnabar, reported to be free from other sulphides than the mercury sulphide. A 75-ton concentrating plant will be built soon. A 10-ton Scott furnace is being installed at present to be used for treating higher grade ore and concentrate. The whole equipment will be working by next spring, the machinery being constructed by Fairbanks, Morse & Co. A. A. Lewis is superintendent of the property. This Company attracted much unfavorable notice in Toronto by reason of its methods of promotion and the effort to make a mine will be watched with interest.

Parkfield, November 25.

Nevada County

A dividend of 6 cents per share, equal to about $30,000, will be paid by the Brunswick company of Grass Valley. Chris Mallen is superintendent.

Placer County

(Special Correspondence.)—The Glenn Consolidated Mining Co.'s property, on the upper Forest Hill divide, 8 miles above Last Chance and 60 miles from Auburn, has been bonded to F. J. Moss of Auburn. G. McAuly is president of the Company and G. R. Cowan a large shareholder. The mine has been watched by local men for a considerable time. Adjacent to it are the Blue Eyes and Pine Nut claims. The area has never been properly prospected. Seven gravel channels run through the divide, and have been very profitably worked at Last Chance. Above the gravel is a lava cap of about 600 ft. in thickness, the gravel averaging 5 ft. depth..

Auburn, November 25.

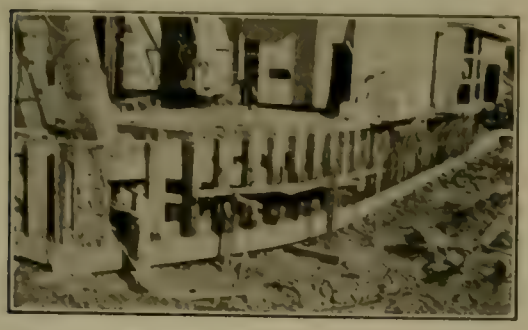
Plumas County

In the suit of J. J. Reilly *v.* the Seneca Mining & Milling Co., heard before the United States Circuit Court, it was agreed that the plaintiff is owner of the Del Monte lode claim near Seneca, and that all of the lode on the property, as well as the extension of the same vein downward through the White Lily and Wedge claims of the de-

fendant, also belongs to the plaintiff. This vein apexes on the Del Monte claim, and in 1909, 1910, and 1911 the defendant extracted ore worth $50,000, judgment for which was entered.

SACRAMENTO COUNTY

During September the Natomas Consolidated company's



REPAIRING NATOMA NO. 6 DREDGE.

dredges at Natoma yielded gold worth $198,621, the profit being $94,864.

COLORADO

GUNNISON COUNTY

The Kubler mine at Mt. Carbon is to be closed for the winter, and the men who are now working there are to be transferred to the Alpine mine. About 50 tons of coal was being mined per day, and 100 tons is being mined at the Alpine mine, and this will be increased materially when the men from the Kubler mine begin work at the Alpine. The tonnage will be increased throughout the winter.

TELLER COUNTY (CRIPPLE CREEK)

On December 1 a cave-in occurred in the Golden Cycle mine, and three men were entombed. Strenuous efforts are being made for their release. Owing to the coal miners' strike in southern Colorado, it has been difficult to get bituminous coal for the mines, so lignite, which is obtained easier, is being burned at several mines, using the Parkinson patent furnace. On December 1, the Golden Cycle shareholders received $45,000 as a dividend, making a total of $405,000 for the year.

Estimates of the November output of the district are as follows:

Where treated.	Tons.	Average value.	Gross value.
Smelters	3,985	$65.00	$259,025
Golden Cycle	34,100	20.00	682,000
Portland, Colorado City	9,500	22.00	209,000
Portland, Cripple Creek	16,200	2.76	44,712
Stratton's Independence	10,107	2.92	29,512
Colburn-Ajax	5,000	4.00	20,000
Gaylord-Dante	1,400	3.00	4,200
Wild Horse	1,200	3.40	4,080
Kavanagh-Jo Dandy	1,600	2.20	3,520
Isabella mines	700	3.00	2,100
Total	83,792		$1,258,149

One hundred feet of a 3-compartment shaft has been sunk by Joe Acton at the Chicken Hawk mine on Guyot hill in 20 days. Two Ingersoll-Rand jack-hammer drills were used, drilling 18 to 20 holes per round in granite. The contract for 250 ft. of sinking is nearly finished, and the shaft will eventually be 1250 ft. deep. The Mary McKinney Mining Co.'s shaft is down 1013 ft. The Doctor-Jack Pot Mining Co. reports that during the second and third quarters of the year, 3662 tons of $15.95 ore was shipped; and 733 ft. of development was done at a cost of $3.79 per foot, mostly on No. 9 level. Cash in banks totals $50,343. There are 12 sets of lessees on the Company's property. The Fountain Valley claim, owned by the Banner company, has been leased to John Kolman, of Cripple Creek, under certain conditions. A dividend of 2 cents per share, equal to $50,000, has been paid by the Elkton Consolidated Mining & Milling Co. A 200-ton concentrating plant is to be erected at the Vindicator Consolidated mine, and foundations are being prepared. The mill was designed by Edward F. Wiard, of Denver. The mine is developing well, and lessees are keeping up their ore production. During the current year, four dividends, totaling $180,000, have been paid.

THE SAN JUAN

The Tomboy mill treated 11,500 tons of ore in October, yielding $85,900 from amalgamation, cyanidation, and shipment of concentrate. The profit, including $4400 from the tramway, was $35,400. On equipment was spent $5185, not included in the above.

Operations at the Camp Bird during the third quarter of the year were as follows:

Development, feet	1,151
Stoping, cubic feet	102,860
Broken ore in stopes, tons	14,406
Ore treated, tons	7,865
Revenue	$204,405
Profit	107,367

On No. 4 level, the east drift is in 1281 ft., the last 35 ft. being 4 ft. wide worth $13 per ton. Raise 626 from No. 6 level, opened some good ore. The east drift on No. 7 level has been driven 174 ft. in $20 ore for a length of 10 ft., no ore for 24 ft., $15 to $20 ore for 20 ft., then no further ore.

IDAHO

LEMHI COUNTY

The lead-silver mines of Gilmore have been described by Ralph Nichols in the *Transactions* of the American Institute of Mining Engineers. The district was opened in 1880, and the present producing mines are near the terminus of the Gilmore & Pittsburg railroad. The mines are at an altitude of from 7400 to 8300 ft., and winters are severe. There are a number of prospects in various stages of development, while the producing companies are the Pittsburg Idaho, Latest Out Mining & Smelting, and Gilmore Mining. The lodes are fissures in limestone, with a northeast-southwest course, dipping west from 40 to 70°, the ore-shoots pitching south. The ores are oxidized, containing an excess of iron over the silica, the lead minerals being mostly carbonate of lead. A peculiar feature of the deposits is that the sulphides have gradually decreased in depth, also a falling off in lead and silver content. The ore is mined in bulk, requires no concentration, and is a most desirable smelting mixture for Salt Lake markets. Lead content varies from 25 to 45 per cent. Since 1910, the properties mentioned have shipped over 100,000 tons of ore.

SHOSHONE COUNTY

An interesting table has been compiled by the *Wallace Miner* showing the results of operations in the Coeur d'Alenes during the past 11 years. The following properties have contributed to the table below: Cleveland, Coeur d'Alene Development, Bunker Hill & Sullivan, Empire State-Idaho, Frisco, Gold Hunter, Golden Chest, Hecla, Hercules, Larson & Greenough (Morning), Standard, Federal Mining & Smelting, California Consolidated, Snowstorm, Tamarack & Chesapeake, Pittsburg Lead, Success, Marsh, Caledonia, Ontario, and various lessees.

Ore mined, tons	15,503,942
Gross value	$138,354,991
Net profit	36,215,027
Losses	955,304
Output for 1913, estimated	18,000,000
Profit for 1913, estimated	4,000,000

Five feet of good silver-lead ore has been opened for 20 ft. on the 1600-ft. level of the Hecla mine at Burke. It is said that the Marsh mine, adjoining the Hecla, may be purchased by F. A. Heinze. Lessees at the Bear Top-Orofino mine, near Murray, are shipping silver-lead ore. Six feet of copper ore has been opened in the adit at the Iron Mask. Under the laws of Arizona the Amy-Matchless Mining & Milling Co. has been organized with a capital of 1,250,000 shares at $1 each. Several claims on Pine creek, where a great deal of work has been done, will be developed. The construction of an electric railway between Wardner and

Kellogg for freight and passengers is proposed by the people of the district. On Thursday, December 4, the Bunker Hill & Sullivan Mining & Concentrating Co. paid dividend No. 195, of $81,750. This makes the total amount of dividends paid $14,729,250.

MICHIGAN

Houghton County

The Calumet & Hecla Mining Co. is preparing to open a series of test pits on the Frontenac and Manitou tracts, about 1½ miles south of the Delaware mine, for the purpose of establishing the relation of several cupriferous beds in these tracts with a number of formations disclosed in the recent diamond-drill operations of the Cliff Mining Co., eight to ten miles distant. The exploratory work on both tracts is under the direction of C. D. Hohl, formerly chief engineer of the Tamarack mine, recently appointed geologist for the Calumet & Hecla and subsidiary companies.

The Western Federation of Miners is making all kinds of rash statements regarding the mines and their ownership, and continues to fool the striking miners. On November 25, several men were tried before Justice Jacola for various assaults, the following names giving an idea of the different nationalities employed in the district: Korpac, Rosen, Steva, Karensky, Mesich, Orlich, Bima, and Stimac.

MONTANA

Fergus County

The Barnes-King Development Co. reports as follows for October: ore treated, 5300 tons, yielding $32,884; expenses, $18,550; balance, $14,334; of this, $10,750 went toward part payment for the North Mocassin property, leaving $3583 for the Barnes-King company.

Jefferson County

Negotiations are in progress between interests said to be identified with the Boston & Corbin and the Livingston Smelting & Refining Co. for the acquisition by the former of property of the Alta company at Corbin. The Alta was one of the old-time famous silver-lead producers of Montana. A large concentrator was operated in conjunction with the mine at Corbin. Suspension of work, with the exception of lessees, occurred in the early nineties, the ore becoming poor, which, with the decreased price of silver, made operations unprofitable. Results obtained by lessees have been encouraging.

Lewis and Clark County

Active operations in the Stemple district, situated in the 'Seven-Up Pete' gulch, are being conducted at the Rover, Lockey, Ibex, Reliable, Munroe, Last Chance, and Black Hawk mines, which produce gold and silver ores. These are hauled 30 miles by wagon to Silver. At their own expense the miners have recently constructed 11 miles of road, and one county commissioner stated that the county ought to start building some good roads.

Silverbow County

The most important development work of the Corbin Copper Co. is at the Gambrinus group of claims at Butte. Satisfactory arrangements have been made with the city of Butte permitting the sinking of a working shaft on the Gambrinus claim. The surface plant is completed and necessary machinery installed. The shaft is down 200 ft., and the location of the western extension of the Anaconda vein has been proved by cross-cuts at the 100 and 200-ft. levels. Four payments of $15,000 each have been made on this property, and the balance or final payment of $90,000 will be due January 17, 1914. It is to make this payment and continue sinking the shaft that an assessment of $1 per share has just been called. The Company is also continuing exploration on the Rochester claims. The option on these claims which expired in September 1913 was extended to March 1914. The exploratory shaft is down 500 ft. and the cross-cut at this depth is within a short distance of the vein. Several stringers carrying copper were cut by this cross-cut and commercial ore is expected when the vein is reached. The vein is an immense quartz fissure, 160 ft. thick, and on the surface shows copper-stained material on both walls.

NEVADA

Esmeralda County

According to the report of Albert Burch, general manager, the Goldfield Consolidated Mines Co. had the following results in October:

Ore treated, tons	30,486
Net realization	$146,918
Costs:	Per ton.
Mining (stoping and development)	$3.58
Shipping expense	0.23
Dump moving	0.04
Transportation	0.08
Milling	1.75
Marketing	0.04
General expense	0.33
Bullion tax	0.13
Flood damage	0.01
Total costs	$6.19
Miscellaneous earnings	0.08
Net costs	$6.11

Development covered 3088 ft. at a cost of $5.52 per foot. In general, the development work for the month did not result in the addition of any important orebodies, though some of them showed improvement in size and value toward the end of the month.

Work in the Combination yielded no pay-ore, but the 301-G and 328-N stopes, which are southerly extensions of the old Hampton stope, were nearly doubled in floor area. In the Mohawk the 176 drift northerly from the Sheets-Ish stopes produced 142 tons of $8 ore; and the 3-R sill in the same ground was extended and produced 52 tons of $12 ore. A cross-cut on the new No. 1 level near the Oddie shaft passed through 20 ft. of ore and produced 135 tons of $10 ore. The 130 drift on No. 1 level, about 200 ft. southwest of the Mohawk shaft, was extended and produced 17 tons of $12 ore. The 490 stopes below the old 354 orebody were largely increased in floor area. Very little development was performed in the Red Top-Laguna mines and no discoveries of importance were made. Most of the work in the Clermont-Jumbo mines was confined to the No. 8 and 9 levels, and while some good assays were obtained at some points, no orebodies of commercial size and grade were developed.

Humboldt County

The new orebody found in the Seven Troughs Coalition was opened about 50 ft. below No. 10 level by a cross-cut from a winze sunk in the foot-wall. There seemed to be a considerably disturbed country for some distance between where the vein was lost and where picked up again. The present work is identical with that above where the vein was regular, persistent, and highly mineralized close to 1000 feet.

Lincoln County

In October the Prince mine at Pioche shipped about 5400 tons, and the present output is 175 tons per day. Fifty men are employed.

Lyon County

The Mason Valley Mines Co. reports the following for the quarter ended September 30, 1913:

Mason Valley ore treated, tons	25,986
Custom ore treated, tons	21,469
Total	47,455

There was produced 2947 tons of matte which yielded 2,707,719 lb. of refined copper.

The financial results of the quarter's operations are as follows:

Gross operating profit		$33,187
Less depreciation	$28,296	
Less deferred charges	3,644	
Less bond interest	14,040	
		45,980
Net deficit for the quarter		$12,793

MINERAL COUNTY

The Lucky Boy adit is in 3000 ft., but it is estimated that another 2700 ft. must be driven to cut the main vein. Several small veins have already been cut, but not opened. The adit is 7 ft. high clear of timber, is electrically lighted, is supplied with fresh air by pipes, a covered drain carries off the flow of water, and machine-drills and electric blasting are in use.

NYE COUNTY

The annual meeting of the Jim Butler Tonopah Mining Co. was held at Philadelphia on November 12. The report of Frederick Bradshaw, the general superintendent, includes the following: During the year 6520 ft. of development was done. The workings on the sixth level of the Wandering Boy shaft are entirely in trachyte, the ore-bearing formation, with the exception of that in the north cross-cut from the winze on the seventh level, at a distance of 120 ft. from the vein, a block of West End rhyolite has been encountered which probably has no effect on the Fraction vein.

Ore shipped to Belmont mill at Millers, tons	18,900
Gross value	$374,903
Net returns from treatment	224,954
Expenditure on wages, power, etc.	109,693
Cash in banks	100,694
Loans on collateral	25,000
Total at September 30, 1913	$125,694
Balance a year ago	2,965

STOREY COUNTY

On November 21 new equipment arrived at Gold Hill for the Yellow Jacket, Crown Point, and Belcher mines, consisting of two Byron Jackson two-stage, electrically driven pumps, transformers, and two 200-hp. Westinghouse motors. The pumps have a capacity of 1500 gal. per minute, and are to be installed in the joint Crown Point-Belcher incline. They will unwater the mines from 1400 to 1700 ft. At the C. & C. pumping shaft the water has been kept at 5 ft. below the 2500-ft. level.

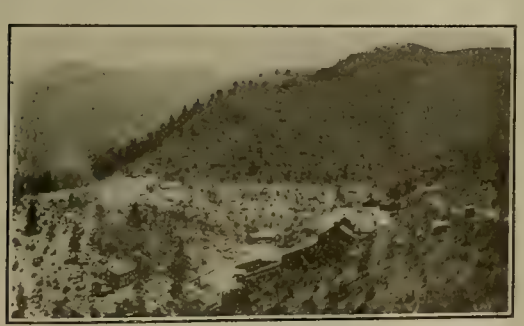
NEW MEXICO

GRANT COUNTY

The Cleveland group of zinc claims in the Pinos Altos district, belonging to G. H. Utter, of Silver City, have been acquired by the Empire Zinc Co. for over $200,000 cash.

SOCORRO COUNTY

Twenty-four bars of gold and silver bullion, weighing a little over a ton, were shipped from the Socorro company's mill to the mint, being the result of the first half of November. Eight tons of concentrate was sent to the smelter.



ERNESTINE POWER-PLANT, MINE, AND MILL.

A pipe-line for air is being laid at the Little Charlie mine. Electric equipment at the Pacific is almost complete. At the Maud, the 500-ft. level drift is to be extended. The Oaks Co. is driving from a winze from the B adit, and sinking is still under way.

SOUTH DAKOTA

LAWRENCE COUNTY

The Homestake Mining Co., of Lead, on November 26 notified its employees that every man of them would receive a Christmas present of 7% of his annual salary. The amount donated by the Company for this purpose is $150,000.

UTAH

Work on the 6000-ft. tunnel, which when completed will provide drainage and transportation for the mines of Alta, has been started. The tunnel is now 350 ft. long, and when completed it will cut the Alta properties 600 ft. deeper than the lowest developed point in the district. One shift is employed at present, and ample protection has been made against snowslides. R. L. Mack is superintendent.

SALT LAKE COUNTY

During the fiscal year ended August 31, 1913, the Utah Apex Mining Co., which produces lead, copper, silver, and gold-bearing ores, had the following results:

Gross value of ore sold	$803,928
Royalties and miscellaneous income	18,897
Total	$822,825
Mining	233,247
Milling	37,171
Freight and smelting	272,200
General, taxes, etc.	42,943
Interest, etc.	12,488
Profit	$224,774
Depreciation	94,585
To profit and loss account	$130,189

The miners' strike, during the latter part of 1912, interfered with operations; also the smelters have caused ore shipments to vary from 400 to 100, then to 300, and finally to 100 tons daily, as at present. This is unfortunate and increases costs considerably, but a remedy will be found for the trouble. By sinking the Parvenu shaft it is figured that the ore reserves will be greatly increased.

A curious affair has arisen at the Utah Apex mine. About two weeks ago a Mexican named Lopez killed a man at the Highland Boy mine. During his flight from capture he has killed five other men, and at last got into one of the adits of this property. The authorities have blocked all openings save one, and are trying to smoke the fugitive out of the mine.

SUMMIT COUNTY

It has been decided to work a portion of the Wasatch Mines Co.'s property by leasing. The Company owns 61 claims in the Little Cottonwood district, and a large output has been made since the start of operations. As soon as conditions are favorable for financing the property, the Company will start active development again.

UTAH COUNTY

High-grade lead-silver ore is being shipped from the Pacific mine in American Fork cañon. All equipment has been covered for winter work. Development is under way at the Dutchman, Comstock, Yankee, and Lehi-Tintic.

WASHINGTON

CHELAN COUNTY

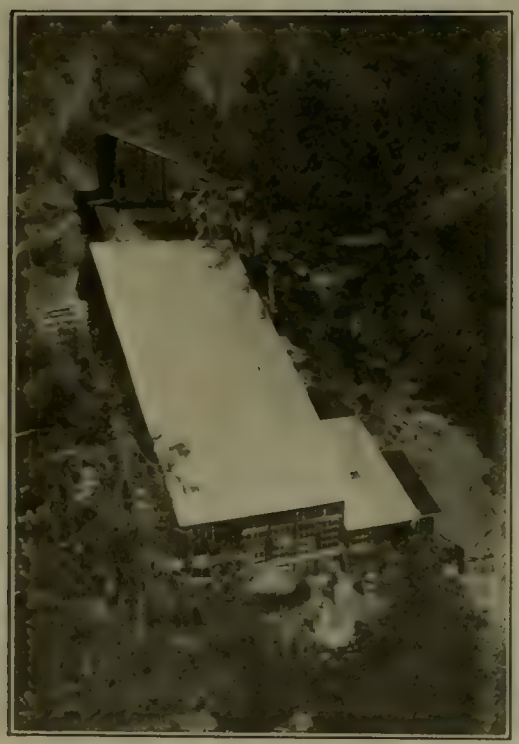
(Special Correspondence.)—The Golden Eagle Mining Co. has made tests in cyaniding its ore during the past summer, with satisfactory results. The gold is in quartz and serpentine, is very fine and flaky, much of it having been lost in stamp-milling heretofore on this account. The ore was crushed dry and conveyed to leaching vats, giving an extraction of about 80%. A 100-ton plant is planned to be in operation next summer. On the North Star claim, owned by this Company, an 800-ft. adit will be driven this winter to cut the vein at a depth of 800 ft. A. G. Clark, of Seattle, is the principal owner.

Litigation is in progress over the principal groups of claims in the Blewett district, these claims being the Peshastin, Fraction, Humming Bird, Bobtail, and Culver. Under various managements they produced considerable gold from 1890 to 1905; the U. S. Geological Survey reports three million dollars. Of late years they have produced nothing but squabbles.

Seattle, November 15.

FERRY COUNTY

(Special Correspondence.)—Mine owners and other consumers of power in the Republic district appear to be undecided whether to use a Diesel engine or electric power from British Columbia. It is stated that a transmission line will be constructed from Republic to Nelson, where a connection can be made with the main line of the West Kootenai Power Co. This work will occupy about 60 days. A 5-stamp mill is to be erected by George W. Steele, of San Francisco, at the Silver Creek mine at Keller camp, 50 miles



GOLDEN EAGLE MILL, BLEWETT, WASHINGTON.

south of Republic. The Gold Chord Mining & Milling Co. owns this mine. The British Columbia Copper Co. has about 300,000 tons of gold, silver, copper, and lead ore blocked out in the Lone Star and Washington mines, on the international boundary. Considerable equipment is to be installed.

Republic, November 28.

STEVENS COUNTY

Approximately 6 ft. of ore of shipping grade is showing in the 100-ft. winze from the main working adit of the Butte-Chewelah mine, near Chewelah, and there is also a promising showing of high-grade ore in the face of the cross-cut.

WYOMING

BIGHORN COUNTY

At a depth of 1660 ft. the Utah-Wyoming Consolidated Oil Co. has started a flow of natural gas in No. 6 well equal to about 7,000,000 cu. ft. per day. The pressure is 800 lb. per square inch at present, and drilling will be continued as far as possible. No. 3 well is down 700 ft., and the gas from No. 5 is to be marketed.

CANADA

BRITISH COLUMBIA

Part of the Old Sport group of copper claims, in the Ella Mountain district, near the north end of Vancouver island, have been sold by Conrad Wolfe and associates of Spokane for about $500,000. It is stated that the control will be held by men interested in the Stewart mine of Idaho. About $30,000 has been spent on development during the last four months, and it is now proposed to construct an electric railway 18 miles from the coast to the property. So far this year, the companies operating in the Kootenai-Boundary district have paid $1,754,875 in dividends, the following being the principal contributors: Granby, $673,000; Standard, $550,000; Consolidated Mining & Smelting, $220,000; Hedley, $160,000; Le Roi No. 2, $43,200, and British Columbia Copper, $88,675. From the Standard mine, at Silverton, 2500 tons of zinc ore is being sent to Argentine, Kansas, for treatment. During the current year a total of 3767 tons of zinc ore and concentrate has been shipped from Slocan mines. During the third week in November the Granby smelter treated 24,183 tons of ore yielding 435,000 lb. of copper, making totals of 75,699 tons, and 1,307,000 lb. for the three weeks, respectively.

ONTARIO

The pumps at Kerr lake are still working, and will continue until the water and mud in the bottom gets too hard, when they will be shut down for the winter. During the week ended November 22, ore shipments from Cobalt totaled 549 tons, and also 193,321 oz. silver. The year's bullion shipments total 8,136,882 so far. Bullion is being sent to London again owing to a final reduction of rates. Changes in these rates have been $4.50 to $7.50, $7.50 to $6, and $6 to $5 per 100 pounds. The Chambers-Ferland company will lease 30 stamps of the Northern Customs mill for five years, when extensions to the plant are completed. On December 15 the Trethewey Cobalt Silver Mines Co. will pay a dividend amounting to $50,000, making a total of $1,012,598. In October the mill treated 3225 tons of ore yielding 62,000 oz. of silver, with 84% recovery. The Hudson Bay mill treated 1742 tons of ore in October, yielding 38,306 oz. silver with 86% recovery. At the Temiskaming mine, the shaft is being sunk from 650 to 725 ft. depth.

The Porcupine Crown mine is opening in a promising way, and the mill is now treating from 85 to 100 tons of ore per day. Results at the McIntyre during October were as follows:

Ore treated, tons	4,131
Value of bullion	$41,098
Extraction, per cent	95.50
Running time of mill, per cent	96.77
Costs:	Per ton.
Mining	$1.806
Development	1.938
Milling	1.425
General	0.964
Total	$7.133

At the present time C. H. Henrotin and Frank Loring are engaged in sampling the Burnside, Tough-Oakes, Wright, and Robbins claims at Kirkland lake for an English syndicate.

COLOMBIA

The Pato dredge of Oroville Dredging Co., Ltd., handled 24,100 cu. yd. of wash yielding $15,900, during the last week of October.

MEXICO

GUANAJUATO

Three lots of ore and six of concentrate were shipped from the Guanajuato district to the Aguascalientes smelter during the last week of October. The 31 tons of ore was worth ₱12,400, and 102 tons concentrate at ₱49,400.

HIDALGO

(Special Correspondence.)—At La Blanca mill extensive changes are in progress. Its capacity is being increased to 500 tons per day, and the agitation is being altered from the intermittent to the continuous system.

Pachuca, October 10.

JALISCO

During October the El Favor mill produced bullion valued at ₱45,000. Returns from ore sent to the Aguascalientes smelter are not in so far. A 25-ton concentrating plant is to be erected at the Zapote copper mine in the Ameca district. This property is controlled by the Mutual Mining & Milling Co. of Mexico City. L. C. Grace is manager. A

new mill is being erected at the San Pedro Analco mine, owned by San Rafael y Anexas Co. Clive S. Newcomb, of Mexico City, is in charge of the work.

The Cinco Minas mining camp, in the Hostotipaquillo district, was entered during the second week of October by a band of rebels variously reported as numbering between 300 and 400 men. The rebels forced a loan from the Company for ₱1000 and looted the store. About the same time a small band of rebels from Tepic entered the camp of the Amajac Mining Co., a Pennsylvania concern, in the Hostotipaquillo district.

MEXICO

October returns of the Mexico Mines of El Oro and El Oro Mining & Railway companies are as follows:

	Tons.	Yield.	Profit.
Mexico Mines	13,430	$141,500	$83,700
El Oro	21,560	177,860	64,140

SONORA

(Special Correspondence.)—The old Babicanora mine was bought about eight months ago by Mr. Brongier and has been put in working order, including considerable timbering and cleaning out. The vein is a strong one, traceable 3500 ft. on the surface. It runs east and west and seems to be a continuation of the Chispas vein. A great deal of work has been done on it and a large amount of rich ore has been extracted during the last 300 years. Twenty-eight inches of ore averaging $30 per ton has been found in the bottom. An underground hoist is to be installed and development work will be started about December 15. Mr. Frazier, of Los Angeles, is superintendent, and E. Frey, of Goldfield, is foreman. The former is in the States at present to buy hoisting machinery. The country is quiet and no harm has been done by rebels.

Arizpe, November 1.

LA BLANCA MILL, PACHUCA, HIDALGO.

The Lucky Tiger-Combination Gold Mining Co., of Kansas City, Missouri, controlling the Tigre Mining Co., operating at El Tigre, reports as follows for October:

Ore crushed, tons	6,525
Cyanide plant, tons	8,199
Value of products:	
Shipping ore	$ 16,166
Concentrate	53,920
Bullion	71,992
Total	$142,078
Costs, including marketing and taxes	81,382
Profit	$ 60,696
Dividend paid November 20, cents per share	6
Total to date	$2,011,552

WESTERN AUSTRALIA

September returns from some of the mines are as follows:

	Tons.	Yield.	Profit.
Associated	10,945	$60,000	$2,400
Associated Northern	8,712	59,000	7,000
Bulfinch	5,545	68,000	43,000
Ivanhoe	20,511	175,000	67,000
Lake View & Star	18,010	96,000	17,000
Oroya Links	12,000	63,000	11,000
Sons of Gwalia	13,500	96,000	19,000

Personal

C. W. MORSE is at Butte, Montana.

JOHN B. FARISH is at Santa Barbara.

AUGUSTUS HEISE is in San Francisco.

H. V. WINCHELL has gone to Colorado.

C. W. MERRILL is back from New York.

M. P. BOSS is at Sacramento, California.

D. C. JACKLING has returned from Juneau.

CARL S. FOOH was in New York last week.

H. C. CALLAHAN has returned from Europe.

G. W. METCALFE has been in San Francisco.

W. H. ALDRIDGE was in San Francisco this week.

M. K. RODGERS passed through San Francisco Tuesday.

F. DANVERS POWER is in New York and will go to London.

P. A. KEEGEL of Los Angeles was in San Francisco Thursday.

S. H. BALL visited San Francisco and the Comstock last week.

JAMES G. BERRYHILL is living in San Francisco this winter.

W. G. PERKINS was in San Francisco, returning from Korea to London.

C. F. RAND has gone to Cuba, expecting to return to New York, December 16.

R. S. BLACK, manager of the Kalgurli mine, Kalgoorlie, has gone to England.

M. H. KUBYLA is in New York, on his way to San Francisco from Mexico City.

S. GREGORY, managing director of Minerals Separation, Ltd., has sailed for London.

FREDERICK H. MORLEY has joined the editorial staff of the *Mining and Scientific Press*.

H. W. HARDINGE, who returned from Russia in September, was in San Francisco this week.

ALBERT H. FAY, of the U. S. Bureau of Mines, is visiting California and other Western states.

L. H. WEBB sailed on the *Carmania*, November 29, for Europe, to investigate metallurgical processes.

H. C. BELLINGER has resigned from the management of the Great Cobar copper mine, New South Wales.

DAVID H. LAWRANCE, manager for the West Mexico Mines Co., of Baja California, is at present in the United States.

C. F. TOLMAN, JR., will address the Le Conte Club, at the University of California Club, tonight on the 'Cycle of Desert Erosion.

DWIGHT E. WOODBRIDGE is in the Monte Cristo country of Washington, and expects to be in New York state much of the winter on iron ore examination.

OTTO WARTENWEILER has completed his work as mechanical engineer in charge of construction of the 400-ton mill of the Commonwealth M. & M. Co., and opened offices in Los Angeles.

GEORGE F. WADDELL has resigned as superintendent of the Steptoe Valley Smelting & Mining Co.'s concentrator at McGill, Nevada, to become general manager of the Ohio Copper Co.'s property at Bingham and Lark, Utah.

F. W. MORGAN, who was manager of the Bulfinch mine and well known throughout Western Australia, died several weeks ago. A. L. HAY, manager of the Hainault, Kalgoorlie, before its absorption by the South Kalgurli, has been appointed manager.

THE annual meeting of the Engineers' Club of San Francisco will be held next Saturday night at the club rooms in Hotel Sutter.

THE next regular meeting of former students of the Freiberg Bergakademie will be held on December 20, in the Hofbrau Haus, New York City. This is the annual meeting, and election of officers will take place. All former students of the old mining school should communicate with the secretary, C. L. BRYDEN, 1701 Jefferson avenue, Scranton, Pennsylvania.

New York Metal Market Review

Dullness and a decline in prices characterized every metal in the month of November. The demand for finished brass and copper products fell off to such an extent that many of the mills did not operate full time. In a few weeks electrolytic copper has dropped over 2c. per pound. Spelter declined about 10 points during the month and in having dropped no further was considered to have held up fairly well. Lead was quiet, but competition for what business there was caused the largest producer to lower its price $2 per ton. Antimony was without feature of especial interest. The tin market proved a disappointment to importers and dealers, inasmuch as expected business did not materialize. Aluminum was stagnant and, as with all the metals, quotations declined repeatedly. The metal trade is doing much mental speculation as to the causes of the general slump. To the tightness of money, which is charged to the currency reform agitation, is credited a good part of the slowing up in operations, but the new tariff is more generally held responsible. What is going on, in the opinion of many dealers, is the predicted readjustment of values, pending which large consumers are limiting their buying to the minimum. They are not disposed to buy freely until the bottom is reached.

COPPER

At the beginning of November, consumers were letting the market severely alone, and they continued to do so pretty much all of the month, and nominal prices were the rule. November 1, quotations were at or near 16.87½c. cash for Lake, and 16.50c. for prompt electrolytic. Resale lots in limited quantities were offered and occasionally pressed for sale, and these usually made the market when there were any dealings at all. Early in the month complaint became more acute that the business of consumers was falling off. This condition did not mend, and toward the end of November it was definitely stated that several of the brass and copper mills in the Naugatuck valley had reduced their working time to five and in some cases four days per week. Melting had lessened to such a degree that considerable October copper had been carried into November, and some of that delivered in the latter month would be carried into December. With the metal carried over and the comparatively small amount bought in November, buying for December, it was seen, would fall below expectations. The second week of the month brought a further decline, electrolytic being quoted November 12, at 15.50c. cash for prompt delivery and 16.25c. for Lake, the latter price being entirely nominal. Until about this time the big agencies had held to their price of 16.75c. cash for electrolytic, but there began to be heard rumors that the producers and their selling agents were willing to sell to Europe on a basis of 16c. f.o.b., while others were anxious to get domestic business at concessions. The Producers' statement for October, issued November 7, showing an increase of 2,773,288 lb. in stocks, created very little comment and in no way changed the trend of the market. By November 17 electrolytic was down to 15.25c. cash for November and 15.12½c. cash for January and February, with Lake nominal at 16c. In electrolytic a fair business was done, chiefly for export at these figures, it being estimated that between 10,000,000 and 15,000,000 lb. was bought. In this movement, which was regarded as below normal in point of quantity, some, but not all, first hands were sellers at 15.25c. The January and February price of 15.12½c. was made by second hands. Lake was inactive. By November 20 complete quiet had set in again with prices still sagging. Quotations for prompt electrolytic had dropped by November 26 to 14.75c. cash, at which price some sales were made, particularly to Europe. Lake was nominal at 15.50c. A carload of high-grade Lake was sold November 24 at 16c., the seller having paid 17.25c. some weeks before. He took his loss of 1¼c. per pound cheerfully and said he was glad to dispose of the carload at the price he obtained. The one optimistic view taken of the situation at this writing is that consumers' stocks are very low and that when the turn in the market does come the recovery will be as thorough and as rapid as the slump. Many find it difficult to believe that consumption has fallen off as completely as the stagnant market would seem to indicate. Exports to November 27 were 23,918 tons. The Waterbury average for October was 16.87½ cents.

SPELTER

The month opened with spelter at about 5.40c. New York and 5.25c. St. Louis. By November 27 quotations had dropped to 5.25c. New York and 5.10c. St. Louis. Dullness prevailed continuously to the latter date and there were no features of interest. In view of the fact that consumption had fallen off to a considerable degree it was pointed out that in losing only 10 points or thereabouts spelter prices had held up fairly well.

LEAD

During the greater part of the month independent producers undersold the American Smelting & Refining Co., and as a result the big interest on November 26 reduced its price $2 per ton and its quotations of 4.35c. New York and 4.20c. St. Louis, which had been adhered to throughout November, came down to 4.25c. New York and 4.10c. St. Louis. A fair activity in the closing days of October evidently supplied consumers for most of their needs of the next month, for following the activity the market was uniformly dull aside from a minor routine business for which there was sharp competition.

ANTIMONY

Late in October there was a slight superinduced flare-up in antimony, but it did not amount to much. Prices declined, the month opening at 7.25 to 7.37½c. for Hallett's, 7.62½ to 7.75c. for Cookson's, and 6.50 to 6.75c. for Chinese and Hungarian grades. November 26 quotations were 7.12½ to 7.25c. for Hallett's, 7.40 to 7.50c. for Cookson's, and 6.25 to 6.50c. for Chinese and Hungarian. The market was dull and without feature, except that the duty under the new tariff was a mooted question, the importers and customs officials having failed to get together on a satisfactory basis of valuation, that is, whether to take the value at the source of production or that in this market. Pending settlement, importers have been paying an excess duty, firmly convinced that they later would obtain a rebate.

PIG TIN

Throughout most of November the trade in pig tin was hampered by the failure of tin plate manufacturers to place orders, and this despite the fact that they had booked many contracts for their produce. It was thought early in the month, when the placing of contracts was stimulated by reductions in tin plate at the mills, that orders for tin would follow, but dealers were disappointed. In anticipation of a good demand dealers loaded themselves up heavily and the metal became concentrated in a few hands, but the end of the month came without the big business expected. Stocks on hand November 1 totaled 2357 tons, and it was felt that a genuine shortage would be felt before the first of December, but this was not the case. The total visible supply October 31, 1913, was 11,857 tons as against 10,735 tons October 31, 1912. The total deliveries in 10 months of 1913 showed a decrease of 3150 tons compared with the same period in 1912. Approaching the middle of the month there was some improvement in buying with the purchases consisting principally of 5, 10, and 15-ton lots, all for quick shipment, which showed that consumers' stocks were low. Throughout November, prices fluctuated between 39.25 and 40.25c. with the lower price prevailing near both the beginning and close of the month. As December drew near it was predicted that contrary to expectations an exceedingly ample supply of the tin would be on hand December 1.

ALUMINUM

Quotations for both domestic and foreign prompt aluminum were on the same level during November. In the first few days of the month the nominal price was 19.75c., about the middle of the month it declined to 19.50 to 19.75c., a few days later came down to 19.37½ to 19.62½c., then to 19.00 to 19.50c., and by November 26 had reached 19.00 to 19.25c. Buyers showed very little interest and at times it was difficult to find anything tangible which might be called the market. As heretofore said, the backwardness of automobile manufacturers in placing orders is left in this metal.

The Metal Markets

LOCAL METAL PRICES

San Francisco is not a primary market for the common metals except quicksilver. The prices quoted below therefore represent sales of small lots and are not such as an ore producer could expect to realise. Ore contracts usually call for settlement on the basis of Eastern prices, less freight and treatment charges. The prices quoted are in cents per pound, except in the case of quicksilver, which is quoted in dollars per flask of 75 pounds.

San Francisco, December 4.

Antimony	10—10½c	Quicksilver (flask)	$40
Electrolytic copper	17¼—17½c	Tin	44—45½c
Pig lead	4 25—5.00c	Spelter	7—7½c

Zinc dust, 100 kg. zinc-lined cases, 7½ to 8c. per pound.

EASTERN METAL MARKETS.

(By wire from New York.)

NEW YORK, December 3.—The copper market is quiet and weak with standard, spot, and futures not quoted. The general tendency of the buyers is to hold back and but few sales are reported. Very little copper is being purchased by the American manufacturers and the brass mills are running on reduced time. It is predicted tha an increase in both American and European stocks will be shown as a result in the decline in consumption and the expansion in production. Lead and spelter are both quiet and weak. Antimony is dull, with Cookson's quotations at 7.50 to 7.70c.

SILVER

Below are given the average New York quotations, in cents per ounce, of fine silver.

Date.		Average week ending	
Nov.	27 Holiday	Oct. 22	61.14
"	28 57.87	" 29	59.98
"	29 57.12	Nov. 5	59.52
"	30 Sunday	" 12	59.62
Dec.	1 56.12	" 19	59.26
"	2 57.37	" 25	58.20
"	3 57.62	Dec. 4	57.22

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	56.25	63.01	July	60.67	58.70
Feb.	59.06	61.25	Aug.	61.32	59.32
Mch.	58.37	57.87	Sept.	62.95	60.53
Apr.	59.20	59.26	Oct.	63.16	60.88
May	60.88	60.21	Nov.	62.73	58.76
June	61.29	59.03	Dec.	63.38	....

The improved tendency of silver, to which attention was drawn recently, has not been altogether maintained. The mainstay has been, and is likely to be, the considerable size of the bear account in existence, according to Samuel Montagu & Co., on November 13. Although this circumstance cannot fail to give support to prices, it is apt to operate with some irregularity for, naturally, bear sales do not fall evenly from day to day, nor do they coincide with the size of the market. Another element of uncertainty at the present time arises from sudden and often unexpected movements of the China exchange. Owing to the heavy rains in the beginning of the summer, followed by a drought in July, the harvesting of crops throughout China had to be delayed from three to five weeks, that is to say, the general movement usually commencing early in October has had to be postponed this year until the beginning of this month. Shanghai cables a stock of £6,130,000, compared with £6,225,000 last week. The premium for spot delivery in Bombay to which attention has been drawn is still more accentuated. The largest difference touched during the week has been about 2¾%. Information has been received by the Indian mail that, owing to unfavorable crop reports from the United Provinces and the short marriage season, a very large offtake is not expected in the coming year.

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.		Average week ending	
Nov.	27 Holiday	Oct. 22	4.35
"	28 4.22	" 29	4.35
"	29 4.22	Nov. 5	4.20
"	30 Sunday	" 12	4.19
Dec.	1 4.15	" 19	4.18
"	2 4.10	" 25	4.13
"	3 4.07	Dec. 4	4.15

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	4.43	4.28	July	4.71	4.35
Feb.	4.03	4.33	Aug.	4.54	4.60
Mch.	4.07	4.32	Sept.	5.00	4.70
Apr.	4.20	4.36	Oct.	5.08	4.37
May	4.20	4.34	Nov.	4.91	4.16
June	4.40	4.33	Dec.	4.20	....

COPPER

Quotations on copper as published in this column represent average wholesale transactions on the New York market and refer to electrolytic copper. Lake copper commands normally from 1-8 to 1-4c. per lb. more. Prices are in cents per pound.

Date.		Average week ending	
Nov.	27 Holiday	Oct. 22	16.38
"	28 14.56	" 29	16.55
"	29 14.55	Nov. 5	16.25
"	30 Sunday	" 12	15.54
Dec.	1 14.32	" 19	15.08
"	2 14.30	" 25	14.62
"	3 14.30	Dec. 4	14.41

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	14.09	16.54	July	17.19	14.21
Feb.	14.08	14.93	Aug.	17.49	15.42
Mch.	14.68	14.72	Sept.	17.56	16.23
Apr.	15.74	15.22	Oct.	17.32	16.31
May	16.03	15.42	Nov.	17.31	15.88
June	17.23	14.71	Dec.	17.37	....

The copper market was dull last week. On November 24 plenty of copper was available through 'second hand' dealers at 14¾c. per pound, and buying was only in small amounts. The strike at the plant of the General Electric Co. had a depressing effect, since that Company uses about 5,000,000 lb. copper per month. By the middle of the week news of buying in London gave a strengthening touch. The Thanksgiving holiday here coincided with the booking of good orders abroad, but sales on Friday were discouragingly small and the week closed with the market as dull as at the beginning. Exports for the week were reported as 4299 tons.

ZINC

Zinc is quoted as spelter, standard Western brands St. Louis delivery, in cents per pound.

Date.		Average week ending	
Nov.	27 Holiday	Oct. 22	5.10
"	28 5.24	" 29	5.25
"	29 5.22	Nov. 5	5.13
"	30 Sunday	" 12	5.09
Dec.	1 5.15	" 19	5.05
"	2 5.12	" 25	5.08
"	3 5.10	Dec. 4	5.16

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	6.42	6.88	July	7.12	5.11
Feb.	6.50	6.13	Aug.	6.96	5.51
Mch.	6.57	5.94	Sept.	7.45	5.55
Apr.	6.63	5.52	Oct.	7.36	5.22
May	6.68	5.23	Nov.	7.32	5.09
June	6.88	5.00	Dec.	7.09	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California, being the largest producer The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending			
Nov.	5 39.00	Nov. 19	39.00
"	12 39.00	" 25	40.00
		Dec. 4	40.00

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	43.75	39.37	July	43.00	41.00
Feb.	46.00	41.00	Aug.	42.50	40.50
Mch.	46.00	40.20	Sept.	42.12	39.70
Apr.	42.25	41.00	Oct.	41.50	39.37
May	41.75	40.25	Nov.	41.50	39.40
June	41.30	41.00	Dec.	39.75	....

TIN

New York prices control in the American market for tin, since the metal is almost entirely imported. San Francisco quotations average about 5c. per lb. higher. Below are given average monthly New York quotations, in cents per pound:

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	42.53	50.45	July	44.25	40.70
Feb.	42.96	49.07	Aug.	45.80	41.75
Mch.	42.58	46.95	Sept.	48.64	42.45
Apr.	43.92	49.00	Oct.	50.01	40.61
May	46.05	49.10	Nov.	49.92	39.77
June	45.76	45.10	Dec.	49.80	....

The Homestake Mining Co. has declared its regular monthly dividend of 65c. and an extra dividend of $1, both payable December 24 to stockholders on record at December 20.

The Stock Markets

SAN FRANCISCO STOCKS AND BONDS

(San Francisco Stock and Bond Exchange.)

BONDS

December 3.

Listed.	Bid	Ask	Unlisted.	Bid	Ask
Associated Oil	$ —	[illegible]	Ass. Oil 5s	$ 73½	—
E. I. du Pont pfd	84	—	General Petroleum 6s	55½	56
do. com	122	—	Natomas Con. 6s	—	50
Natomas Con. 6s	—	70	Pac. Port. Cement 6s	99½	—
			Santa Cruz Cement 6s	—	90

STOCKS

Listed.	Bid	Ask	Unlisted.	Bid	Ask
Amalgamated Oil	75	[illegible]	Mascot Copper	—	2½
Associated Oil	37½	38½	Noble Electric Steel	2½	—
Giant	—	89	Natomas Consol.	—	5½
Pac. Cst Borax, pfd	65	—	Riverside Cement	50	—
Pacific Crude Oil	—	35c	Santa Cruz Cement	—	40
Sterling O. & D.	85c	—	Stand. Port. Cement	17½	—
Union Oil	55	—			

NEVADA STOCKS

(By courtesy of San Francisco Stock Exchange.)

San Francisco, December 4.

Atlanta	$ .09	Mizpah Extension	$ .30
Belcher	.40	Montana-Tonopah	.96
Belmont	7.60	Nevada Hills	.46
Big Four	.11	North Star	.37
Cash Boy	.07	Ophir	.18
Florence	.20	Pittsburg Silver Peak	.37
Goldfield Con.	1.45	Round Mountain	.33
Goldfield Oro	.07	Sierra Nevada	.06
Halifax	1.32	Tonopah Extension	1.60
Jim Butler	.69	Tonopah Merger	.55
Jumbo Extension	.09	Tonopah of Nevada	5.12
MacNamara	.08	Union	.12
Mexican	1.05	West End	1.30
Midway	.31	Yellow Jacket	.30

COPPER SHARES—BOSTON

(By courtesy of J. C. Wilson, Mills Building.)

December 4.

	Bid	Ask		Bid	Ask
Allouez	$ 32	33	Mohawk	$ 39	40
Ariz. Commercial	4½	4¾	Nevada Con.	15¼	15½
Butte & Superior	29	29½	North Butte	25	25½
Calumet & Arizona	62	62½	Old Dominion	48	48½
Calumet & Hecla	405	[illegible]	Osceola	69½	70
Copper Range	52½	52¾	Quincy	53	54
Daly West	2½	3	Shannon	6¼	6½
East Butte	9½	10	Superior & Boston	2½	2¾
Franklin	2½	2¾	Tamarack	27	28
Granby	69½	69¾	U. S. Smelting, com.	37	37½
Greene Cananea	28	29¼	Utah Con.	7¾	8¼
Isle-Royale	18	19	Winona	1¾	2
Mass Copper	2	2¼	Wolverine	41½	41¾

NEW YORK CURB QUOTATIONS

(By courtesy of E. F. Hutton & Co. Kohl Building.)

December 3.

	Bid.	Ask.		Bid	Ask
Braden Copper	6¾	6⅞	McKinley-Dar.	1⅛	1¼
Braden 6s	136	142	Mines Co. Am.	2	2¼
B. C. Copper	2¼	2½	Nipissing	8	8⅛
Davis-Daly	1½	1¾	Ohio Copper	⅜	½
Dolores	2	4	San Toy	15	20
El Rayo	1	2	Sioux Con.	1	2
Ely Con.	2	3	So. Utah	¼	⅝
First Nat.	1¾	2¼	Stand.Oil of Cal.	224	..
Greene Can.	6	7	Tri Bullion	⅛	¼
Giroux	¾	1	Tuolumne	¾	1
Iron Blossom	1⅛	1¼	United Copper	¼	¾
Kerr Lake	4⅜	4½	Wettlaufer	6	8
La Rose	1⅞	2	Yukon Gold	2	2¼
Mason Valley	3¼	3½			

NEW YORK STOCK EXCHANGE

(By courtesy of J. C. Wilson, Mills Building.)

December 4.

	Bid	Ask		Bid	Ask
Amalgamated	71½	71¾	Nat. Lead	$ 44½	45
Anaconda	34⅛	34¼	Quicksilver, com.	1⅛	2
A. S. & R.	62½	63	Ray Con.	18½	18¾
Calif. Pet.	17½	17¾	Tenn. Copper	29¼	[illegible]
Chino	39¼	39¾	U. S. Steel, pfd.	104¾	105¼
Guggenheim Ex.	44½	—	U. S. Steel, com.	67	67¼
Mexican Pet.	46	47	Utah Copper	48¾	49¼
Miami	21½	21¾			

LONDON QUOTATIONS

(By cable, through the courtesy of Catlin & Powell Co., New York.)

December 4.

	£	s.	d.		£	s.	d.
Alaska Mexican	1	10	0	Kern River Oilfields	0	6	3
Alaska Treadwell	8	0	0	Mexico Mines	5	5	0
Alaska United	3	12	6	Messina	1	8	9
Arizona	1	17	6	Oroville*	0	11	3
California Amalg.	0	1	3	Pacific Oilfields	0	2	6
California Oilfields	6	0	0	Rio Tinto	71	[illegible]	0
Camp Bird	0	15	0	Santa Gertrudis	0	17	6
El Oro	0	15	0	Stratton's	0	2	[illegible]
Esperanza	1	0	0	Tanganyika	1	17	6
Granville	0	11	3	Tomboy	1	6	3

AUSTRALASIAN

December 4.

	£	s.	d.		£	s.	d.
British Broken Hill	1	17	6	Mount Boppy	0	16	9
Broken Hill Prop.	1	15	0	Mount Elliott	4	6	3
Golden Horse-Shoe	2	13	9	Mount Lyell	0	16	9
Great Boulder Prop.	0	13	9	Mount Morgan	3	6	3
Ivanhoe	2	15	0	Waihi	2	17	6
Kalgurli	1	12	6	Waihi Grand Junc.	1	6	3

Mineral Products of the United States

Final figures, covering the output for 1912, have recently been prepared by W. T. Thom, under direction of Edward W. Parker, and issued by the U. S. Geological Survey in the form of a large chart showing the following data:

Material.	Quantity.	Value.
Pig iron, long tons	30,180,969	$ 420,563,388
Ferro alloys, long tons	328,685	12,223,776
Silver, ounces	63,766,800	39,197,500
Gold, ounces	4,520,717	93,451,500
Copper, pounds	1,243,268,720	205,139,338
Lead, short tons	415,395	37,385,550
Zinc, short tons	323,907	44,699,166
Quicksilver, flasks of 76½ lb.	25,064	1,053,941
Aluminum, pounds	65,607,000	11,907,000
Antimonial lead, short tons	13,552	1,311,348
Tin, pounds	260,000	124,800
Platinum, ounces	1,005	45,778
Bituminous coal, short tons	450,104,982	517,983,445
Anthracite coal, long tons	75,322,855	177,622,626
Natural gas	.....	84,563,957
Petroleum, barrels of 42 gal.	222,113,218	163,802,334
Peat	.....	228,572
Clay products	.....	172,811,275
Cement, barrels of 380 lb. net.	83,351,191	67,461,513
Glass sand, short tons	1,465,386	1,430,471
Gypsum, short tons	2,500,757	6,563,908
Lime, short tons	3,529,462	13,970,114
Sand, short tons	66,889,175	21,682,737
Sand-lime brick, slate, and stone	.....	85,528,113
Abrasives	.....	1,576,556
Arsenious oxide, pounds	6,282,000	190,757
Borax, short tons	42,315	1,127,813
Bromine, calcium chloride, and fluorspar	.....	1,022,609
Phosphate rock, long tons	2,973,332	11,675,774
Pyrite, long tons	350,928	1,334,259
Sulphur, long tons	303,472	5,256,422
Sulphuric acid from smelters, short tons	614,073	4,240,941
Salt, barrels of 280 lb. net.	33,324,808	9,402,772
Barytes, mineral paints, etc.	.....	10,222,901
Asbestos, short tons	4,403	87,959
Asphalt, short tons	449,510	4,620,731
Bauxite, long tons	159,865	768,932
Chrome, feldspar, fuller's earth	.....	828,837
Gems and precious stones	.....	319,722
Graphite	.....	212,033
Manganese ores, long tons	53,181	35,665
Mica, sheet and scrap	.....	331,896
Mineral waters, gallons sold	62,281,201	6,615,671
Quartz, talc, and tungsten ores	.....	2,400,806
Unspecified	.....	500,000
Total of all materials		$2,243,630,326

Current Prices for Ores and Minerals

(Corrected monthly by Atkins, Kroll & Co.)

The prices are approximate, subject to fluctuation, and to variation according to quantity, quality, and delivery required. They are quoted, except as noted, f.o.b. San Francisco. Buying prices marked *.

	Min.	Max.
Antimony ore, 50%, ₱ ton	*$75.00	$80.00
Arsenic, white, refined, ₱ lb	0.02½	0.03½
Arsenic, red, refined, ₱ lb	0.08	0.08½
Asbestos, chrysotile	100.00	350.00
Asbestos, amphibole	5.00	25.00
Asphaltum, refined, ₱ ton	11.50	20.00
Barium carbonate, precipitated, ₱ ton	40.00	45.00
Barium chloride, commercial, ₱ ton	40.00	42.50
Barium sulphate (barytes), prepared, ₱ ton	20.00	30.00
Bismuth ore, 15% ₱ ton	*250.00	upward
Chrome ore, according to quality, ₱ ton	10.00	12.50
China clay, English, levigated, ₱ ton	15.00	20.00
Cobalt metal, refined, f. o. b. London, ₱ lb	2.50	
Coke, foundry, ₱ 2240 lb	15.00	20.00
Diamonds:		
Ballas according to size and quality, ₱ carat	70.00	
Borts, according to size and quality, ₱ carat	2.00	15.00
Carbons, according to size and quality, ₱ carat	55.00	90.00
Feldspar, ₱ ton	5.00	25.00
Firebrick:		
Bauxite, ₱ M	175.00	
Magnesite, ₱ M	190.00	275.00
Silica, ₱ M	50.00	55.00
Flint pebbles for tube-mills, ₱ 2240 lb	21.00	22.50
Fluorspar, ₱ ton	10.00	15.00
Fullers earth, according to quality, ₱ ton	20.00	30.00
Gilsonite, ₱ ton	35.00	40.00
Graphite:		
Amorphous, ₱ lb	0.01½	0.02½
Crystalline, ₱ lb	0.04	0.13
Gypsum, ₱ ton	7.50	10.00
Infusorial earth, ₱ ton	10.00	15.00
Iridium	55.00	
Magnesite, crude, ₱ ton	5.00	7.50
Magnesite, dead calcined, ₱ ton	20.00	25.00
Magnesite, brick (see firebrick).		
Manganese ore, oxide, crude, ₱ ton	10.00	25.00
Manganese, prepared, according to quality, ₱ ton	30.00	70.00
Mica, according to size and quality, ₱ lb	0.05	0.30
Molybdenite, 95% MoS_2, ₱ ton	400.00	450.00
Monazite sand (5% thoria), ₱ ton	150.00	200.00
Nickel metal, refined, ₱ lb	0.45	0.60
Ochre, extra strength, levigated, ₱ 100 lb	2.00	2.50
Osmiridium, ₱ oz	25.00	
Platinum, native, crude, ₱ oz	30.00	45.00
Silex lining for tube-mills ₱ 2240 lb	35.50	37.50
Sulphur, crude, ₱ ton	20.00	25.00
Sulphur, powdered, ₱ ton	30.00	35.00
Sulphur, 80%, ₱ ton	16.50	18.50
Talc, prepared, according to quality, ₱ ton	20.00	50.00
Tin ore, 60%, ₱ ton	500.00	550.00
Tungsten ore, 65%	425.00	450.00
Uranium ore, 10% min.	25.00	per unit
Vanadium ore, 15% V_2O_5, ₱ ton	150.00	180.00
Wolframite (see tungsten ore).		
Zinc ore, 50% up, ₱ ton	*15.00	20.00

Current Prices for Chemicals

(Corrected monthly by Braun-Knecht-Heimann Co.)

Prices quoted are for ordinary quantities in packages as specified. For round lots lower prices may be expected, while in smaller quantities advanced prices are ordinarily charged. Prices named are f.o.b. San Francisco and subject to fluctuation. Other conditions govern Mexican and foreign business.

	Min.	Max.
Acid, sulphuric, com'l, 66°, drums, ₱ 100 lb	$0.85	$1.10
Acid, sulphuric, com'l, 66°, carboy, ₱ 100 lb	1.25	1.75
Acid, sulphuric, C. P., 9-lb. bottle, bbl., ₱ lb	0.13	0.18
Acid, sulphuric, C. P., bulk, carboy, ₱ lb	0.09½	0.12
Acid, muriatic, com'l, carboy, ₱ 100 lb	1.85	3.00
Acid, muriatic, C. P., 6-lb. bottle, bbl., ₱ lb	0.15	0.20
Acid, muriatic, C. P., bulk, carboy, ₱ lb	0.10½	0.15
Acid, nitric, com'l, carboy, ₱ 100 lb	6.00	6.50
Acid, nitric, C. P., 7-lb. bottle, bbl., ₱ lb	0.16	0.22
Acid, nitric, C. P., bulk, carboy, ₱ lb.*	0.12½	0.15
Argols, ground, bbl., ₱ lb	0.10	0.20
Borax, cryst. and conc., bags, ₱ 100 lb	3.00	4.35
Borax, powdered, bbl., ₱ 100 lb	3.38	4.50
Borax glass, gd. 30 mesh, cases, tin lined, ₱ 100 lb	10.50	13.50
Bone ash, 60 to 80 mesh, bbl., ₱ 100 lb	5.50	6.50
Bromine, 1-lb. bottle, ₱ lb	0.55	0.65
Candles, adamantine, 14 oz., 40 sets, ₱ case	4.80	4.80
Candles, adamantine, 14 oz., 60 sets, ₱ case	5.25	5.45
Candles, Stearic, 14 oz., 40 sets, ₱ case	5.00	5.20
Candles, Stearic, 14 oz., 60 sets, ₱ case	5.70	5.90
Clay, domestic fire, sack, ₱ 100 lb	1.50	2.00
Cyanide, 98 to 100%, 100-lb. case, ₱ lb	0.18	0.22
Cyanide, 98 to 100%, 200-lb. case, ₱ lb	0.18	0.22
Cyanide, 128%, 100-lb. case, ₱ lb	0.22	0.25½
Cyanide, 128%, 200-lb. case, ₱ lb	0.22	0.25
Lead acetate, brown, broken casks, ₱ 100 lb	9.00	10.50
Lead acetate, white, broken casks, ₱ 100 lb	10.50	10.75
Lead acetate, white, crystals, ₱ 100 lb	12.50	13.25
Lead, C. P., test., gran., ₱ 100 lb	13.00	15.00
Lead, C. P., sheet, ₱ 100 lb	15.00	18.00
Litharge, C. P., silver free, ₱ 100 lb	11.50	13.50
Litharge, com'l, ₱ 100 lb	8.00	9.50
Manganese ox., blk., dom. in bags, ₱ ton	20.00	25.00
Manganese ox., blk., Caucasian, in casks, ₱ ton (85% MnO_2—1% Fe)	39.00	47.50
Nitre, double ref'd, small cryst., bbl., ₱ 100 lb	7.00	8.00
Nitre, double ref'd, granular, bbl., ₱ 100 lb	6.50	7.50
Nitre, double ref'd, powdered, bbl., ₱ 100 lb	7.25	8.00
Potassium bicarbonate, cryst., ₱ 100 lb	12.00	15.00
Potassium carbonate, calcined, ₱ 100 lb	7.50	9.00
Potassium permanganate, drum, ₱ lb	0.10½	0.13
Silica, powdered, bags, ₱ lb	0.03	0.05
Soda, carbonate (ash), bbl., ₱ 100 lb	1.50	1.75
Soda, bicarbonate, bbl., ₱ 100 lb	2.25	2.75
Soda, caustic, ground, 98%, bbl., ₱ 100 lb	3.00	3.25
Soda, caustic, solid, 98%, drums, ₱ 100 lb	2.50	2.75
Zinc shavings, 850 fine, bbl., ₱ 100 lb	12.00	13.00
Zinc sheet, No. 9—18 by 84, drum, ₱ 100 lb	10.20	11.00

*Extra charge for packing nitric acid for shipment to conform to regulations.

Metalgesellschaft Statistics

The Metallbank und Metallurgische Gesellschaft of Frankfort has recently published its annual volume of comparative statistics for the year 1912, which contains valuable information and tables giving the production of lead, copper, spelter, tin, aluminum, nickel, quicksilver, and silver. According to this report, the generally favorable conditions of trade and industry during the year 1912 caused a natural increase in the consumption of the metals, although a diminution in the demand was felt during the last quarter. The world's production of lead, copper, spelter, and tin for the years 1911 and 1912 was as follows:

	Metric tons		Increase in
	1911.	1912.	1912, %.
Lead	1,132,900	1,189,100	5.0
Copper	893,400	1,019,800	14.1
Spelter	902,100	977,900	8.4
Tin	118,700	123,100	3.7

Of this production the United States contributed 32.5% of the lead, 58.1% of the copper, and 32.2% of the spelter, being therefore the most important factor in the increased production of copper during the year. The consumption of these metals by the United States increased slightly over that of the previous year. The ratio of the consumption of this country to the world's output was 33.5% of the lead, 36.5% of the copper, 31.9% of the spelter, and 42% of the tin.

The new Underwood tariff will cause the average prices of the metals in the United States to correspond more closely with the prices in Europe. In previous years the differences in price have been very wide. For example, the price of lead in 1910 was 2.82c. per pound in London, while in New York the price was 4.446c.; and in 1911 the prices per pound in London and New York were 3.03c. and 4.42c., respectively. Under the Payne tariff the duties on the metals, computed on an ad valorem basis, taking the average prices for the year 1912, were about as follows: Aluminum, 43%; lead, 55%; nickel, 17%; spelter, 24%. According to the Underwood tariff, these duties will be reduced to about 25% and less, ad valorem, being 25% on lead, 15% on spelter, 10% on nickel, and approximately 15% on aluminum.

The amount of foreign ore smelted in the United States should be greatly augmented on account of the probable increase in the importation of ore from Mexico and Canada due to the lowering of the duties. This should be a stimulus to the lead and zinc smelting industries in this country.

The most notable increase in metal production in 1912 was in copper, the bulk of the increase being attributable to the United States, whose output of raw copper increased from 518,700 tons in 1911 to 592,400 tons in 1912. Most of this increase came from the prophyry properties of Arizona and New Mexico.

Company Reports

THE MEXICO MINES OF EL ORO, LTD.

The mines of the Company are at El Oro, state of Mexico, Mexico. The capital of the Company is £180,000 in 180,000 shares of £1 each. All are issued and fully paid. The report for the year ended June 30, 1913, gives the amount of ore mined during that time as 158,630 tons. The tonnage crushed in the mill was 158,395 tons. The average assay value of the ore was $8.23 gold and $3.61 silver. The bullion realized was $1,200,519.02 gold, $469,021.75 silver, a total of $1.30 per ton, that of development $130,453.81 or $0.82 per ton, of milling $34,692.12 or $0.22 per ton, of cyaniding $152,954.71 or $0.97 per ton. The water supply cost $550.48. The general expense amounted to $55,784.28 or $0.35 per ton, and the taxes to $73,012.34 or $0.46 per ton. The total cost was $653,287.28 or $4.12 per ton. The all around recovery of the gross gold and silver contents of the ore treated was 88.99%, as compared with 87.30% in 1912. The ore in the lower levels is less amenable to treatment than the oxidized ore of the upper portions of the river and as a greater proportion of the ore will be coming from the lower levels, a slightly lower extraction must be expected in future. During the year, four dividends have been paid, of 4s. per share, in all amounting to £162,000. The year shows a realized profit of £201,576 19s.6d.

STATEMENT OF COSTS

Month.	Tonnage.	Mining. Cost.	Mining. Per Ton.	Development. Cost.	Development. Per Ton.	Milling. Cost.	Milling. Per Ton.	Cyaniding. Cost.	Cyaniding. Per Ton.	Water Supply. Cost.	Water Supply. Per Ton.	General Expense. Cost.	General Expense. Per Ton.	Taxes. Cost.	Taxes. Per Ton.	Total. Cost.	Total. Per Ton.
1912.		$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$
July	13,340	17,030.10	1.27	[illegible]	0.78	2,867.58	0.22	13,586.93	1.02	188.24	0.01	4,145.59	0.31	5,857.81	0.44	54,037.13	4.05
August ..	13,380	17,544.75	1.31	11,303.72	[illegible]	2,875.22	0.21	13,079.16	0.98	117.90	0.01	4,681.37	0.35	5,741.83	[illegible]	55,343.95	4.14
September ..	[illegible]	17,220.60	1.32	10,840.31	0.83	2,914.95	0.23	12,899.09	[illegible]	[illegible]	—	4,245.99	0.32	5,847.53	0.45	54,011.49	4.14
October	13,380	16,920.99	1.27	11,581.76	0.86	2,697.20	0.20	12,892 55	0.97	[illegible]	—	4,249.02	0.32	5,980.22	0.45	54,410.41	4.07
November	13,110	17,152.40	1.30	10,436.41	0.79	2,960.69	0 22	12,182.49	[illegible]	112.65	0.01	4,823.91	0.37	6,004.02	[illegible]	53,672.57	[illegible]
December	13,390	17,658.82	1.32	10,442.38	0.78	3,160.12	0.24	12,926.91	[illegible]	—	—	5,529.93	0.42	6,094.82	0.45	[illegible]	4.17
1913.																	
January	13,250	17,663.07	1.32	10,871.59	0.82	3,035.23	0.23	12,642.04	0.94	—	—	4,796.32	0.36	6,038.03	0.45	55,046.28	4.12
February	12,515	16,508.18	1.32	10,747.10	0.86	2,737.18	0.22	12,041.41	0.96	—	—	4,367.71	0.35	5,972.50	0.47	52,374.08	4.18
March ..	13,360	17,270.61	1.29	10,906.46	[illegible]	2,872.84	0.22	12,710.52	0.95	—	—	4,460.00	0.33	6,411.48	0.48	54,631.91	4.09
April ..	12,910	17,066.61	[illegible]	11,454.00	0.88	2,874.10	0.23	12,241.13	0.95	—	—	4,496.23	0.35	6,219.03	0.48	54,351.10	4.21
May	13,400	18,033.19	1.34	11,696.48	0.88	2,902.08	0.22	13,730.82	1.02	—	—	5,130.60	0.38	4,256.80	[illegible]	55,749.97	4.16
June	13,200	15,779.22	1 20	9,812.72	0.74	2,794.93	0.21	12,012.66	0.91	—	—	4,857.61	0.36	8,588.27	0.66	53,845.41	4.08
Total ..	158,395	205,848.54	1.30	130,453.81	0.82	34,692.12	0.22	152,945.71	0.97	[illegible]	—	55,784.28	0.35	73,012.34	0.46	653,287.28	4.12

MILL AND CYANIDE STATEMENT—1912-1913

Month.	Mill ran days.	Tons per day.	Tons Crushed.	Assay Value of the Ore. Gold.	Assay Value of the Ore. Silver.	Theoretical Extraction. Gold.	Theoretical Extraction. Silver.	Theoretical Extraction. Total.	Bullion Realized. Gold.	Bullion Realized. Silver.	Bullion Realized. Total.
1912.				$	$	%	%	%	$	$	$
July...	30·3	440·2	13,340	8.31	3.27	92·78	81·65	89·64	102,813.15	36,113.42	138,926.57
August	30·1	444·5	13,380	8.66	3.02	92·61	78·81	89·04	107,615.86	32,465.33	140,081.19
September	29·4	444·2	13,060	8.72	3.33	92·32	78.98	88·63	105,636 38	34,596.42	140,232.80
October	30·4	440·1	13,380	8.13	3.66	92 18	78·14	87·79	101,104.05	37,847.21	138,951.26
November	29·4	445·9	13,110	8.32	3.55	92·19	78·31	88·04	100,884.55	36,766.41	137,650.96
Décember	30·4	440·4	13,390	8.18	3.54	92·17	78·25	87·97	101,660.98	38,422.57	140,082.95
1913.											
January	28·7	465·2	13,350	7.93	3.70	92·06	79·73	88·14	98,071.87	40,279.36	138,351.23
February	27·4	456·7	12,515	8.34	3.82	91·85	79·58	87·99	96,973.13	39,631.92	136,605.05
March	30·7	435·1	13,360	7.87	3.89	92·00	79·95	88·01	97,605.55	42,151.56	139,757.11
April	29·4	439·1	12,910	8.35	3.74	91·61	80·21	88·09	97,775.19	43,557.99	141,333.18
May	30·1	445·1	13,400	8.23	3.72	90·28	80·11	87·11	98,128.91	41,717.53	139,846.44
June	28·7	459·9	13,200	7.79	4.10	90·25	79·27	86·46	92,250.00	45,472.03	137,722.03
Totals and Averages	355·0	445·9	158,395	8.23	3.61	91·85	79·50	88·09	1,200,519.02	469,021.75	1,669,540.77
Percentage of values actually recovered									92·04	82·02	88·99

THE MESABI IRON RANGE, in Minnesota, was opened in 1892, and yielded a production in that year of less than 30,000 tons. In 1894 it yielded nearly 2,000,000 tons; in 1902 it produced over 13,000,000 tons, or nearly half the total output of the Lake Superior iron ore.

Book Reviews

PROBLEMS IN PHYSICS. By Morton Masius. P. 23. Paper. P. Blakiston's Son & Co., Philadelphia. For sale by the *Mining and Scientific Press*. Price 10 cents.

This pamphlet contains 274 problems in physics which are based upon Duff's Text-book of Physics. The purpose is to supply teachers with additional problems to those given in the book, allowing a wider range of selection for students' use. The publishers will supply the pamphlets gratis to all students using this text.

NEW ENGLAND AND NEW FRANCE. By James Douglas. P. 560. G. P. Putnam's Sons, New York. $3 net.

Mining men may perhaps be unaware that Dr. Douglas, in addition to his achievements in the fields of business and engineer, is also known as an authority, of no mean rank, on the early history of New England and Canada. In an earlier volume he has treated at length of the influence of the French in the development of eastern Canada. The present volume deals with the French influence in New England, and is not intended to be a consecutive narrative of the history of New France, but is rather a comparison of the motives of the French settlers in Canada and the English settlers in New England and the effects produced by different methods of treatment of the Indians, of elementary education, the status of women, and the church in the two areas. Dr. Douglas' argument as to the causes which led the New Englanders into the founding of a nation through their failure to create a theocracy, while the French, with more influence over the natives and more energy for exploration, made but limited progress as the founders of a permanent colony, is of great interest. The average mining engineer has but little concern with colonial history, but he will find it productive of pleasure when put into such readable form as this.

MINE SURVEYING. By Edward B. Durham. P. 391. Index and Ill. McGraw-Hill Book Co., New York, 1913. For sale by the *Mining and Scientific Press*. Price $3.50.

While the fundamental principles in surface and underground surveying are the same, the problems of mine surveying are not the same as those met with in the ordinary surface work, and as such a special study devoted to these problems is a valuable adjunct to mining literature. This latest work on the subject of mine surveying presupposes a general knowledge of survey methods, and the application of these principles to the special problems of mining is the purpose of the author. The scheme of treatment of each division of the subject is to outline the principles and general procedure such as an engineer familiar with the ordinary methods of survey would be conversant with and follow this with examples showing the variations in mining practice. The methods that are used for the overcoming of difficulties in the conduct of mine survey work are of special interest, and will serve as guides for the planning of work for special problems in mine surveying. The subject of mine surveying instruments is discussed with special reference to instruments peculiarly adapted to underground work. But few of the common instruments are shown, as they may be obtained from any maker and are fully described in catalogues. The modern tendency to represent mine models of three dimensions as an improvement over the mapping methods, which are more difficult to interpret by the layman, has led to the development of various types of models such as plaster models, plate models, and skeleton models. These types of models have been found well adapted to presenting an accurate figure of the character of a tract of land, the geological formation of a locality, or the plan of a mine. The building of such models is an interesting subject and is treated fully in this work. As both prospecting and development work are expensive, exploratory surveys have been found to greatly facilitate this work and reduce subsequent mining costs by reducing the amount of excavation to the minimum.

Recent Publications

ESTADISTICA MINERA DE CHILE EN 1910. The work of compiling these data was entrusted by the federal government to the Sociedad Nacional de Mineria and completed under the direction of Don Guillermo Yunge, engineer of mines. P. 466. Maps. Santiago de Chile, 1913.

New Zealand government reports, Wellington, 1913:

MINES STATEMENT FOR 1912. Compiled by the officers of the Department of Mines. P. 158. Ill., maps, plans. This is the annual report covering statistics, reports relating to metalliferous mines and stone-quarries, state aid to mining, roads through goldfields, prospecting drills, water-races (ditches and flumes), schools of mines, inspection of mines, examinations for certificates (mine managers and mill superintendents), geological survey, state coal mines. The total value of all minerals produced during 1912 was worth $14,500,000, a decrease compared with 1911, on account of several prolonged strikes in both islands. The gold output was 343,163 oz.; silver, 801,165 oz.; coal, 2,177,615 tons; kauri-gum, 7908 tons; and sundry minerals, 1729 tons.

REPORT OF THE ROYAL COMMISSION ON FORESTRY. P. 87. Ill., maps, plates. Gives details of investigations on the forest situation in New Zealand, and future proposals.

TWENTY-THIRD ANNUAL REPORT OF THE TRANSVAAL CHAMBER OF MINES FOR THE YEAR 1912. P. 480. Index. Johannesburg, South Africa, 1913. This volume is always of interest, and contains a considerable amount of valuable information on the mining industry responsible for a yield of gold worth £38,711,581 during the past year. The ore treated totaled 25,486,361 tons, and £8,291,477 was paid in dividends. The average number of employees was 23,817 whites and 192,575 natives, who received £6,962,690 and £5,962,997 in wages, respectively. Stores valued at £10,208,004 were purchased by all gold mining companies, and the Union of South Africa received a total of £2,305,689 as mining revenue from all mines. There were 5717 machine-drills at work, and the percentage of waste sorted from the ore was 12.57. The coal output was 4,7o1,850 tons; diamonds, 2,131,486 carats; silver, 1,018,253 oz.; copper ore, 1624 tons; and tin ore, 2948 tons. The report also contains the following matter: The annual meeting of the Chamber of Mines, and balance sheet, president's address, details of native labor, miners' phthisis, Sunday work, mining taxation, water supply, coal transport, statistical matter relating to the mining industry, exports from South Africa, legislation, and the annual report of the Witwatersrand Native Labour Association, Limited.

U. S. Geological Survey, Washington, 1913: Advance chapters from 'Mineral Resources of the United States, 1912':

GOLD AND SILVER IN 1912. By H. D. McCaskey. P. 55. The report contains valuable tables of the world's production of gold, as well as the statistics of the gold and silver production in the United States, and fairly detailed accounts of the production of the separate states.

PRECIOUS AND SEMI-PRECIOUS METALS IN CALIFORNIA AND OREGON. Mine Production. By Charles G. Yale. P. 90.

PRODUCTION OF COBALT, MOLYBDENUM, NICKEL, TANTALUM, TIN, TITANIUM, TUNGSTEN, URANIUM, AND VANADIUM. By Frank L. Hess. P. 77.

PRECIOUS AND SEMI-PRECIOUS METALS IN COLORADO. Mine Production. By Charles W. Henderson. P. 74.

THE PRODUCTION OF NATURAL GAS. By B. Hill. P. 61.

MINERAL RESOURCES OF ALASKA. Marble Resources of Ketchikan and Wrangell Districts. By E. F. Burchard. P. 77. Map. A fairly detailed account of resources that are likely to become important.

ZINC AND CADMIUM IN 1912. By C. E. Siebenthal. P. 53.

Advance chapters from Bulletin No. 540:

PHOSPHATE DEPOSITS IN SOUTHWESTERN VIRGINIA. By George W. Stose. Bulletin No. 540-L. P. 16.

Pioneer Electric Locomotives in Alaska

What is claimed to be the first electric locomotives ever used in Alaska were placed in service within the past few months for mining operations by the Alaska Treadwell in connection with the readjustment of haulage incident to the opening of the new central hoisting shaft. The locomotives are used to haul ore in trains of 10 or more cars (80 tons) from the central hoisting to the various mills. The two initial electric locomotives are each of six-ton

ELECTRIC LOCOMOTIVE IN USE AT THE ALASKA TREADWELL MINE.

capacity and are operated on a 500-volt, direct-current circuit from an overhead trolley. They were manufactured by the General Electric Co. and are of the standard outside frame type, in which the side frames are placed outside of the wheels. Each machine is equipped with two type HM-801 motors having ball-bearing armatures. The motors are mounted in tandem, whereby one motor is placed in front of the rear axle and the other between the forward axle and the front end-frame.

The motors are of the usual series-wound type, and the controller is of the rheostatic, magnetic, blow-out type. A commutating switch is incorporated in the reverse cylinder, the handle of which has four 'on' positions, two for each direction of motion, one with the motors in series and the other with the motors in multiple. This system of control, by permitting the motors to be started in multiple, allows them to exert their maximum tractive effort independently, so that the slippage of one motor does not affect the other. With the series connections, economy in current consumption is effected while running, for the locomotive will then develop a given drawbar pull with one-half the current required with the motors in multiple, the speed, of course, being reduced in approximately the same ratio.

A New Drill

A small drill with automatically rotated bit is now being manufactured by the Hardsocg Wonder Drill Co. The drills use the ordinary seven-eighths and one-inch hexagon hollow steel and are operated in the same manner as an ordinary 'sinker,' except that it is unnecessary to rotate by hand. The rotation is accomplished by means of a ratchet following a long curved groove. The drills are in use in a Los Angeles quarry where, in soft rock, holes 2 to 6 ft. deep are drilled. Including changing of bits, the maximum depth is accomplished in 14 minutes.

Graphite Brushes for Dynamos

For the convenience of users of Dixon's graphite brushes, the following is a summary of the conclusions deduced from tests and observations made by Albert F. Ganz, professor at the Stevens Institute of Technology: (1) Before brushes are applied to a machine the commutator must be given a true and polished surface. A rough commutator will quickly wear away graphite brushes; (2) no oil, vaselin, or other lubricant should be used with brushes, but the commutator must be kept perfectly free and clean from such materials; (3) don't soak brushes in oil or grease; (4) when a new graphite brush is inserted on a commutator, its surface should be fitted to the surface of the commutator by means of finest sandpaper; (5) sandpaper the contact surfaces and commutator occasionally, as the bearing surfaces of the brushes will take on a high glaze in time and may cause squealing; (6) the brush holder should be so constructed that the entire contact surface of the brush is touching the commutator, and that the brush pressure is evenly distributed over the contact surface of the brush; (7) for slow-speed machines with little vibration the lower pressures will give satisfactory results, while for high-speed machines with considerable vibration the high pressures must be used. The pressure should always be as light as possible. (8) Where two or more brushes are used in parallel on one machine, it is important that the brush pressure be the same for all brushes; and (9) motors require individual treatment, some require more petting than others. One must study conditions carefully and adjust brushes accordingly.

Commercial Paragraphs

The Pacific Tank & Pipe Co. has moved its San Francisco sales offices to its former offices, 318 Market street.

The Alberger Pump & Condenser Co. announces that "on October 20, Frank E. Getts took charge as district sales manager of its Chicago office. At the time of his appointment to this position Mr. Getts was engineer in the Chicago office of the General Electric Co., and in connection with important steam turbine installations is well known throughout the United States."

Allis-Chalmers Manufacturing Co. announces the removal of the sales and engineering offices of its mining machinery department from Chicago, Illinois, to the Milwaukee works at West Allis. The Chicago shops will also be removed to Milwaukee in the near future. The advantages to be gained by concentrating all departments, both commercial and manufacturing, at one plant are the reasons for this move.

The Dorr Cyanide Machinery Co. has opened an office at 50 Church street, New York, to handle its expanding business in metallurgical and industrial lines. The Dorr thickener is now being installed by the large copper companies quite extensively, both in connection with water concentration and flotation process. Mr. Dorr will spend a great deal of his time in New York this winter in connection with the Company's business and professional work.

The International Motor Co. makes the following announcement: Considerable publicity has been given to proceedings brought by George E. Blakeslee, a stockholder, to the extent of 187 shares of preferred stock, in which he asks for the appointment of a receiver and an injunction prohibiting the Company from borrowing other funds. His application for a receivership and permanent injunction has been dismissed by the court. Plans have been completed under which the existing or future merchandise creditors of the Company will have unusual protection for credit extended. With the exception of bills for merchandise, the Company will have practically no obligations to meet for the next three years, beyond its current requirements.

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EDITORIAL

FROM Agra and Oudh comes the report that the short marriage season has had a discouraging effect upon the silver market. Are wedding bells of silver in the country east of Suez?

HANDLING flue-dust by mixing it with converter slag in a rotating cone is an ingenious method in use in the Southwest. It was described, as practised at Cananea in 1910, by Mr. Courtenay DeKalb in the *Mining and Scientific Press* for July 2 of that year. Details of the practice at Douglas are given this week in the article by Dr. James Douglas.

STUDENTS of fault phenomena should study the report of the 'Committee on the Nomenclature of Faults,' appearing in the *Bulletin* of the Geological Society of America, June 6. The committee, consisting of Messrs. H. F. Reid, W. M. Davis, A. C. Lawson, and F. L. Ransome, has prepared a comprehensive and well illustrated report, too long for reproduction here, and worthy of wide reading.

TUBE-MILL calculations are none too easy and there are many points upon which theoretical knowledge alone is not sufficient. We printed, October 11, a short summary of the principal calculations necessary, taken from an excellent general catalogue issued by the Cyanide Plant Supply Company of London. That catalogue, by the way, is a mine of technical information of high value.

IT is a pleasure to commend the frankness of Mr. D. E. Alves, chairman of the Venezuelan Oil Concessions Limited, who in his address before the annual meeting of the stockholders in London said: "I take this opportunity of informing the public generally, through the columns of the important financial organs, that until we have the results which the Company's engineers on the spot, and the management in London confidently believe will be achieved, the operations of this Company must be and are absolutely speculative." The Company has a concession covering 3000 square miles in Venezuela and, according to letters from the managing director who is on the ground, there are excellent indications of six oilfields. Gas has already been found, but expectations are not oil and at present, as Mr. Alves says, the business must be considered speculative. As one of the stockholders said, "if the chairmen of other companies would advise the public in the same way, I suppose we should hear of fewer scandals." Mr. Alves and his associates have set an excellent example and deserve the abundant success that we join in wishing them.

IN choosing between the mottoes, 'do your Christmas shopping early' and 'spugs,' we would cast our ballot with the former.

DECISION of the United States Supreme Court that a railroad company may not convey hay on its own line for the purpose of feeding its own mules used in the operation of its own mines without paying itself for the transportation of the hay, results in the Lackawanna railroad having to pay the Government for not paying itself.

HOISTING in balance results in economies, but also introduces problems. Some of these are brought out in connection with a description of the Balliet system of counterbalancing that we print this week. Unfortunately, considerations related to pending patents forbid printing at this time of drawings or details regarding the means adopted to accomplish the automatic increase of weight on the balancing rope.

PRIMARY and secondary are terms which have come to mean many things to students of ore deposits. Essentially they relate to order of deposition and give no clue to the source of the ore defined. None the less, 'secondary' ores are usually those which have been formed by downward leaching by surface waters of older orebodies. In places exactly similar orebodies have been formed by the same agencies, but where there were no older bodies to be leached; as in the case of the Leona Heights deposit discussed upon another page by Mr. A. R. Whitman. This nomenclature produced the absurdity of a 'secondary' orebody where there was no preëxisting primary ore. Mr. F. L. Ransome has proposed to meet this difficulty by introducing the term hypogene for the minerals formed by ascending hot solutions, and supergene for those deposited by generally downward moving and initially cold solutions. Presumably these terms are also to be applied to the deposits in which the minerals occur. Under this system it would be possible to define a supergene deposit that was primary or a hypogene deposit that was secondary.

ZINC metallurgy has been so frequently referred to as backward, that the statement has come to be accepted without question. On another page we present part of a vigorous defense of the art, written by Mr. George C. Stone, who as chief engineer for the New Jersey Zinc Company has had unequaled opportunities both for observation and experiment. Looking at the matter in a large way he makes a strong case for the retort system and he believes that progress is to be in the direction of still further improvement of the old Belgian furnace. Others think differently. At the Bully Hill mine in Shasta county, California, Mr. J. B. Keating and his staff are making zinc in a small way by a wet process and are steadily overcoming the difficulties met in increasing the scale of operations. Many others are busy upon wet processes and on electric furnaces, and the Continuous Zinc Furnace Company at Hartford, Connecticut, is obtaining surprising results from treatment of mixed ores in a furnace of new type. Improvement of both old and new types is to be expected. For ourselves, we prefer the attitude of the optimist to that of the agnostic; the man who hopes for the best, rather than the man who does not know.

MINE examination in a far country and among a people strange to the engineer and perhaps strangers to mining, involves constant friction over little things. The geology and the mining problems involved may be simple enough, but the human equation must be taken into account, and in hundreds of small details there are potentialities of trouble. In the articles on 'Prospecting Conditions in Peru,' of which we print the first this week, Messrs. Charles S. Haley and C. A. Rodegerdts confine attention to these things. As members of the staff of Messrs. D'Arcy Weatherbe and N. B. Knox they saw several months' service in the mountains of Peru, and they have attempted to give that semi-technical information which they lacked at the beginning of the journey and would have found useful. Karl Baedeker established a great system of guide books, but it is in the letters of personal friends that we find mention of the little things that make or mar the pleasure as well as the success of a trip.

Federal Workmen's Compensation Law

The finding of the commission, which was appointed by an act of Congress passed on June 10, 1910, to investigate the subject of workmen's compensation, is such that favorable action upon the proposal to require interstate railroads to establish a system of compensation for accidents is likely to be taken by Congress. After numerous public hearings, at which all sides of the subject were debated, the consensus of opinion became that the old system of employer's liability has been outgrown, and that some form of accident compensation should take its place. The only differences of opinion were in respect to details. The fundamental principle that accidental injuries and death should be compensated as automatically as possible and that this compensation should be without regard to the cause of the accident, has been unanimously agreed upon. Statistics gathered by the commission show that the combined railways of the United States, during the years 1908, 1909, and 1910, paid for injuries to their employees and for death claims, either voluntarily or as the result of judgments, a total of $10,085,000 per annum. Of this amount only about one-half reached the employees and their dependents; the balance being paid for legal and for other attendant expenses. Under the proposed compensation act, railway employees will receive approximately $17,000,000 annually instead of the $5,000,000 which at present is paid to them by the companies.

Under existing conditions the tendency is for the employee to exaggerate the employer's negligence, if any exists, in an effort to secure greater damages and for the employer to minimize his liability by a distortion of facts in the opposite direction. The result is that an unbiased statement of conditions is seldom brought out in the court room. With this condition of affairs removed it is believed that a coöperation between employer and employee will

result in a true report of working conditions and the number of accidents will be materially decreased. The passage of a bill along this line was recommended by the President in his recent message and will probably be considered by Congress during the present session.

While the law now proposed will affect railway employees only, it is generally conceded to be the first step toward accident compensation in all departments of industry. The success of such legislation is being attested to in various parts of the world and the project is generally believed to be past the experimental state. In England, Germany, and Australia, results have been most satisfactory to both men and companies. In England the average cost per miner amounts to $5.35. In Germany every working man or woman regardless of nationality is insured against sickness, accident, invalidity, and old age, and during the twenty-five years since the system was established in Germany, it has proved an institution for the furtherance of the well-being of the working class, while under it employer and employees have been brought closer together in the promotion of mutual interest. In the United States, a number of the states have compensation acts. Even where not required by law, individual companies have in many instances established systems of automatic compensation for injuries and have found it most satisfactory to employer and employee. It brings workman and employers closer together and avoids the waste of time and money in litigation.

Geologists and Engineers Again

Complaint is made from time to time to the effect that geologists are prone to overlook the work of mining engineers when the latter trench upon their field. Recently Mr. T. A. Rickard brought up one instance falling within his own experience as a case in point, and last spring Mr. George Collins indulged in some gentle sarcasm apropos the subject and at the expense of the staff of the United States Geological Survey. Mr. J. F. Kemp replies this week to Mr. Rickard's request for information, and does so, as always, in excellent part. The merits of the particular case interest us little, but as one who has managed to make a living first as a professional geologist and later from mine management, and who is now outside both lines of work, we may be permitted to comment as an innocent bystander—even at the proverbial risk of attracting rocks from both sides.

There is, we are convinced, a wide-spread feeling that mining engineers do not get their just deserts at the hands of geologists; that their observations and statements of facts are absorbed without due credit; and that their suggestions as to structure and theory, based on long and careful work but expressed briefly and indifferently, are dismissed without consideration or are treated as lucky guesses. There is a distinct feeling among engineers that the geologist, by reason of facility in writing, reaps glory that in reality is due the engineer. We are convinced furthermore that there is just basis for this feeling and that in many instances the visiting geologist has quietly appropriated the intellectual property of the resident engineer. This is all the more resented since each particular incident is petty and the engineer cannot claim his own without seeming to show an ungenerous and self-seeking spirit.

On the other hand, the geologists are unconscious of their fault, and even widely experienced men deny promptly that there is any such general sentiment as we have observed. We do not believe that geologists are less keen or less generous than other men, and the explanation lies in the difference in their training and mental attitude from that of engineer. The geologist is primarily a scientific investigator. To him, theories, from any source, are mere material for study. They have no validity, so far as he is concerned, until he has tested and proved them. This exposes him to the danger of assuming that nothing is discovered until he has found it out, but on the whole it is a sound and necessary mental attitude. A chance suggestion made by some one of his engineer friends may lead to sound or unsound conclusions; it is sure to lead to long and painstaking investigation if it be tested at all, and it is not unnatural that the investigator sees mainly the work that he did to establish the conclusion reached and forgets or minimizes the source of the suggestion. The engineer is not accustomed to the same methods of research. His main work and interest is concerned with other things, and, as is true of most men who work mainly in other lines and make few contributions to science, he is apt to overestimate such as he does make. There are mining engineers who are excellent geologists, but the majority are not, and some of the veriest geological nonsense we have ever read has been written by excellent engineers. The geologist sees this constantly and comes, perhaps unconsciously, to believe that as to geology a conclusion reached by a mining engineer must be tested before being accepted; and in the main he is right.

It is equally true that the geologist turned miner makes ridiculous mistakes and that the mining engineer has, and rightly, an equal distrust of his opinions on matters relating to the technology of mining and metallurgy. Here, too, there are exceptions, and some of the best mining engineers of our acquaintance were first trained as geologists. The rule, however, holds true, that the work of the two is distinct and that one attempting to cover both fields may rightly be held to high standards.

With this mental attitude on both sides, it is not surprising that friction and soreness occasionally develop. A further cause of misunderstanding lies in the fact that engineers and geologists do not read the same periodicals except in part. A geologist taking up a new problem and reviewing the literature as a first step, must go through a whole series of journals that few mining engineers ever see. It is not surprising that he does not comb with equal care those whose columns are devoted mainly to engineering. He ought to do so, but he does not. The men of the two professions have much in common and the world around they are the best of comrades. We believe that each will gain by cultivating the other. If the engineer will test his geological theories a bit more carefully and write of them somewhat more fully, we believe the geologist can be brought to make the fuller acknowledgment for which any circumstance calls.

Prospecting Conditions in Peru

By Charles S. Haley and C. A. Rodegerdts

From the days of Magellan and Pizarro, that part of the Andean region comprising the northern half of Chile, the western half of Bolivia, and almost all of Peru, has been fraught with much interest to civilized humanity, because of its great mineral wealth. Spanish galleons, laden with the historical 'pieces of eight', continually furrowed the oceans with their treasure-laden hulls, and the whole history of the terrible struggle between England and Spain for the mastery of the sea is inextricably bound up and intertwined with the history of the production of the precious metals from the fabled exhaustless treasure-stores of the Incas.

The days of Sir Francis Drake and Sir Henry Morgan have long been memories of the past. The buccaneer and the 'gentleman adventurer' have made

ENGINEERS' CAMP IN PERU.

their bow and passed into the wings. The "pieces of eight" are one with the "fifteen men on the dead man's chest," in the hold on the memories of our boyhood. And yet, quietly and unostentatiously, in the shelter and protection of modern civilization and law; with the aid of all the vast resource of modern mechanical skill, this same territory is again being exploited, and attention is again being turned toward this latest of earth's treasure-houses.

It is the purpose of this article to give an idea of the conditions which are to be found in Peru today, by any one engaged in the examination of mining property, and from this to reflect, as far as possible, some idea of the conditions for subsequent working of property after it has been acquired.

Relation of Peru to Latin-America

Peru is taken as the subject, because general conditions in that country are typical of practically all of this region in which so much interest is now being taken. As a matter of fact, the position of Peru among her Latin-American neighbors is potentially superior to all of them, with the exception of Brazil; but actually, Peru has just begun to take advantage of her own. Development of transportation facilities is at present her most crying need and the exploitation of her mineral wealth will follow swiftly upon its heels.

As everybody knows, Peru is accessible on the Pacific Coast by steamers from Panama. The Peruvian government has built and subsidized one of the most important lines; an English company is backing two others, one is operated under a Spanish name called the Chilean line, or Compania Sud-Americana de Vapores; and another known as the Pacific Steam Navigation Company. Of the three lines, running as far south as Callao, the Chilean line is perhaps the best operated and most comfortable; from Callao south, the Pacific Steam Navigation Company maintains a service which is excellent. In the last few months, however, W. R. Grace & Company has put on a magnificent line of steamers which make the trip from New York to Seattle by way of the Horn. Aside from these lines, the Kosmos (primarily a line of freighters), is said to run some comfortable little steamers, though more or less irregularly.

The Voyage to Peru

The voyage is ordinarily smooth and pleasant, from Panama down to Callao. It is supposed to take from six to seven days, and usually does. The principal ports of call on the way down are Eten, Paita, Pacasmayo, and Trujillo. A good deal of freight is usually taken on at these points, chiefly consisting of sugar, hides, rice, wool, and even cotton. Most of this is transshipped for England and the Continent, though a certain amount of it is kept for local use.

From the appearance of the country along the coast (which is not visible during the first two days of the voyage from Panama, as far as Eten, at the extreme north of Peru), one wonders where all this produce is grown. Barren, dry, and wave beaten, the low cliffs, for the most part sandstone, look as if guarding an absolutely barren and desolate land. Once in the interior, however, and traveling up the streams, this is readily explained, and the wonderful fertility of this soil where supplied with water from the rivers (for this is an absolutely rainless belt), is well demonstrated.

After leaving Trujillo, the course of the steamers again leaves the coast, until the broad harbor of Callao swings into view. The first thing the traveler will notice about Callao is the mosquito fleet of *fleteros*. As the big steamers do not discharge passengers at the docks, their passengers and baggage are left to the tender mercies of a swarm of smiling pirates who compete with one another along the decks of the ship for the disembarking passengers. Having picked out the most promising, and, if he is wise, having carefully arranged details of price beforehand, the traveler will disembark from the ship's ladder into a rowboat, with such hand grips, or *maletas* as are convenient, and allow himself to be freighted to the pier. By previous agreement, all grips and trunks will be delivered at whatever hotel may be desired, either in Callao or Lima, but the traveler must be prepared to first escort them through the custom house.

At Callao, as at all ports of Peru, this institution

is not very prepossessing in appearance. A long, low, wooden shed, filled with perspiring officials and assistant officials with their assistants, a sprinkling of soldiers, and a motley crowd of *fleteros* on guard for fear that their patrons may get away with their luggage unawares, makes the position of the traveler, especially of the gentler sex, not the most enviable thing in the world. The inspection of luggage is, for the most part, rather thorough. One of the first things to startle the incoming traveler, however, is the enormous duty on personal effects, such as kodaks, typewriters, or revolvers. These articles, no matter what the intent of the user as to retaining them personally may be, are subject to duties from 25% of their value to as much as they are worth.

Duties on Machinery

Furthermore, in case of importing mining or industrial machinery, rather anomalous conditions exist at different ports. All mining machinery is supposed to go in free, when it is to be used for the development of a particular mine in the country, or to prospect it. Yet, at the port of Mollendo I know of an attempt to hold a man up for twelve hundred dollars in duties, which was only thwarted by a direct appeal to the authorities in Lima, through influential friends. During the recent rush to Bolivia, many of the American miners who brought machinery for prospecting purposes through Mollendo as the port of entry, complained bitterly of having to pay the Peruvian government duties on goods in transit to another country, when, as a matter of fact, it appears to have been plain and simple graft.

The traveler and his goods having safely landed at Callao, will probably take the electric road to Lima, although there is a regular local train service at about hourly intervals through the day. There are few hotels worthy of the name in Callao, whereas in Lima, twenty-five miles away, there are good hotels and restaurants. Nothing, of course, to be compared to the average city hostelry in this country, but nevertheless, fairly comfortable and clean. There are a few comfortable little clubs whose hospitality, to a visitor, is very acceptable.

After disposing of the attempts to overcharge on the part of the *fleteros*, and getting his luggage comfortably settled about him, the visiting engineer will probably want to get his bearings and see his bankers. While there are street railways in Lima, the principal means of travel for the better classes consist of little victorias drawn by one or two shaggy little ponies. The usual tariff for these vehicles is twenty centavos (ten cents gold) for any journey within the city limits. This means between stopping places, and an extra fare is charged for every stop. For communication with any of the surrounding suburbs and watering-places of Lima, such as Chorrillos, Barranca, and Miraflores, there is a line of electric coaches.

Then comes the problem of getting one's mail. So long as this has been sent in care of one of the leading merchantile or banking houses, there will not be much trouble about getting it; but if merely sent in one's own name, care of general delivery, you may be given all the personal assurance possible that there is nothing for you, and then drop in a day or two later and see a letter advertised on the bulletin board with your name. This difficulty increases as one goes into the less settled regions in the country until it becomes a rather serious problem. The best solution is to have all mail sent in care of one of the two or three leading English or American merchantile houses, and retained until your arrival in one of the larger cities. By this means, though delay may be occasioned, you are sure eventually of receiving your mail; otherwise you are taking chances.

In the case of outfitting a prospecting expedition, aside from the main essentials, such as machinery, instruments, etc., the main details may be safely left to be completed at Lima, or in the south at Arequipa. Tents, bedding, etc., are apt to be of a better quality and cheaper if brought with one. All the food supplies, tinned goods, hardware, and even minor pieces of machinery, can readily be obtained in Lima. One exception that comes to mind is that of a stove, however. A portable camp stove was not to be found in Lima a year ago.

SAN PEDRO, ONE OF THE CITIES ON THE ROUTE.

Prospecting Equipment

In the case of minor prospecting equipment, however, such as rockers, portable sluices, etc., carpenters and sheet-metal workers, as well as blacksmiths, can be found to make them at reasonable prices, in Lima, Callao, and Arequipa. Such work as one might expect to have done in a small country town in the States can readily be depended upon here.

Food supplies are cheap, due, of course, to water transportation and cheap markets. By the time, however, that one has delivered them in the more out-of-the-way parts of the country, their original cost will probably be lost sight of. This is due to the lack of railroad facilities.

Callao and Lima are the entries for the Cerro de Pasco Mining Company, and a railroad scrambles up the mountains behind the city to an altitude of 17,000 feet. A road to Huancaya runs off in a southeasterly direction from Lima, without any apparent

purpose in life. In the south, a road from Mollendo, on the coast, connects with Arequipa, the second largest city of Peru. From Arequipa this road goes northeast to Juliaca, not far from Lake Titicaca and the Bolivian line. At Juliaca is a junction between the rail and steamer line running to La Paz, Bolivia, and a narrow-gage railroad running north and slightly west to Cuzco, the ancient Inca capital of the country. This road extends through the heart of Peru, reaching toward Lima, whence the aforementioned road to Huancaya stretches out to meet it. The junction between the two, however, will necessitate the traversing of a rough wild country. The intention is to connect them, however, at some time in the future, as the road is not only a necessity, but will open up one of the wealthiest river-valleys from an agricultural standpoint in Peru, that of the Pachechaca. As at present planned, this road, passing through Ayacucho and Abancay, and connecting with Cuzco, will greatly facilitate the transportation problem, which is one of the greatest drawbacks to the development of the mineral wealth of Peru. When this road is constructed, spurs and connections can be built to serve the major portion of the mineral and agricultural country of the south. As stated, the government is planning this road, but funds are not available at present to build it, so how soon it will actually be under construction is largely a matter of conjecture.

Aside from the roads mentioned, there are a few short railways connecting the coast with points on the interior, but the main and dominant factors in the transportation remain, as of old, the mule and the llama. The latter shall be treated again at greater length.

Food Supplies and Minor Equipment

The minor items of an outfit, such as tinned goods, coffee, etc., it is possible to buy at reasonable prices at Lomas, Chala, or Mollendo, all coast ports. Arequipa, the largest city of southern Peru, is a good outfitting point, served through Mollendo, and practically all supplies can be bought there as cheaply as in Lima. Cuzco can be depended upon for food supplies, leather goods, and blankets.

Assuming as an average case, that the prospecting or examining party expects to go inland from one of the coast ports mentioned, and that the outfit has been all assembled, the next and most important question is the mule train for transportation of the outfit. The pack-saddles and riding saddles can be obtained in Lima, provided that the engineer decides that he wants to buy his mules and complete outfit. This, however, we should strongly advise against, unless it is expected that permanent use is to be made of the outfit. In the latter case, however, it will be well to give a short statement of conditions to be encountered.

In the first place, if you can obtain a trustworthy purchasing agent in one of the smaller coast ports, you are lucky. I will assume that you are not. You may have every assurance that your man is looking out for your interests—but—wait till the bill comes in. It is, of course, best to go immediately to the ground yourself, and hurry matters as much as possible, for if you try to do anything at long distance in the country you will have an experience with the *manana* proclivities of the people which will wear out your patience. Once on the ground, and possessing a moderately good knowledge of the language (which with reasonable application, can be acquired in two months or less), you have some chance of getting things done.

On the coast, good riding mules are quoted at prices ranging from £25 to £30 apiece. Pack mules cost ordinarily less; from £15 to £18. In this connection, it should be mentioned that the Peruvian monetary unit is the English pound, divided decimally into ten soles (the sol is about the size and weight of a silver dollar, and worth about forty-nine cents), which are again divided into centavos, or hundredths. There are also five-sol pieces, of gold, valued at ten shillings, English money.

Pack Animals

In the interior, mules cost much less. Mules are offered at £10 each in Sandia which at Lomas, on the coast, and to the north, would have cost twice that sum. Further, and this is a very important point, the coast mules do not do well in the altitudes, being unused to the rarefied atmosphere. For this reason, it is unwise to load more than two hundred pounds per mule; and even with the mountain-bred mules, this load is not usually exceeded. To one who has handled mules in the western country of the United States and seen them carrying three or four hundred pounds over the rockiest trails, this seems ridiculous; but it is none the less a fact. Although appearing as large and strong as American mules, they simply lack the stamina. Further, the style of packsaddle that is used by the Peruvian *arriero* is, in its very nature, a mule-killer. It is a treeless saddle, consisting mainly of a pad, surmounted by a cinch, with sheepskins and blankets distributed in fearful and wonderful fashion underneath and above. You may have bought your saddles in Lima, with full assurance that you have bought the only suitable thing, and have paid a price that opened your eyes, considering the price of a cross-tree saddle such as is used in other countries. However, your chief *arriero* will assure you that they are absolutely unfitted for your needs, and use the saddles to excuse his own inefficiency in handling the loads.

Nevertheless, where two white or half-breed Indian packers in the States, with the aid of a bell-boy, will handle a string of thirty mules, a string of half that size in Peru will necessitate about one man to every two mules. Of course, the wage cost is much less, but the delay and aggravation of having your packs slip over to one side, every hundred yards of the journey, and the consequent damage to the backs of your animals, as well as to the contents of the packs themselves, are things that would take a good deal of money to compensate.

Native Labor

In this, as in all things, to one trained in the gospel of efficiency, with the belief ingrained in his heart that all things should be done well and as speedily as possible, or else there is no excuse for doing them, lies the greatest difficulty of work in Latin-American countries. A man will wear himself out

in working against the inertia of the whole country, and trying to accomplish something. Only a young man, or one in full possession of the best of his physical and mental powers, can stand the constant irritation, and he must school himself to an abnormal patience, though in no whit yielding the fight.

As to the *arrieros* themselves, many of the same conditions applying to the mules will be found applicable to them. On and near the coast, they are mostly of a mixed Indian breed, speaking a sort of Spanish. They will readily chaperon a string of mules as far as seventy-five or a hundred miles into the interior, but beyond that they are extremely reluctant to go, and it is advisable to change to the mountain drivers, who are practically pure Indian, and who, in their turn, do not much care to go down to the coast. On the whole, the mountain Indian, who speaks scarcely any Spanish, if at all, is more faithful, and a better attendant to the needs of his charges, than his more highly educated brother of the coast.

Freight Contracts

This matter of the care of one's mules is one of the principal reasons for contracting freight. If the head *arriero* does not have to be responsible to the owner of his mules (and, in the case of a foreign engineer, such responsibility is *nil*), it is almost a certainty that he will ruin them. Careless, slipshod packing, poor feed, and careless shoeing will soon reduce the best string of mules procurable to a pitiable state of suffering. As the usual cure for saddle galls seems to be thrusting a lance into them until the animal becomes weak from loss of blood, it is advisable not to get more saddle galls than you can help. And if you take positive measures to insure proper care of your own mules, you will have to do it with your own hands, while the members of your *arriero* gang are sitting around watching you, with the resulting maddening delay in the journey; for unless you are in a position to drive things along all the time, you will get nowhere.

So much for private ownership of mule trains. Most of these evils can be avoided by contracting your mules, both for freight and riding purposes. In the first place, your *arrieros* live in fear of the *patron* who employs them, and who owns the mules. He naturally wishes the trip made in as quick time as possible, and at the same time is in a position to insist on proper care of his beasts—this last, of course, from utilitarian rather than humanitarian motives, because he is in the contracting business, and realizes the value of his stock, and the benefit of getting as much work out of them as possible before they are worn out.

As a rule, the contractor knows the routes well, and practically all the strain of conducting a journey in a strange country is taken off your shoulders. This amounts to a good deal, at times, for if your guides are inefficient, you may have to go for thirty-six hours without water or suffer some other inconvenience. No assurance is to be had that your guides are efficient, unless you contract for them.

Most important of all, you are spared the private graft which must always be faced by the foreigner in transaction of any buying and selling. This you cannot get around, and it is useless to expect to avoid it. The main problem is to reduce it to a minimum. No one objects to paying a reasonable commission for time and labor involved in purchasing mules, for instance, but when this commission amounts to more than the original purchase price of the animals, it becomes an imposition.

Of course, as stated, if a long stay is contemplated, as in the development of a mine, it may be advisable to purchase your own pack-train. Under these conditions, it is advisable to import a good packer to take charge of the train, to use cross-tree saddles, and to establish a regular route of rest and feed stations. Some of the larger mines have done this, and run their pack-trains after the American style.

Assuming, however, that you are merely making an examination, and wish to contract, it is well to quote some of the prices which you will have to pay. From almost any of the coast points mentioned, it will cost you about six dollars gold per mule load of two hundred pounds, per hundred miles. In heavy packing, the contractor is apt to be overcareful of his mules, and reduce the load if possible. For instance, the limit on packing an Empire drill, with four inch casing, is two sections per mule, according to one contractor of Sañaica, in the province of Aymares! At this rate, it would require about ten mules for one drill and sixty feet of pipe. They can usually be rendered more optimistic in their estimates by competition, however.

In the southern portion of Peru, in the provinces of Sandia, Carabaya, and Cuzco, the llama is often used in competition with the mule. For instance, the Inca Mining Company with a wagon road a hundred miles in length, reaching from Tirapata northward, can use carts and wagons for freighting, and then transfer to muleback for distribution purposes. Nevertheless, to deliver goods in Sandia, about a hundred miles from the railroad, costs about five soles a hundred weight. On the other hand, the llama, because of his lower standard of living, being able to pick up his food by the wayside like a sheep, can deliver for about four soles in the same place. On level ground, such as the pampas, llamas can carry as much as a hundred and twenty-five pounds; but in the rougher hill country, they are limited to about fifty pounds. Their use is not confined to any one portion of the country; they are the Peruvian national beast of burden. They cannot be hurried out of a walk, and it is rather amusing to watch them striding sedately by. Their flesh is sometimes used for food, but it is coarse and often tainted with disease.

Native Porters

Competing with the mule and the llama, one sometimes sees the peon himself. For instance, in carrying a pulling-post for an Empire (and it may often be necessary to do this for a hundred miles, so scarce is the timber in places), a gang of Indians is about the best available means, especially if the trails are steep and tortuous. On one occasion, an Indian was hired to carry a five-gallon can of coal oil a distance of twenty miles, for twenty cents; and he seemed well satisfied with his pay.

To return to the expedition, about to leave the

coast region, and ascend into the mountains, at all postoffices, *tiendas*, and other places, where one has to transact business, near the coast, Spanish is fairly well understood. As the mountains are reached, however, this can no longer be said. In fact, if contemplating doing much business with the natives or even hiring a gang of them to work, it is well to learn a little of the Quichua dialect. This is very easy, as the forms and grammar are quite regular. The pronunciation is a little troublesome, as one peculiarity of the language is that double and even triple consonants occur with frequency. However, a couple of hundred words will suffice for all ordinary purposes.

Use of Coco Leaves

Also, among the Indians of the mountains, it is well to use a good supply of coco leaves. This is a bitter plant, grown in considerable quantity in some districts and dried. Its use seems to be an inveterate habit among these people, and they chew it incessantly. Every man, woman, and child among them will have his little leather pouch, and will trudge contentedly along all day, chewing ruminatively on a cud of the stuff.

The usual method of access to the mountains is, of course, through the river valleys. In the immediate vicinity of these rivers the fertility of the soil is evidenced by luxuriant growths of cane, while outside of the limits of irrigation, the ground will be barren and desolate. The rivers themselves are very small during the greater part of the year, and usually run underground before reaching the ocean. As a result, there are no fertile deltas visible along the coast. On one side and another of the main river valley, are dry *quebradas*, reaching to the towering mountains on either side. The trail ascends from the river basin, and eventually will follow one of these dry and rockstrewn *quebradas* and straight up the side into the mountains.

The evidence of sudden torrents is plain. Great boulders of many tons of weight lie in the dried up channels, and the courses are torn and scarred. The general dryness of the country, by contrast with the river valley just left, becomes oppressive. Finally, winding steeply up the scarred and jagged shoulder of the mountain, you come out upon a bench of almost level ground. Before you, and more forbidding than ever, in the wearied state of yourself and your animals, rises another terrace, towering two thousand feet above you.

The Approach to the Cordillera

In the coarse of two days of this sort of travel you may climb ten thousand feet or more. Suddenly the character of the country changes. Still dry, but no longer forbidding, it stretches away from your feet, in the undulating ground of the pampas, and you realize that you are at last on the roof of the world; but not quite on the ridgepole. Far away to the east rise the snow-capped peaks of the Cordillera, towering up a good five thousand feet higher, and reminding you that yet another barrier must be surmounted if you would gaze down the eastern slope into Bolivia and Brazil.

Here you notice a marked change in climatic conditions. Before this, you have been in an absolutely rainless country. Now, riding along the edge of the pampas, you look down for two or three thousand feet into broad valleys and plateaus which bear all the marks of irrigation and cultivation, although exceedingly patchy and spotty. It is from the cultivators of these little green spots that you will draw your labor later on.

Here are the towns of San Pedro and Pulquio, on opposing flanks of the Andes, with a broad valley some ten miles in extent between them. Like clinging fragments of a last year's swallows' nest, the mud and stone built houses flank the steep and narrow streets. Extending down from the towns, and out across the valley, stretch the long, interminable wavering stone fences so characteristic of this country. What may have been the purpose of these irregular quadrangles originally, in the days of the Inca, is beyond power to guess. At present, so dry and barren are many of the patches of ground that they enclose, that one assumes the fences are there to keep anything living from getting on the ground and starving to death.

Leaving this valley, and climbing higher, you come out on another bench of the pampas, at an altitude of about fourteen or fifteen thousand feet. If your heart is weak, you may at this time be suffering from *saroche*, the dread 'fever' of the Andes. Many, however, remain absolutely unaffected. Beyond a very quick-coming fatigue attendant upon exercise, and at times a shortage of breath, it may be that no other effect will be noticed. After a few weeks' residence, even this will pass off, and one can walk many miles at fifteen or sixteen thousand feet elevation, without the least after-effect.

Population

As the pampas are ascended, the villages become fewer, farther apart, and scantier. At this altitude, during the summer season (which comes in the months of December, January, and February), there are apt to be frequent rain and hail storms. Owing to the abrupt slopes and lack of vegetation in the country, the water runs off directly into deep gorges of the mountain torrents. As a result, coarse grass such as a sheep alone may thrive on, and a brush somewhat similar to our sage-brush, is about the only vegetation that abounds. There are practically no trees of any size in the country, though there is an occasional scrubby type, somewhat similar to the buckeye, which clings closely to the watercourses. These latter streams are more abundant, as you near the Cordillera, where their source, the snow, is continually feeding them, and the pasturage becomes better. As a matter of course, the inhabitants of this region are shepherds, totally ignorant of Spanish, and extremely peaceable and meek. There are some few cattle ranging here, but your meat diet is confined almost solely to mutton. Old men, old women, and children do most of the sheepherding, and occasionally shear a little wool, which is wound into thread on hand spindles, and woven on hand looms into the inevitable poncho. One poncho serves the average peon for from ten to twenty years, and is then worn to fragments by his children. As their only other need is an occasional handful of maize, raised in abundance on the river bottoms, naturally

the question of currency is of little importance to them save as a solution of the liquor problem. For every specimen of the Quechua race—man, woman, and child—appears to be an alcohol drinker. In reading an account of the various imports and exports of Sandia province for one year, it is to be noted that the value of alcohol imported amounts to one-third of the total exports of the province. In other words, all the surplus above living expense. The houses of these pampas-dwelling people are, for the most part little circular walls of stone, topped with a thatch of the longer, coarser pampas grass.

Crossing the Cordilleras, a different type of country is entered. There is much more evidence of rainfall, and in the summer the rains are daily. Little shallow lakes abound and great herds of sheep and llamas, as well as alpacas, are grazing over the flats. Often one rides along the shores of a mountain lake for a mile or two, and the surface is spotted with wild ducks and geese, called *guachas*.

The Eastern Slope

Suddenly one comes to a break in the pampas. Down below, stretching for thousands of feet, lie the brown flanks of the mountain sides, and, invisible at five thousand feet lower elevation, flows one of the headwaters of the Amazon. Along the banks and benches above the river, stretching up into the well watered *quebradas* on either side, are little patches of alfalfa and maize, which are the main support of the countryside. At intervals along the river banks little terra-cotta colored villages appear, each with its chapel and bell tower standing guard over the community. From these villages are supplied the main body of laborers upon whom you will have to depend. Many of these speak quite a little Spanish. If it were not for the desire to buy alcohol, there would be practically no incentive for them to bend their backs to the service of the strange desires of the white men.

Here again comes a temperamental clash. It will be supposed that the neighborhood of one of these little towns is the goal of your journey, and that you contemplate a two or three months residence here while examining a large alluvial or quartz property. You are naturally anxious to get to work at once, and go down to the village to see about labor and food supplies. You will probably make the acquaintance of the mayor of the town, and the principal storekeepers. These men are naturally interested in the employment of the men of their village, because it means that they will eventually get the money paid in wages. In many cases they have a hold on the peons, who may have run in debt to them. If you contract for men from them, you will be much surer of your labor supply, although you will be expected to allow the *patron* to make a profit on each man's labor, running from twenty to fifty per cent. Even in doing this way, you will probably be disgusted by the dilatory fashion in which your labor is furnished. However, if you do not do it, you will often find yourself utterly without men, in spite of your best efforts. The Indian simply does not need money, because his standard of living is so low. He will contract to work for a week at a time, and when his week is up, you may depend upon it that you will not see him again for some time. If, however, the principal men of the village have a financial interest in supplying you with labor, you will find the supply much more regular.

The attitude of the average Peruvian toward the Quechua is well expressed by the remark of a young Limanian friend of mine, who said, "*Esos no son Peruanos; no mas Peruanos que las llamas.*" (Those are not Peruvians, no more Peruvians than the llamas.) The price of labor per diem is very cheap in most parts of Peru, varying from twenty cents gold in the central provinces to one dollar gold in the quartz mines of the south. The cheaper the labor is, however, the more costly it seems to be, looking at it from the standpoint of work accomplished. I have found the average Indian of the south to be worth much more per day than his less-paid brother of the north and central portions of the country. One who is used to handling intelligent white labor on the theory that it is cheaper to discharge a man than to waste your time watching him, finds a different condition here. On that theory, it would be necessary to discharge all of your men faster than you could hire them.

(To Be Continued.)

Electrolysis of Aqueous Solutions of the Simple Alkaline Cyanides

According to G. Howell Clevenger and Mortimer L. Hall, the following conclusions were arrived at after considerable experimenting and presented at the twenty-fourth general meeting of the American Electrochemical Society at Denver, Colorado: (1) The bulk of the decomposition of cyanide occurring during electrolysis is due to oxygen liberated at the anode through the decomposition of water. (2) The principal final reaction in solutions of cyanide containing proctective alkalinity, which in cyanide mill practice is usually due to lime, is the formation of the corresponding alkali carbonate. This accounts for the formation of large amounts of calcium carbonate during the electrolytic precipitation of gold and silver from cyanide solutions. (3) A consideration of the reactions previously discussed will explain the failure in many cases to obtain regeneration of cyanide when such regeneration is theoretically possible. It is apparent that the decomposition of cyanide may easily be equal to or greater than that regenerated through the precipitation of the metal in solution. (4) The Liebig titration for the estimation of cyanide in an electrolyzed solution gives results which are low. (5) The changes taking place in fresh and electrolyzed cyanide solutions, upon standing, are different. (6) While not wishing to discourage investigators working along the lines of aiding extraction with refractory ores by electrolysis, it is of importance to call attention to the disadvantages which may arise through the indiscriminate use of electrolysis with an ore pulp. First, a large loss of cyanide may result from which there is no benefit derived, and, second, electrolysis may actually interfere with extraction through the formation of a coating of calcium carbonate upon the ore particles.

Synthesis of Pyrite

ALFRED R. WHITMAN

*Economic geologists have been debating whether certain deposits of pyritic copper ore could have originated through the re-deposition of pyrite leached by meteoric waters from overlying rock. But in the experiment here described pyrite was actually re-deposited from meteoric waters which had leached it from overlying rock, in the laboratory. Therefore the potency of the process to perform the function of creating a deposit of pyrite, can no longer be doubted.

The type of copper deposit referred to is that which produces the pyritic copper ores of Shasta county and the pyrite of Leona Heights in Alameda county, California. These deposits are large solid masses of pyrite containing copper, enclosed in a country rock of rhyolite or andesite. The sulphide masses are not crustified, nor do they necessarily lie along faults, but they are apparently isolated in most cases from any connection with possible channels of ascent for deep seated mineral-bearing solutions, and are devoid of evidence of foundation in subterranean chambers. If they have originated through magmatic segregation in intrusive bodies, the mode and evidence of segregation are very obscure; but at Leona Heights, at least, the enclosing rock is a series of lava flows, a fact which precludes the possibility of such an origin.

Origin of Leona Heights Deposits

The only reasonable mode of origin remaining for the Leona Heights deposits, is that of deposition from waters descending from the surface. In the case of the Shasta county deposits, the idea has been proposed that descending surface waters oxidized the primary pyrite grains, disseminated through the country rock, and carried the resulting sulphate in solution to, or near, the ground water level, where, in a reducing environment, the sulphate was transformed back into a sulphide, replacing the country rock, and giving rise, by slow accretion about a central core, to the large solid bodies now being mined. I examined the pyrite deposit at Leona Heights, owned by the Leona Chemical Co., and formed the same conception of its origin. From a detailed study of this body, it appeared that the pyrite deposit had grown by accretion, and had replaced the enclosing rock as it grew, the rock being changed to kaolin and amorphous silica immediately before being replaced by the pyrite. The process had evidently been brought about by solutions, and since acid solutions are generally understood to be the chief agents of kaolinization, it was assumed that some reaction of sulphate solutions had taken place at the growing points of the orebody to liberate the sulphuric acid which must have produced the kaolin from the feldspars of the rock.

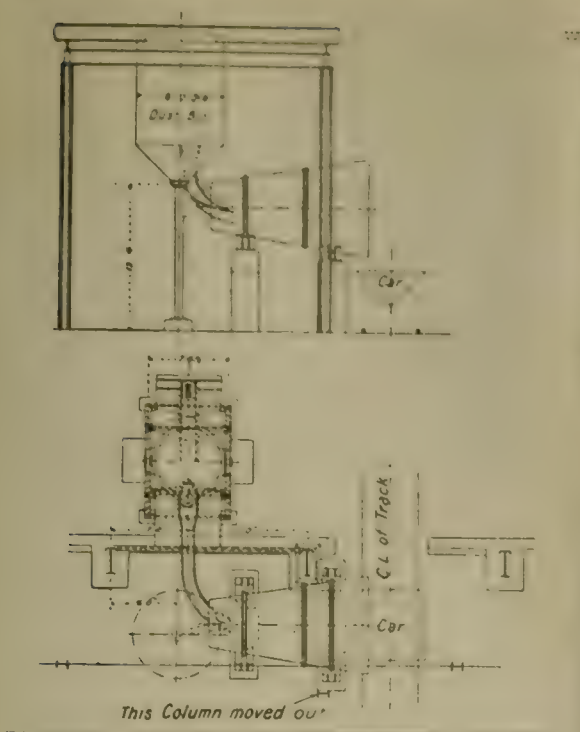
With the hope of clearing up these obscure points of geochemistry or of at least circumscribing them within the limits of laboratory research, the following synthetic experiment was undertaken toward the end of last year. A zone of leaching corresponding to the region above ground water level, was constructed. Below this, there was placed a zone of reduction, corresponding to the region below ground water level. And two water solutions, corresponding approximately to two types of surface water, were allowed to percolate downward through both zones. The zone of leaching consisted in two coördinated sets of five vertical glass tubes, 1¼ inches in diameter, and from 2 to 4 ft. long, filled with crushed andesite, with pyrite and chalcopyrite artificially disseminated through them. One set of tubes received one surface water, and the second set the other, the solutions flowing from one tube to another through each series. Half of each system was electrically heated to 45°C. in an asbestos-lined wooden box. From this zone the solutions flowed through small glass tubes into four vertical larger tubes filled with reducing agents, carbonaceous in two of the tubes and mineral in two. After passing through this portion of the reducing zone, the solutions passed in two cases, directly into carboys, and in the two other cases through horizontal tubes half filled with kaolin, and then into the same carboys. The solutions flowing through the kaolin tubes had previously passed through the heating box in the upper zone. Solutions of humus acid were introduced into the carboys in small quantities to assist in producing reducing conditions there. The carboys also contained mineral and carbonaceous reducers and kaolin. The rate of flow through these systems was fairly constant, averaging one drop per minute.

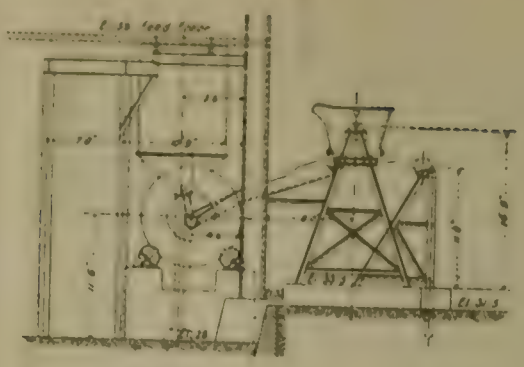
About one month after the experiment was started a green slime began to accumulate around the grains of sulphide in the zone of leaching, showing that the process of conversion of sulphide into sulphate was in progress. Gradually more of this green sulphate appeared in this zone, then in the tubes leading to the lower zone, and finally at the bottom of one of the reduction tubes. This indicated that the iron sulphate was being transported through the zone of reduction. About a month later, a black discoloration was observed in the kaolin of the kaolin tubes. From day to day this black discoloration spread, and increased in intensity until solid black masses had formed, imbedded in the kaolin.

Result of Synthetic Experiment

In the sixth month from its inception, the experiment was dismantled. No sulphide precipitate was found until the kaolin tubes were examined. Then it was discovered that the black substance was powdery pyrite, and that the black masses within the kaolin were clusters of cubic crystals of pyrite. Small pyrite cubes were also found disseminated through the kaolin. This pyrite had been precipitated from the solutions and proved that cold, dilute water solutions could oxidize and transport pyrite, and that sluiced kaolin could precipitate pyrite from them. It also appeared that it made no difference whether the initial solutions were enriched in sulphuric acid and ferrous sulphate, or in acid potassium carbonate. The experiment was successful to the extent that it duplicated the results of nature by a method supposedly similar.

*From *California Journal of Technology*, November 1913; a detailed account of these experiments appeared in *Economic Geology*, August 1913.





ARRANGEMENT OF PLANT FOR MIXING CONVERTER SLAG AND FLUE-DUST.

Handling Flue-Dust at the Copper Queen Smelter

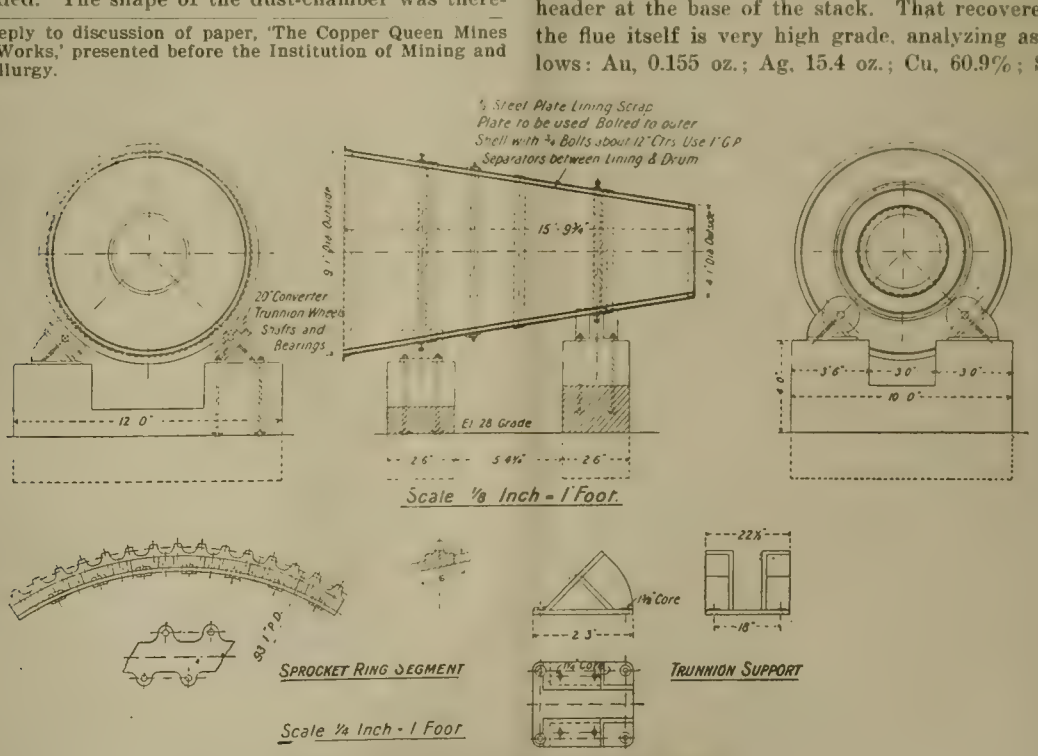
By James Douglas

*Experiments made at the Copper Queen smelter during 1909-10 showed that by reducing the velocity of the gases in the dust-chamber and preventing eddies, a large amount of the dust loss could be avoided. The shape of the dust-chamber was therefore altered, and its size increased. The gases from the converters were led through a large independent flue into a small subsidiary part of the dust-chamber at the base of the stack, and the finer material, as well as the dust, was extracted from the cupola charge and passed to the reverberatory furnace. A series of fresh experiments is about to be made to determine the efficiency of these conservative methods. But proof of their value is offered by the fact that the dust produced by the blast-furnaces has dropped from an average of 227 tons per day during the first half of 1912, when the reverberatory furnaces were not running, to an average of 116 tons per day since they started up.

*Reply to discussion of paper, 'The Copper Queen Mines and Works,' presented before the Institution of Mining and Metallurgy.

Coarse Particles

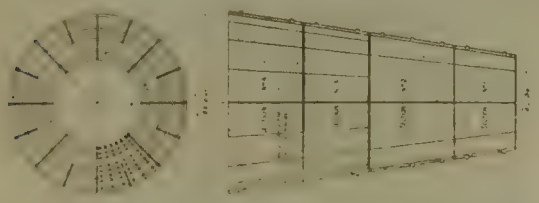
The amount of coarse particles caught in the converter flue is two tons per day, but this is independent of the finer particles which settle in the brick-header at the base of the stack. That recovered in the flue itself is very high grade, analyzing as follows: Au, 0.155 oz.; Ag, 15.4 oz.; Cu, 60.9%; SiO_2,



MIXING DRUM FOR CONVERTER SLAG AND FLUE-DUST.

2.2%; Fe, 8%; S, 11.6 per cent.

A dust-chamber of 1200 sq. ft. cross-section and 132 ft. long was built, connected with the reverberatory furnaces, from the roof of which are hung some 30,000 wires. From this chamber, during a period of thirteen months, only nine tons of dust has been recovered. The dust in the chambers has not yet reached a point where the daily accumulation



LINERS FOR SLAG-DUST MACHINE.

can be regularly drawn off. Most of it, however, probably will always settle in the boilers and flues which are interposed between the furnaces and the dust-chamber. The dust-chamber connected with the McDougall roaster plant is 1370 sq. ft. cross-section. It is 144 ft. long, and has some 42,000 wires hanging from the roof. To date, the dust recovered is 6% of the charge roasted.

Frank Rutherford has furnished the drawings and following description of the converter slag and flue-dust sintering apparatus and methods at Douglas:

In June 1909 a cylinder 4 ft. in diameter and 9 ft. long, lined with firebrick, was set up in an inclined position so that the material made would discharge from the end. This machine soon demonstrated that a good product for blast-furnaces could be made by pouring molten converter slag and flue-dust together into one end of it, but that the crust or collars made were very difficult to remove. Naturally, the conditions suggested that instead of a cylinder a truncated cone would overcome all the difficulties and still give a good product. The working of the cone completely satisfied expectations as to dislodging the crust, and was a delightful surprise as to the tonnage it could handle. The conveyor, as shown in the drawing, was an essential part of the plan.

Operating Results

This machine ran for a number of months and proved conclusively the practicability of the process. The machine, working three shifts, easily handled all the converter slag made, and from 60 to 70 tons per day of flue-dust. The best and most even product was made when the dust used was from 18 to 20% of the converter slag by weight, and 25% was found to be the practical limit at which good coarse product could be made unmixed with flue-dust. The maximum day's product, 24 hours run, was 535 tons, with an average of 325 tons per working day over a period of five months, which included time taken for all minor repairs done while the shifts were on. The power was supplied by a 50-hp. motor through a train of gears and chain drive, and gave eight revolutions of the drum per minute. This speed might, with advantage, be somewhat reduced, and the method of drive be improved upon. Both of these changes would have been made had the experiments been prolonged, but the reverberatory furnaces going into commission required all the flue-dust and brought the experiments to an end.

If the flue-dust contains much sulphur, the amount of sulphur dioxide gas liberated is very great, and provision for its removal must be made, and for collecting a small amount of fine dust. Trial runs made with matte instead of converter slag proved that, although the matte would take up much more flue-dust, the collars were much heavier than with the slag, and therefore harder to break. While working with converter slag and dust it was found that a small jet of water playing on the crust as it formed was sometimes quite a help, but with hot slag, free from white metal, the crust broke by its own weight, and therefore did not require the aid of a bar and hammer. Had the work been continued it would have been desirable to rebuild the machine, making it much heavier and increasing the diameter of the small end to about 6 ft. in order the better to dislodge the crust. Two of these cones have been installed in the new smelter of the Arizona Copper Co., Clifton, Arizona, primarily to mix fine silicious material with converter slag before going to the reverberatory furnaces, and thus obtain a better fluxing of this silicious material than could otherwise be obtained.

Mineral Production of Colorado

The following table has just been issued by the U. S. Geological Survey, and gives the value of the products for the past two years.

Mineral.	1911.	1912.
Clay products	$ 1,606,709	$ 1,437,394
Coal	14,747,764	16,345,336
Copper	1,003,061	1,172,705
Gems and precious stones	2,520	4,506
Gold	19,001,975	18,588,562
Lead	3,135,568	3,385,902
Lime	34,614	36,478
Manganiferous ore	109,340	12,646
Mineral waters	104,763	75,314
Petroleum	228,104	199,661
Sand and gravel	65,366	45,983
Silver	3,884,989	5,050,423
Stone	1,514,827	1,420,607
Tungsten ore	234,513	297,533
Zinc	5,392,625	9,123,374
Uranium and vanadium ores	302,000	*
Miscellaneous	1,153,678	970,975
Totals	$52,522,416	$58,167,399

*Included in miscellaneous.

The value of the pig iron is not included, as the ores come from New Mexico and Wyoming.

Iowa increased its mineral production in 1912 by $1,787,454 over the 1911 output of $21,112,896, according to figures compiled by E. W. Parker, of the U. S. Geological Survey, in coöperation with the Iowa State Geological Survey. The value of the state's production of coal in 1912 was $13,152,088, clay products $4,522,326, portland cement $2,790,396, an increase of 50%, and sand and gravel $1,509,245.

Nearly 265,000 acres of land, previously withdrawn from entry in the United States, have been restored to the public domain recently.

Belgian Furnaces in Zinc Smelting

By George C. Stone

*It is frequently stated that there has been no change in the metallurgy of zinc since the first Belgian furnaces were built in the early part of the last century. It is true there have been no such spectacular and radical changes as were worked in the metallurgy of copper and iron by the introduction of converters; but, in the essentials, I believe the progress in zinc metallurgy has been as great as in that of the other common metals. The main reason that there have not been revolutionary changes is that the chemistry of zinc differs radically from that of the other metals and these differences control the type of apparatus that can be used. The differences are:

1. The temperature at which zinc is reduced by carbon is much above the volatilizing point of the metal and it is therefore always produced as a vapor.

2. To obtain a merchantable product the vapor must be condensed at a temperature well above the melting point of the metal. More than this, the temperature necessary to condense zinc depends on the concentration of its vapor and is lower the more dilute the vapor. When the mixture of zinc vapor and gases enters the condenser it is rich in zinc, and the condensation temperature must therefore be high in order to prevent sudden solidification and the production of blue powder. As the vapor leaves the condenser it is very dilute, and unless the condenser temperature is much lower there will be a loss of zinc. This means that the temperature of the condenser must be close to the boiling point of zinc (920°) nearest to the retort and very much lower at the opposite end.

3. The reaction by which most metals are obtained commercially is

$$RO + CO = R + CO_2$$

With all the common metals but zinc, this reaction is only reversed when there is a considerable change in temperature or a very large increase in the concentration of CO_2 in the atmosphere. Neither of these is quite true of zinc. For any given temperature the equilibrium between CO_2 and the zinc vapor determines the amount of reaction. That is, the reduction of zinc proceeds until there is a certain ratio of CO_2 to zinc in the atmosphere and then stops. A decrease in the CO_2 causes the reaction to start again in the same direction, and an increase causes it to start in the opposite direction. The lower the temperature the less CO_2 it requires to reverse the reaction. In order to effect complete reduction this equilibrium must be continually destroyed by the presence of an excess of carbon, and the equation must be either

$$ZnO + C = Zn + CO$$

or

$$ZnO + C + CO = Zn + 2CO$$

These three essential facts limit the possible apparatus for the production of zinc in several ways. The reduction must take place in a closed chamber to prevent the loss of volatilized zinc. As the reoxidation is proportional to the total CO_2 present and not to its concentration, and as the difficulty of proper condensation increases very rapidly with dilution of the zinc vapor, the volume of gas going off with the zinc must be kept as small as possible. This means that the gases from the heating fuel must not come in contact with the charge, or, in other words, the heating must be external. As the mixture of ore and coal forming the charge is a poor conductor of heat, the size of the chamber containing it must be small in at least one direction or the heating will be too slow. The charge must, at all stages, contain a large excess of carbon to at once reduce all CO_2 formed. The condensers should be as close to the charge as possible and as small as will do the work in order to make it possible to maintain the proper heat gradient in them. The condensers must be kept within proper limits of temperature, diminishing toward the exit.

The first spelter furnaces built filled these conditions, and it is difficult to conceive of any other type that will do so.

Heat Consumption

It is commonly stated that the spelter furnace is very extravagant in heat. This I venture to question. Any furnace in which the issuing gases heat the incoming charge and thereby economize fuel is out of the question for reasons already given. It is therefore necessary to introduce cold charge in the furnace and heat it there. The heat used for this purpose is certainly not wasted. The heat escaping to the stack is not a large proportion of the total in a properly designed regenerative furnace supplied with gas of good quality, especially if waste-heat boilers are placed between the furnace and the stack. The main unavoidable loss of heat is by radiation. The end walls of the furnace are usually made very thick and the radiation from them is not great. The radiation from the roof is much greater, and is often excessive, as the roofs are usually thin. A great part of this loss can be prevented by covering the roof with a thick layer of porous material such as well burned boiler ashes. The main radiation is from the front of the furnace, and this is necessarily so, as the front must be made very thin in order to keep the retorts hot to the ends, otherwise there would be a considerable amount of unworked charge left in the front. But is this large radiation all loss? Considered only in relation to the heat required for reduction, yes; but considered in relation to the heat required for the entire operation, no. This heat is only sufficient, and not always sufficient, to keep the condensers up to the proper temperature, and it should therefore not be considered as lost, as heat from some other source would have to be supplied to the condensers if this were not available. This radiated heat regularly and automatically keeps

*Abstracted from a paper on 'Improvements in the Metallurgy of Zinc,' read before the New York Section of the American Institute of Mining Engineers.

the condensers at a suitably graded temperature, which would be difficult to do if they were heated in any other manner.

Forty or fifty years ago the typical Belgian furnace contained from fifty to ninety retorts of about 0.8 cu. ft. capacity each. At the present time the furnaces used in the natural-gas field contain from 500 to 700 retorts of about 1.4 ft. each, an increase in capacity of 1300%. Furnaces containing 1008 retorts are in operation, doing satisfactory work; this is an increase of about 2400% in size and capacity. The increase in capacity of the spelter furnaces is therefore about the same as that of the modern coke furnace making pig iron over the old charcoal furnace.

Increased Efficiency of Furnaces

Mere increase in size, however, does not amount to much unless accompanied by increased efficiency. In this respect the zinc furnaces show well. In the iron furnaces there has been no improvement in the proportion of metal recovered, the old furnaces having given almost theoretical results. With zinc the improvement has been very marked. In 1844, at the Vieille Montagne works, the recovery was about 62%, and even as late as 1880, 75% was considered good work. Today 87% is only fair and many works can show runs of long periods averaging 90% and over. The fuel consumption has been largely decreased, mainly by the adoption of regenerative gas-firing. A comparison of furnaces using the same kind of coal, shows that where the hand-fired furnaces 25 years ago required 2, 3½, and even 4 tons of coal per ton of ore, well equipped gas furnaces using the same coal and working the same class of ore now take only 1½ to 1¾ tons. Labor has also been largely reduced. The old Belgian furnaces required five days' labor per charge, two men working 24 hours continuously, and an extra helper on the day shift only. As these furnaces worked only about a ton of ore, they required five days' labor per ton. At present all 24-hour work is done away with, and not over 1½ days' labor is required per ton. In 1844 fifteen to twenty days was the usual life of a retort. Now good retorts made in hydraulic presses last from 30 to 40 days, and at that more are replaced because they are filled up than because they leak.

Regarding the future, I believe progress will continue to be made, but rather on the lines of improvement in the present processes than by the adoption of radically different ones. The present types of furnaces can be much improved. Fuel can be saved by better design and proportions of regenerators; better arrangement of the parts and decreasing radiation losses by more thorough lagging of the parts of the furnaces from which radiation is purely wasteful. A determination of the best size and shape of retort and condenser for different ores, and the choice of such as suit the particular ore to be worked instead of using one size and arrangement for all, will give improved results in recovery and output. A careful study and application of the principles on which ores should be mixed offers a wide field for improvement.

There have been a number of furnaces patented for the production of zinc. Several of these are on the general lines of the present furnaces, and many of them show probabilities of being advantageous. Many others are shaft-furnaces, some heated by coal and some by electricity. Nearly all of these have the peculiarity of requiring the zinc vapor to go in one direction and the gases in another, which is obviously impossible of accomplishment. The coal-fired furnaces of this type have the additional disadvantage of producing a large volume of gas which would increase the amount of blue powder made and the difficulty of condensation. In the old days, metallurgy was purely empirical and progress was slow in all lines. Iron and steel were the first to be taken up by trained men, and the results they obtained were startling and revolutionary. Copper and lead followed next, with equally beneficial results. Zinc was about the last to employ trained metallurgists, but they have taken hold of it at last, and I have sufficient confidence in them to believe they will continue to improve on the good work they have already done.

Costs at the Oriental Consolidated Mines

According to the last annual report of this Company, reviewed in this journal of November 29, costs at the various mines and mills operated were as follows:

Mining:	Tons.	Cost per ton.
Tabowie	112,529	$1.59
Taracol	93,558	1.91
Kuk San Dong North	12,757	1.00
Kuk San Dong South	13,774	0.81
Kuk San Dong Central	606	2.68
Kisen	6,986	1.02
Chintui	28,487	1.79
Charabowie	37,658	3.64
East Candlestick	6,463	4.88
Total and average	312,818	$1.95

Ore transport:	
Taracol	$0.02
Kuk San Dong	0.03
Chintui	0.03
Average per ton	$0.01

Milling:	Tons.	Cost per ton.
Tabowie	112,529	$0.44
Taracol	122,928	0.45
Kuk San Dong	34,123	0.64
Maibong	37,658	0.94
Candlestick	6,463	1.00
	313,701	$0.54
Less receipts for milling tribute ore	883	0.75
Total and average	312,818	$0.54

Concentrate treatment:	Tons treated.	Cost Per ton treated.	Cost Per ton milled.
Tabowie	12,863	$3.48	$0.40
Taracol	12,456	2.82	0.29
Kuk San Dong	3,968	1.52	0.18
East Candlestick	6,463	1.19	1.19
Maibong (charges)	1,202	11.38	0.36
Total and average	36,952	$2.91	$0.34

General expenses averaged 40 cents per ton.

The Camanche Dredge, California

By C. G. Leeson

During February of this year the Oro Water, Light & Power Co. has started operating a dredge with 9-cu. ft. buckets at Wallace, Calaveras county, California, on lands adjacent to the Mokelumne river.

Details of Construction

The boat has a useful digging capacity of 40 ft. below water. The designers, who are also large dredge operators, call attention to the following important points. The hull is 45 ft. wide at the bottom, 115 ft. long, and 9 ft. deep, containing a total of 250,000 board feet of lumber. This was thoroughly dried and the hull treated with crude oil. The top spud strain is carried through four steel girders running above the screen and attached direct to the main drive structural foundation, which is strongly anchored. Bow and stern gantry guys both anchor on the same foundation, thus counterbalancing gantry strains through the entire steel construction. The digging ladder is 83 ft. long, having a maximum depth of 8 ft., and being composed of two plate steel girders, cross bulkhead, and having a depressed carrying sluice on top. The bottom side of the ladder at the lower end is exceptionally well protected by heavy rider bars to keep the bucket line from abrading the under side of ladder. An effective lower tumbler rock guard is provided. The upper tumbler is the 'seat cast on body type,' with a shaft 18 in. diameter, and heel plates 3 in. thick of manganese steel, supported by 3 in. of body metal underneath. These heel plates butt against a shoulder which effectually prevents shear on fastening bolts. Digging buckets are of the integral bottom and lip design, and weigh 1600 lb. each when machined. The lip weighs 420 lb., bucket pins are 5⅜ in. diameter, and the pitch is 32⅞ in. Buckets are of 9-cu. ft. capacity, and the carrying angle is so designed as to minimize spill when the dredge is digging high. The ladder rollers are of manganese steel and are 16 in. diameter, and the bucket-line is designed to run 21 buckets per minute. All ladder hoist sheaves are 40 in. diameter, bronze bushed, and manganese steel castings, also the sheaves working on side lines, spud hoist lines, etc., are manganese steel castings. All bearings throughout the dredge rest upon a structural steel sub-base, and bearing cap bolts are capable of removal without disturbing bearing base. The main driving machinery has extra large shafts with four bearings on each intermediate and pulley shaft, and gears throughout the boat are steel with rim and spider integral. The main pulley shaft is divided in the middle and is connected by a large flange coupling, which also acts as a brake wheel for the main driving machinery. Flange couplings fitted in this way allow of adjustment of pinions for bearings on each side without offsetting keys. The main hopper, which receives the gravel from the buckets, is a large one and is lined with a cast steel hopper spout. The revolving screen is 6½ ft. diameter and 33 ft. long, and is made up of ¾ in. thick perforated, and liner plates made of 0.4% carbon steel. Screen tires are of exceptionally massive type with large bearing surface, many rivets, and with extension wings cast on for attaching longitudinal bars of screen. A screen thrust roller is carried at the top of the screen in an accessible position. This roller is 24 in. diameter and is carried on a large long bearing. Gold-saving tables have a total area of 2000 sq. ft. on a single deck and are equipped with steel-lined Hungarian riffles. They are not covered by housing, but are enclosed by wire safety netting. The table area is supplied by two 10-in. Yuba Construction pumps, having a capacity of 2800 gal. per minute, each at 60 and 40-ft. heads, respectively.

CAMANCHE DREDGE ON MOKELUMNE RIVER.

MAIN DRIVE SHAFT, BRAKE, AND GEAR.

Transformers on the dredge reduce electric current from 4400 to 440 volts. The main digging motor is 200 hp., and the motors total 465 horse-power. All electrical equipment is provided with automatic circuit-breakers, and oil switches, auto-starters, etc., are enclosed in steel air-tight boxes. Electric equipment is of General Electric Co.'s manufacture. The structural parts of the dredge were furnished by the Modern Steel Structural Co., of Waukesha, Wisconsin; and carbon and alloy castings were furnished by the Bucyrus Co., the Taylor, Wharton Iron & Steel Co., and the Edgar Allen American Manganese Steel Co., all parts thus furnished being made according to the specifications of the New York Machine Shop at Oroville. The total weight of machinery, including structural work, is 700,000 lb., and the boat cost $160,000 in its completed condition.

Results of operation, in attacking an average gravel bank of 25 ft., show that the dredge is handling 75,000 cu. yd. more than estimated, the monthly total being 225,000 cu. yd., with an average running time of 20.5 hours per day. Gold recovery is 10c. per yard, and the boat is saving 50% more than prospecting indicated.

Portable Electric Mine Lamps

By H. H. Clark

*Portable electric mine lamps are a comparatively new development in this country, although such lamps have been used in European mines for some time. For at least five years, and probably for a longer time, portable electric lamps have been used in the attempt to develop a satisfactory substitute for the safety lamp. There are a number of qualities that an electric lamp must have in order to make it acceptable for mine use. Chief among these is safety. The principal reason for the Bureau of Mines advocating the adoption of the electric lamp is that fire and explosion hazards will be thereby decreased. It is therefore manifest that the electric lamp itself must not be a source of danger. The Bureau proved by actual test that the glowing filaments of portable electric lamps are capable of igniting mine gas, but that sparks from portable electric lamp equipments of not more than six volts are not capable of igniting mine gas, unless the equipments are unusually large.

Permissible Lamps

Permissible portable electric lamps, according to the Mining Bureau, shall be so designed and constructed that under no circumstances can the bulb of a completely assembled lamp be broken while the lamp filament is glowing at a temperature sufficient to ignite explosive mixtures of mine gas and air.

The first requisite of an electric lamp is the production of light, and for mining service a lamp should burn steadily and with undimmed brilliancy for a certain number of hours of every day in the year. The next requisite is lightness, that is, a lamp should not weigh so much that it hampers a man's movements or becomes a burden to him. The cost of operation and maintenance should be consistent with the work done and the benefits received. It is also important that there is no leaking or spilling of electrolyte while the lamps are in use.

A true measure of the illuminating power of a portable electric lamp must consider not only the candlepower but also the angle over which the intensity is maintained. An intensity of light of one candlepower maintained all around a lamp results in twice as much light as if maintained only half way around the lamp. The term candlepower used without qualification is not only confusing, but really meaningless. If all sources of light distributed light equally in all directions, then a single measurement of their candlepower would suffice to compare them. Practically, however, sources of light differ a great deal in the way they distribute light, and this is especially true if reflectors are used. Therefore, if a lamp is stated to give two candlepower, the statement should also explain whether 'head on' candlepower is meant, or average candlepower over the stream of light, or average candlepower in a given plane—such as, for instance, the horizontal. A lamp that uses a reflector may have a 'head on' candlepower three to ten times the average candlepower over its entire stream of light. Generally it is best to state the average candlepower of a lamp instead of the candlepower at a single point or group of points. A statement of the candlepower of a lamp does not sufficiently define its light-giving capacity. A 100-cp. lamp is seemingly 33 times as desirable as a 3-cp. lamp, and yet a 100-cp. lamp shining through a hole ½ inch in diameter gives less actual light and much less useful light than a 3-cp. lamp shining through a hole 3 inches in diameter. Therefore, in order properly to define the light-giving capacity of a lamp, a statement must be made regarding both the candlepower and the total flux of light produced by the lamp.

The Bureau suggests that lamps designed to be worn upon the cap should give the same intensity of light as that required for hand lamps, but that the minimum flux of light required from cap lamps should be not more than half the minimum demanded from hand lamps, because when a lamp is worn upon the head any light that is thrown to the rear is wasted. Twelve hours was selected by the Bureau as a reasonable time of burning. A lamp should be able to give the required light up to the time when the exhausted condition of the battery requires that the discharge be stopped in order not to impair the battery. Therefore, at least an hour of burning should be allowed over and above the usual requirements of the miner in order not to push the battery too hard in an emergency and to allow for possible incomplete charging. It is also not unreasonable to require 300 hours of actual service from each lamp bulb.

It is not necessary to suggest that anything should be well made if it is to be used underground. Under this head should be considered simplicity of design, strength of parts and fastenings, design of moving and removable parts, and the design and construction of electrical circuits and contacts.

*Abstract from an address delivered on December 5, 1913, at Pittsburgh, before the Coal Mining Institute of America.

Costs at the Oroya Black Range Mine

This gold mine is in Western Australia, and during the past fiscal year a total of 59,680 tons was mined and treated, at the following cost:

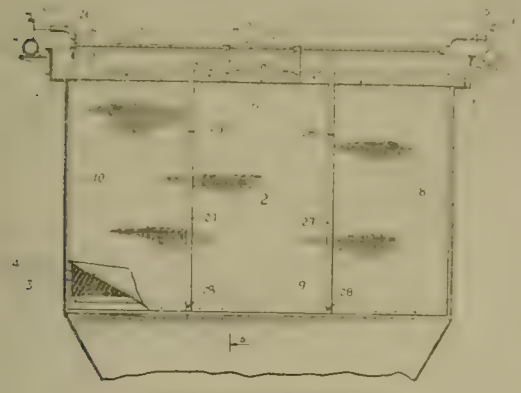
	Per ton.
Ore extraction:	
Breaking ore, including ore from development	$1.88
Filling stopes	0.05
Tramming and raising	1.14
Total	$3.07
Ore treatment:	
Crushing	$0.10
Milling	0.48
Treatment by vacuum-filter	1.14
Fine grinding sand	0.64
Cyaniding by percolation	0.62
Precipitation and melting	0.08
Disposal of residue	0.19
Total	$3.25
Realization of bullion	0.10
Grand total	$6.42

The Butters Salvador mine, in October, produced bullion worth $49,000 from 3150 tons of ore, yielding a profit of $20,000.

Dislodging Slime Cakes From Filter Media

Improvements in vacuum-filtration continue to be made by active workers in the field, and considerable litigation has been the result. United States patent No. 1,078,994 was granted on November 18, 1913, to Charles Butters for a 'Process of Dislodging Slime Cakes from Filter Media,' and the following notes are taken from the patent specifications.

In the treatment of slime, one of the most difficult and troublesome problems is to dislodge reliably and within an economical time, the slime cake from the surface of the filtering medium after the filtering process has been completed, without injuring the filtering surface of the leaf. It has been the practice heretofore to dislodge slime cakes by air-pressure from the interior of the leaves while suspended in the air, or this has been accomplished in some cases by water under pressure being passed through the filtering medium in a direction reverse



NEW BUTTERS FILTER LEAF.

to that of the filtrate. It has been supposed that, to remove the cake reliably, pressure was necessary, whether air, water, or other fluid was used in the process, whether used interiorly or exteriorly. When used interiorily, special precaution has sometimes been taken to get a uniformly thick, cohesive, and resistant cake, such that the fluid under pressure might dislodge it as an entirety, and make it unnecessary to use additional means to dislodge the cake completely. By the new process such uniformity of the cake is of no importance at all to the cake dislodgment, and consequently the filtering operation may be more economical.

In practice, it is found that slime cakes have great adhesion and cohesion, and that when a cake is formed on each side of a filter-leaf they are not easily dislodged. This adhesion depends on the percentage of water in the slime, and partly on the character of the filtering surface. Mr. Butters has found that from a comparatively smooth filter surface the cake can be removed if it is first partly dried and then copiously flooded externally. A cake at the end of the filtering process, before special drying, contains about 30% moisture. By the drying step, the highest vacuum being maintained on the cake for 5 to 10 minutes while it is suspended in air, the moisture is reduced to about 20%, and may be more or less concentrated toward the inner parts of the cake. The drying also tends to crack the cake at the top, and initiate there a separation of the cake from the filter. Then the vacuum is shut off, and water applied at this point, immediately dislodging the cake.

The Filter Leaf

Referring to the numbers in the accompanying illustration, the filter leaf is described as follows: The leaf consists of headers 12, which support it on shoulders 31, of the vats; a fibrous filler 13, preferably of cocoa mat; and a filtering medium 14, such as canvas, mounted on each side of a frame and the cocoa mat. The medium may be composed of two pieces sewed along the sides and clamped at the top between the headers 12, or it may be a single piece sewed on the sides, clamped at the top between the headers and open across the bottom. The open portions extend 6 to 8 in. below the frame member 15. The extended open portion of the medium 14 may be stitched every 9 or 10 in. as shown. This type of leaf is preferred, although others may be used. Connections 4 communicate with the interior of the leaves through the frame members 8, 9, and 11. The lower frame member 9 is perforated or slotted along its upper side, and the upper one along its lower side in the well known manner. A vacuum pump 3 is connected with the interior of the leaves through the pipe 7, valves 6, sight glasses 5, connections 4, and members 8, and perforated members 9 and 11. The members 8, 9, 10, and 11 are connected so as to form a rigid frame structure, and are all in open communication with one another. No. 10 extends upward through headers 12 to a T joint 16. In this extension is a plug 19 to seal the vacuum there and prevent the entrance of water from the pipe 26 to the leaf. In order to place the leaves easily in the vats, spacers 27 are put on the sides and are held in place by bolts 28 through them. A pipe 15, perforated along its lower side with, say, ¼-in. holes 3 in. apart, is supported above the headers 12 of each leaf, and above the top of the slime pulp in the vat, and so above the top of the cake on the filter leaf by means of straps 17. They may be bolted through the headers by bolts 18, and may bend around the pipe and have a bolt 21 passing through the straps below the pipe. To remove the leaves at any time, holes 20 are provided in the headers 12 for the insertion of hooks. Connected with pipe 15 is a pressure pump 22, through valve 23, pipe 24, valves 25, and connections 26. By this means water at any desired pressure comes from the pipe 15 on top of the headers 12. The header will take the pressure of water rather than the cake, and the water will merely run down over the leaf and its attached cake without any great pressure.

Indiana in 1912 produced minerals to the value of $42,239,193, an increase of nearly $5,000,000 compared with $37,430,187, the production of 1911. The 1912 figures, however, do not include the value of the pig iron produced in the state, which was more than $17,000,000. The principal products of the state are coal, clay, cement, and stone, these having a value of 90% of the total output.

Mining Conditions in Western Chihuahua

From a recent report to the shareholders of the Rio Plata Mining Co., by Henry W. Miller, president of that Company, the following relative to the conditions under which mining is being conducted in some parts of Mexico is abstracted. The property of the Company is situated in the Sierra Madre mountains near the western boundary of the state of Chihuahua at a distance of about 250 miles southwest from the city of Chihuahua.

The Mexican revolution, which has now been going on for about three years, has increased greatly in violence during the past year, and has caused more serious interruptions to business than in previous years. Many properties of mining and commercial companies have been damaged; a great many companies have been forced to stop business; both life and property have been placed in peril. We have been able so far to keep possession of our property and obtain a limited number of workmen with whom the development at the mine has been continuously carried on. Thus the safeguarding of the works and improvements had been successfully accomplished to the date of the last advices from the mine, October 8. These unsettled conditions compelled curtailment of mining and milling during all these years. Labor, always scarce, has been made more so by the incessant drafting of the able bodied men into the armies. Procurement and transportation of food and operating supplies heretofore has been difficult, but this year it has been almost impossible. The ore mined a year ago and treated in the Company's mill in the last quarter of the fiscal year 1912, is the last that has been treated. Operation of the reduction works, during the present year, would have been impossible for the want of supplies and men, even if millable ores in sufficient quantities had been ready for treatment, and the further shipping of the product in safety would have been entirely out of the question.

During the current year, railroad transportation and trail freight routes used heretofore by the Company have been out of commission or abandoned: mails have been slow, irregular, unreliable; no telegraphic connection with the mine or with any place near it, and runners sent from the mine, and to the mine from the city of Chihuahua and elsewhere, with messages, letters, reports, orders, etc., have been stopped or detained by the different revolutionary factions—papers greatly delayed, some of them lost or destroyed. To illustrate: A transfer of ₱5000 bank credit from Chihuahua to Alamos arrived, but the acknowledgment was not received by the Chihuahua bank until September, and notice from the Alamos bank to the mine superintendent was never received. From general information during August it was learned that the Alamos bank had been forced to stop business some time in May.

Shipments of dynamite and powder are prohibited. Revolutionists have been almost constantly active and troublesome in different parts of the country districts between the mine and the city of Chihuahua. Supplies could not be safely transported from Chihuahua at any time after December of last year. Goods, supplies, and money could not be sent out over the trail in the usual way. These the superintendent procured by various means for a time from Alamos and later from other quarters. At times and especially in recent months he obtained powder and other supplies from different mining companies in nearby districts which had been forced to stop operations.

The Company's correspondence since last May has been sent from El Paso, Texas, to Chihuahua by private conveyance and by special runners from Chihuahua to the mine, a total distance of five hundred miles across a rough country in all parts of which either federal or revolutionary troops and bandits have been and are carrying on warlike operations. Reports from the mine have been sent out in the same manner.

Counterbalancing Hoists

A new system of counterbalancing hoists, for which patent is being applied by Letson Balliet, manager for the Buckeye-Belmont mines at Tonopah, who supplies the following account.

When skips or cages used in hoisting are run upon double-drum hoists the process is called 'hoisting in balance' which technically is not the case, for when the empty skip, cage, or bucket is to be returned to the bottom of the shaft it is lightest when leaving the top, and often is lighter than the weight of the cable that is extended down the shaft to the other cage or skip. The loaded skip or cage with the cable on leaving the bottom is the heaviest, or at its heaviest, when the empty skip is giving it the least aid. Furthermore, the total friction loss averages from 30 to 40% of the power used in hoisting, as can easily be verified by computing the work done, in foot-pounds, when hoisting a known weight or load, and subtracting it from the meter reading for the trip, or indicator card of the power actually used. It is evident that the double-drum balancing system helps a little, but it is far from being efficient. Moreover, the weights are frequently 'out of balance' with the cages at different levels.

Another form of balance is a transverse balance, where a weight suspended in a pipe, wooden flume, or on a guide, is directly connected with the cage or skip, by a cable that is passed over a sheave, like the old fashioned well buckets, where two buckets are handled on one rope, over a pulley suspended above. This form of 'direct balancing' has a greater efficiency than the double-drum hoist, because it eliminates the gears and mechanical friction of one side of the hoist, and the cable wind upon the drum. It is limited to shallow mines, for manifestly there will come a time when the weight of the cable on the counterweight, plus the weight of the skip or cage, would overweigh the counterweight and pull it into the sheave. Conversely, the counterweight, plus the weight of the cable when the counterweight is down would weigh so much that the empty skip, or cage, would not descend. Like the double-drum hoisting, the counter-

weight is lightest when the loaded skip or cage is to be lifted from the bottom, at which time the counterweight rope is extended down the shaft and attached to the load. In some shallow mines, a tailrope system has been installed where a sheave at the bottom allows a cable to run from the counterweight to the skip or cage. This compensates the weight of the cable nicely, but it has some disadvantages and limitations. It must be kept tight or the lower rope gets out of the sheave, lubrication is difficult, and the extra rope is always hanging in the shaft. If in water or a 'wet-shaft,' troubles may multiply, and a dropping rock or a falling car, cage, or skip, makes a worse condition than ever, with a broken sheave and tangled rope to remove. The Balliet system of counterweighting consists of a superimposed sheave-wheel in the head-frame, with an extra cable running from the skip or cage over the upper sheave and down to the counterweight. The mathematics of the system is that of two variables, wherein the skip or cage and its rope is changing weight at all points, which must be counterbalanced in the other shaft by a gain of weight at all points. Thus when the empty skip is at the top and counterweight resting upon the bottom, the weight of the rope only prevents the skip from starting down. At the instant it starts from its topmost point it takes up, without jolt or jar, a weight which still leaves the empty skip or cage about 350 to 400 lb. heavier than the weight and its rope. This allows the skip to get a good start and causes it to gain weight as the rope gets longer on the skip side, and shorter on the counterweight side. As the weight rises, it follows a guide and takes up additional weight at all points, increasing in weight faster than the skip does, until it becomes in exact balance at the bottom, or at any point where it is desired to set the balancing system.

Advantages of the System

One advantage of this system is that the skips or cages do not accelerate, but maintain practically a uniform speed in descending until near the bottom, where they begin to go slower. Another advantage is that a skip operating in a shaft with any number of levels can be set in a few seconds time to stop or come to balance at any level desired, and it cannot descend to lower levels till the balance is adjusted for the purpose. A shaft a few feet deeper than the lowest level, can have the weight so adjusted that if the counterweight alone is holding the skip or cage, when the hoisting rope breaks or a runaway drum accident happens, the skip will come to rest at a balance suspended above the bottom, without jar, damage, or injury, even if the dogs and the cut-off latch fail to hold. The weights can be increased instantly, but are picked up gradually without jar by the engineer giving a pull at a lever. It also automatically increases if the engineer overwinds. It cannot be ignored by the engineer in overspeeding, nor can it be put out of balance, but will always run as it is set. It can be applied to either single or double-drum hoists and to passenger elevators. It is 'fool proof' in that a skip or cage loaded with men can be cut loose at the top and its descent will be only at the speed it is set to travel, until the ever increasing counterweights overbalance the load and bring it to rest suspended in the shaft. It can be installed in any vertical or near-vertical shaft. It removes the peakloads to considerable extent, because the greatest weight of the counterbalance is when it is up and the loaded cage is ready to be lifted. It reduces the power costs by the amount required to handle the dead weight unbalanced. In the case of double-drum hoists each cage is balanced independently of the other, exactly as if they were two single-drum hoists.

No power is required for the descent of the skip or cage, as the latent energy exerted by the skip or cage descending by gravity picks up just as much load as it can carry until it picks up enough to bring the skip or cage to rest at any point desired. The latent power, having been transferred from the skip to the weight, is then ready to aid in raising the skip when it is loaded. When the hoist is started it has to overcome the net load placed on the skip, while the counterweight handles the dead weight of the skip and cable.

Hoisting at the Buckeye-Belmont

In the Buckeye-Belmont No. 1 shaft the skip weighs 1600 lb., 1200 ft. of cable weighs 744 lb. (the cable required to run from the collar up over the sheave and back to the collar is balanced and need not be considered), the counterweight itself weighs 500 lb., while the variable weight adds 1768 lb. It will be seen that when the skip is dropping back out of the tipple, much of its weight is over the bin and not in the guides—at this point the 500-lb. weight rests on the bottom and the skip needs balance only 744 lb. of counterweight cable. At the instant that the skip rights itself and its whole weight is in the guides, the engineer lowers it out of the tipple with the brake, and the cable tightens on the 500-lb. weight. At this instant the 1600-lb. skip is offset by 500 lb. plus 744 lb. of cable, or 1244 lb. total.

It will be seen that the empty skip overbalances the counterweight and its rope by 356 lb., which allows it to be returned promptly, and it starts immediately. The counterweight comes up, following a guide in the manway or other compartment, picking up weight at all points as the empty skip descends in the working shaft. It is evident that when the skip reaches the bottom it will have 1600 lb. weight plus the 744 lb. of counterweight cable which has been pulled into the working shaft by the descent, and meanwhile the counterweight has ascended to the top of the shaft and has picked up 1768 lb. of weight in addition to its original 500 lb., which gives 2268 lb. total counterbalance weight, to lift the 2344 lb. of deadweight upon the hoisting side. This 76 lb. difference was necessary in this case, to allow the skip to sink into the sump a distance of one inch over the bailing valve in the side of the skip.

Taking 4c. per kilowatt as a basis of power-cost, the same skip unbalanced hoisted 1500 lb. at a cost of 14c. per trip for power, two trips 28c.; with the balance the skip is filled with 3000 lb. of ore or rock, and costs 10c. per trip. It is easier upon the motors, machinery, and head-frame, as every jar and vibration is removed. The entire cost of this installation was about $850.

Discussion

Readers of the Mining and Scientific Press are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment. The selection of any contribution is determined by its probable interest to the readers of this journal.

Water in Veins

The Editor:

Sir: T. A. Rickard's invitation, on pages 693 and 694 of the issue for November 1, with its R. S. V. P., demands, according to the usages of polite society, an acknowledgment without delay. All his friends concerned in the invitation would do so promptly and frankly under any circumstances, but most of all when it is evident that one for whom and for whose writings all entertain a particularly high regard, feels himself to be suffering from a failure on their part to properly recognize and cite his published work. It may be stated very positively at the outset that no one would fail to do so for the reasons mentioned in his letter, since his contributions to mining geology are everywhere recognized to be the results of world-wide and accurate observation, and to be illustrated with an extremely faithful pencil. In the present instance, the nature of the early records in Mr. Rickard's papers themselves seem to the writer to furnish a sufficient defense for not citing them as having priority in the question of the shallow zone of the ground-waters. As to the lack of ground waters in the depths of at least one unusually deep mine, there is a record of almost identical purport with Mr. Rickard's, and about six years earlier.

The paper on 'The Cripple Creek Volcano' was read at the Washington meeting of the American Institute of Mining Engineers, February 1900, and was published in Vol. XXX of the *Transactions*, pp. 367-403. In the portion of the paper from which Mr. Rickard quotes in his letter, he is discussing the agency of water in causing explosive volcanic outbreaks. In his view, the water is derived from the surface, by downward movement; that is, in our modern phrase, it is meteoric in nature and not magmatic. The full paragraph, pp. 376-377, reads as follows:

"There is therefore ample evidence that water does penetrate into the conduit of the volcano, and that it is originally derived from the surface. As against the contrary belief, namely, that the water vapor accompanying eruptions is an essential constituent of the lava, and therefore shares with it a deep-seated origin, there is the following evidence. It has been found, as the result of a large number of accurate observations in wells, shafts, and bore holes that the temperature underground increases 1 F. for every 48 ft. of descent. At 7776 ft., the boiling point, and at 31 700 ft. the critical point, 773 F., of water would be reached. The exhaustive force of steam increases rapidly with the temperature, so that at 773 F. it would be equal to the pressure of 350 atmospheres. This is termed the 'critical point,' because, at this temperature, water, however great the pressure to which it is subjected, can no longer exist as a liquid, but becomes dissociated into its constituent gases. Although the exact conditions which obtain at these great depths cannot be known with certainty, nevertheless all the evidence goes to show that there is a limit set to the descent of surface water by the rapid increase in the expansive force of its vapor, due to the rising temperature. Prestwich put the maximum limit at 6 to 7 miles, and Delesse estimated it at 60,000 ft., or about 11 miles. Moreover, experience goes to show that the water encountered in mines is the drainage from the surface. Deep mines are usually dry ones. I may instance the deepest metal mines, the Calumet & Hecla and Tamarack, in the Lake Superior region, and the '180,' 'New Chum-Victoria,' and neighboring shafts, at Bendigo, in Australia."

We can only infer from this passage that Mr. Rickard was arguing for the deep descent of the surface waters and adduces in proof the obvious experience that the water encountered in mines comes from the surface. All the context goes to show that the dryness of deep mines never suggested itself as an argument for shallow ground-waters. Additional corroboration will be found on pp. 219-220 of Vol. XXXI, 1901, of the *Transactions*, in Mr. Rickard's paper on 'The Formation of Bonanzas in Gold Veins,' in which, a year after the paper on the Cripple Creek volcano, he writes as follows:

"It does not appear to me that Professor Van Hise has erred by exaggerating any particular view of the subject. His elucidation of the water circulation as a complete system is based on a broad conception of the whole matter," etc. The reference to Van Hise means his views as expressed in the paper entitled 'Some Principles Controlling the Deposition of Ores,' which was read at the Washington meeting of the Institute, February 1900, and published on pp. 27-177 of Vol. XXX of the *Transactions*. Whatever views are expressed in this paper, the shallowness of the zone of meteoric waters is not among them, since the paper is a strong argument for exactly the reverse. Its great feature is the descent of the meteoric waters possibly even to the limit of cavities, their migrations through the rocks and return by trunk channels to the surface.

It does seem strange as we look back upon the animated and interesting discussions of this period, that participants generally were not moved to check up their conclusions by the actual experience of the miner and the driller. Instead, however, of basing reasoning about deep-seated waters primarily on facts of observation, almost everyone was so deeply under the influence of the time-honored views inherited from Delesse, Prestwich, and other early writers, and from the experience in the shallow mines of preceding generations, that this new evidence was either overlooked or twisted into a support for the old-time conceptions. While I would not wish to exaggerate its significance, I do not think that its force is generally appreciated today. Could we have attacked the problem of the deep veins and orebodies primarily with these facts in mind, we might well have felt forced to look around for some other kind of water. So far as I know the first con-

tribution in which this attitude is taken, is the one in Vol XXXI pp 169-197 1901, of the *Transactions* where on pp. 184-195 the subject is set forth with some fullness. The question of priority interests the author of this paper but little, but the importance of securing for these matters a proper place in the discussions is great. I can say for him, now, that he regrets at the time he did not know of Mr. Rickard's mention of the Keweenaw Point and Bendigo Deep mines the year before so that the latter could have been cited and acknowledgments made. Keweenaw Point, however, was no new thing and had been well known to him from personal visits for nearly twenty years. The omission of Mr. Rickard's remark was quite unintentional.

Nevertheless in the contribution on 'Water in Veins: A Theory' in *The Engineering and Mining Journal* for March 14, 1903, two years later, Mr. Rickard makes no mention of this earlier contribution, although he traverses almost the same ground. The next year, 1904, in the *Proceedings* of the Colorado Scientific Society, J. W. Finch brought out his interesting discussion entitled, 'The Circulation of Underground Aqueous Solutions and the Deposition of Lode-ores.' (Vol. VII, pp. 193-252) Mr. Finch takes a decided stand for a zone of meteoric ground-water even shallower than had been believed by the earlier writers. Perhaps these citations will correctly set forth the matters of priority, except so far as the point of decrease and final absence of the application of these facts to its distribution.

Posepny certainly knew that the surface waters decreased and finally failed at Przibram, since he writes as follows in Vol. XXIV of the *Transactions* of the American Institute of Mining Engineers, p. 971, 1894:

"The Przibram district lies, in round numbers, about 500 metres above sea-level, and the mine-workings extend as is well known to more than that distance below sea-level. The ground-water level is but a few metres under the surface. The deepest adit drains the mines to about 100 metres; and everything below that level is strictly deep workings, from which the water is lifted to the adit-horizon. A comparison of the water raised from different levels shows that the largest quantities come from the upper ones, and that the amounts diminished with increasing depth, so that at about 300 metres below sea-level no water remains to be raised, the ruling rock and air temperature of about 23°C. (74°F.) at that depth sufficing to evaporate the small existing quantity of water. This is certainly a striking proof that the water encountered in mining is of atmospheric origin." The mines were developed to about 1100 metres from the surface, leaving some 300 metres at the bottom practically free from water. What efforts, if any, were made to impound the waters immediately below the 100 metre adit, Posepny does not state.

In preparing the paper on the 'Rôle of the Igneous Rocks in the Formation of Veins' for the meeting of the Institute of February 1901, I consulted with my colleague, H. S. Munroe, of the department of mining, and received confirmation of my own impressions that the general experience in deep mines was that, with the impounding of the waters in the upper levels pumping became unnecessary at greater depths. The deep dry well at Wheeling, West Virginia, had been a matter of record for ten years, and the deeper one at Pittsburgh for four years. The application of all these and others as an argument for a shallow zone for the ground-waters was with some justice considered new.

In closing, I can only express the wish to have treated this uncomfortable subject in a proper manner and one calculated to bring out the truth and to give no offence. No one could wish more than I, to see Mr. Rickard get all due credit and recognition for his contributions on the ground-waters and all other subjects; and likewise that justifiable claims to priority should also be no less recognized.

J. F. Kemp.

New York, November 17.

The accumulation of helium in the rocks and the radium, uranium, and lead ratios probably serve as the best recorders of time that geologists possess. The work of Strutt and others in determining these ratios indicate that the earth is really an old world after all. The ages of the various rocks on this basis are about as follows:

Class of rock.	Years.
Carboniferous	340,000,000
Devonian	370,000,000
Ordovician	430,000,000
Algonkian	1,000,000,000
Archean	1,300,000,000 to 1,600,000,000

Continued work of this kind will perhaps serve as a very important aid in really making geology a chronological science and giving dates to geological history.

The principal mineral product of Kentucky is coal, which in value constitutes about three-fourths of the state's total mineral output. In 1912 the value of Kentucky's mineral production was $22,452,984, of which the coal output made up $16,854,207, according to figures compiled by E. W. Parker, of the U. S. Geological Survey, in coöperation with the Kentucky State Geological Survey. The increase in the total mineral production over 1911 is $3,156,370. The clay-working industry is second in importance in the state, with manufactured products in 1912 valued at $2,443,740, against $2,368,094 in 1911. The principal clay products are firebrick and other forms of refractory material made from fireclay and common brick.

The work of the United States Geological Survey is reflected chiefly in the publication and distribution of its printed reports and maps. According to the annual report of the Director, recently made to the Secretary of the Interior, during the fiscal year ended June 30, 1913, the number of reports printed was 253,850 copies, and the number distributed of these reports and reports previously printed was 375,213 copies. The reports are sent out only on application.

The ore minerals at the Mount Lyell mine, Tasmania, in the order of their observed prominence, are pyrite, chalcopyrite, enargite, tetrahedrite, sphalerite, galena, bornite, and chalcocite.

Concentrates

Most of these are in reply to questions received by mail. Our readers are invited to ask questions and give information dealing with the practice of mining, milling and smelting.

Operating costs at the North Broken Hill mine are: mining, $3.04; development, $0.60; and milling, $0.84 per ton.

Franckeite is a sulphide of tin, composed of $Pb_5Sn_2Sb_2S$, or $2PbSn_2Pb_3Sb_2S$, found in the province of Oruro, Bolivia.

After 30 years, land in the Joplin district, Missouri, on which the regular taxes have not been paid, reverts to the state, and is sold for delinquent taxes.

Shovelers at Joplin, Missouri, average 19.7 tons per man per shift. They are usually paid by the tub, 4 to 8 cents each, these being 28 by 30, 30 by 30, and 30 by 32 inches in size, holding from 850 to 1100 pounds.

Javanese coolies working at the Ketahoen mine, Sumatra, are paid from 16 to 24 cents per day, depending on length of service, not ability. A white miner gets from $100 to $130 per month, his work consisting mainly of supervising natives.

Costs of milling at the Nevada Wonder mine were as follows during the past year, in the treatment of 39,118 tons: direct, $3.092; indirect, $0.157; making a total of $3.249 per ton. The recovery was 93.1% of the metal contents, the ore containing approximately 70 of silver to 1 of gold.

Spares used in the Oriental Consolidated company's five mills, containing 240 stamps, which crushed a total of 313,701 tons of ore during the past year, were as follows: 658 shoes, 454 dies, 14 heads, 10 tappets, 23 cams, 7 cam shafts, 8 stems, and 3 pulley flanges. The consumption of quicksilver was 21,500 ounces.

In making geologic notes underground, a simple color scheme has been adopted at the Anaconda Copper Mining Co.'s mines. Red pencils are used to indicate vein filling, which may be ore, barren pyrite, in fact any metallic mineral or quartz, and the record of the minerals present is found in the written notes. Blue coloring indicates evidence of faulting, either as the definite planes of movement or the crushed granite resulting from such movements.

Consumption of chemicals at the four cyanide plants of the Oriental Consolidated company, during the last fiscal year, was as follows:

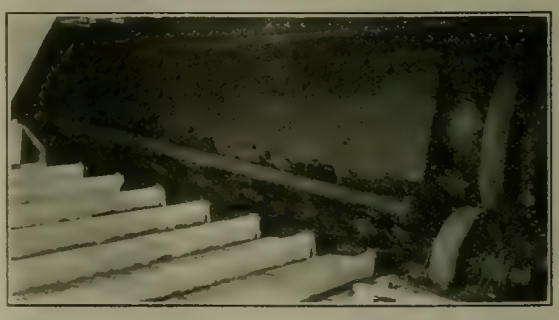
Chemical.	Quantity, pounds.	Cost per ton treated.
Cyanide	167,330	$0.56
Zinc and zinc dust	50,200	0.07
Borax	10,640	0.04
Lime	818,385	0.11
Soda	4,256	0.005
Litharge	1,456	

A total of 53,923 tons of products was treated.

Cobalt has been often tried as a steel alloy without making a notable improvement in the resulting steel. There has recently come on the market a German product known as 'iridium steel.' It contains cobalt, but no iridium, and its price is prohibitive. Its analysis shows: cobalt, 4.25%; tungsten, 16%; chromium, 3.55%; vanadium, 0.67%; molybdenum, 0.80%; carbon, 0.60%; a low percentage of manganese, silicon, sulphur, and phosphorus; and 74% of iron.

Comparing the Waihi deposits described in the 'Geology of the Waihi-Tairua Subdivision, Hauraki, Auckland,' by J. M. Bell and Colin Fraser, with the Tonopah deposits described by J. E. Spurr, one is impressed with the many similar features of the two regions, according to W. H. Emmons in *Economic Geology*. Both groups of deposits are in igneous rocks of comparatively late age, nearly related in composition; both are capped in places by later barren rocks. The ores of both carry carbonates and adularia, and the proportion of sulphides to gangue minerals is low in the ore of both districts. Tellurides and selenides are present in both, and the lists of ore minerals are closely similar, although the proportions of the minerals present show considerable variation. Hydrothermal alteration, as already pointed out by Finlayson, is closely similar—silicification, sericitization, and development of adularia and carbonates being the dominant hydrothermal processes in both regions.

Recovering gold from gravel dug by dredges is simple. After leaving the buckets, the gravel passes either through a revolving or over a shaking screen, this eliminating all material over about half-inch size, while the finer sand and gravel passes through the screen to the bottom of a hopper. During its passage through the screen, water is added copiously to the gravel to disintegrate it, also at the bottom of the hopper below the screen, from which the pulp flows over a series of riffles. These usually cover a large area on the boats, and consist of either strips of beveled pine shod with ⅛ by 1¼-in. iron, or of 1 by 1 by $^3/_{16}$-in. angle-iron riveted together. Quicksilver is added to the riffles and the gold caught as the pulp flows across them, and two or three times per month all the fine gravel and sand and amalgam is collected and washed. The accompanying half-



PART OF GOLD-SAVING TABLES ON CAMANCHE DREDGE.

tone shows part of the revolving screen, hopper, water pipes, and riffles on the Camache dredge described on another page of this issue.

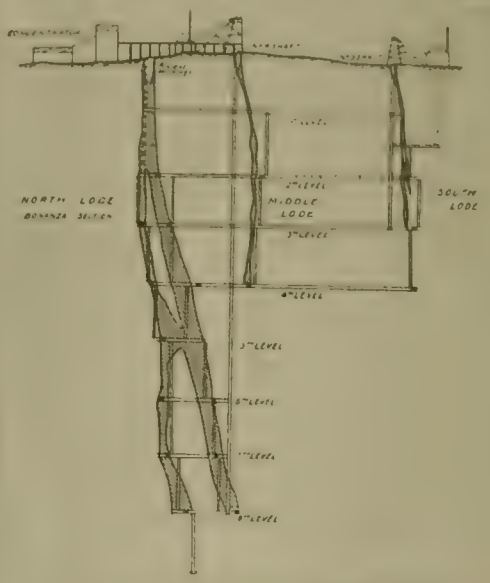
Special Correspondence

LONDON

LITIGATION BETWEEN ELMORES AND THE MINERALS SEPARATION — THE MESSINA COPPER MINE AND ITS DEVELOPMENT.

An unusual event has happened in connection with the hearing of the appeal of the Elmores, before the Judicial Committee of the Privy Council, against the judgment of the New South Wales court in connection with their suit for infringement of patents on the part of the Sulphide Corporation which uses the Minerals Separation process. The appeal was heard early in November and judgment was reserved. Now comes the news that the case is to be reargued in January next. A vast amount of speculation has been rife as to the meaning of this hitch, and at the time of writing I have not heard that the Lord Chancellor has divulged the reason why the views of the judges have not been given or accepted. It is assumed, however, that the three judges were not unanimous and that a majority judgment in so small a court would not be acceptable in Australia. The constitution of the court was a strange one, for two of the judges had already passed opinions in connection with the English litigation, one on each side. Lord Moulton, who had been in favor of the Elmores in the Court of Appeal, did not hesitate to express his opinion forcibly at the recent hearing, thereby disconcerting his brother judges and the counsel engaged. Lord Moulton ought never to have been on the bench in connection with these patents, for before his elevation he had given an opinion as to the validity of the first Elmore patent. In an American court this fact would be sufficient to disqualify him from sitting on the case. I am not aware that Minerals Separation raised the point, or whether it would have done any good if it had been done, but the Company would surely have been fully justified in objecting to his association with the case. In the course of a week or two I shall have further news to send.

After many years of struggle the Messina copper mine, in the north of the Transvaal, has arrived at the profitable stage. It is a round dozen of years since A. M. and J. P. Grenfell had their attention drawn to the old workings just south of the Rhodesian border. They visited the property, and after due inspection decided to make the financial plunge. These two gentlemen are well known in the United States, Canada, and Mexico in connection with their multifarious land and mining interests, and Camp Bird and Santa Gertrudis may be mentioned in particular. More recently the name of Grenfell has become associated with the General Petroleum of California. The Messina mine contains a rich ore deposit, but, owing to absence of railway communication, the cost of development and of realization on the ore won was abnormally high, and for years the sale of ore in Swansea, Wales, was only sufficient to pay for development. The method of handling the property has proved satisfactory, however, for the Company has not been overburdened with capital. At the present moment the profit in sight is over five times the nominal capital. Naturally the shares stand at a big premium, but not too much so, considering the excellent prospects at the mine and the other copper deposits at present undeveloped, not to mention the coal mine owned by the Company. The great event of the day is the completion of the railway connecting the mine with Pretoria and Cape Town. Another railway is in hand to connect with the Selati railway which runs from Leydsdorp to Delagoa bay on the east coast of Africa. Two reverberatory furnaces have just been put into commission under the metallurgical management of T. D. Nicholls, who was for many years with the Cape Copper Co., and is known among copper people as the co-inventor with the late Christopher James of the 'direct' method. During the past 12 months, 3462 tons of picked ore and jig concentrate was shipped to Swansea, averaging 45 to 50% copper, and a profit was made of £29,734. An account of the ore deposit will be of interest to readers. The ancient workings are all open cuts, and some are as deep as 80 feet. Most of them have been filled with debris, presumably by the old miners as the faces advanced. The workings approximately follow three lines, which have since been identified with definite lodes, and named the North, Middle, and South lodes. Their general trend is northeast to southwest, and they approach each other toward the west. The country for a mile round the mine is granite, with hornblende-gabbro dikes penetrating it in various directions. On the line of lodes many other rocks are found, principally decomposed or altered granites. Both red and gray granites, frequently of a gneissic structure, are exposed in the cross cuts between the lodes. Soft decomposed felsites, in substance like china-clay, and colored yellow, red, or green, are associated with the lodes in some places. Elsewhere white quartz is the gangue of the lodes. The copper minerals are chalcocite, bornite, and chalcopyrite, and they are found occasionally in large irregular blocks, at other places cemented in the cracks of the quartz or disseminated through its mass. When prospecting was started, seven shafts were sunk, three on the line of the North, three on the South, and one on the Middle lode. At first the results were disappointing. It was not until crosscuts were driven on the No. 1 and 2 levels from the shaft on the Middle lode to the North lode that a large body of ore was found in the latter. This was called the Bonanza. It forms part of the North lode, and on the upper levels was about 100 ft. long and from 25 to 40 ft. thick, consisting of chalcopyrite and bornite mixed with felsite. The North lode has been exposed for 1500 ft. along the strike on the second level, and has been proved to a depth of 900 ft. The ore-shoots consist of a series of lenticular masses having no observable connection between each other. The lode is generally 3 to 4 ft. wide, with granite walls. At places it widens to 10 or 20 ft. where it includes granite 'horses.' In the Bonanza stope the copper minerals are dissimeniated in irregular blocks throughout the mass, and the gangue and wall rock are much decomposed. In depth the proportion of chalcopyrite decreases. Below No. 3 level the Bonanza stope splits into two parts. The Middle lode is more erratic than the North lode and is about 2 ft. wide, consisting of bornite and chalcopyrite, widening occasionally to 20 ft. with 'horses' of granite interposed. The South lode has been worked to No. 4 level and consists of chalcocite and quartz within hard granite walls. Occasionally it splits into two parts, each about 3 ft. thick, separated by 3 to 6-ft. granite through which stringers of ore penetrate from one side to the other. An excellent account of the mine was recently given by the manager, J. A. Woodburn, to the South African Society.



SECTION ACROSS THREE LODES IN MESSINA MINE.

WASHINGTON, D. C.

Bureau of Mines Estimates.—Proposed Petroleum Investigations.—Alaskan Railways.—Land Law Revision.

Estimates for appropriations for the United States Bureau of Mines, approved by the Secretary and submitted to Congress, call for $752 000, an increase of $90,000 over the current appropriation. The principal new items are $30,000 for equipment of mine-rescue stations and cars, and $30,000 for petroleum investigations. The first is made necessary by the fact that the old cars, originally the gift of the Pullman company, are about worn out. This is not surprising, since, when they were planned, such work was entirely new and experimental. The Pullman company generously gave to the Bureau a number of old sleeping cars which were converted to their new use. Since then steel cars and steel-frame cars have come to be the standard equipment for first-class trains. As a result, a number of these older cars can not be hauled upon the fastest trains, a fact that may at any time prove of first importance. To reconstruct them or buy new cars is now necessary. The money for petroleum investigations is necessary because of the large direct interest of the United States in reserved petroleum-bearing lands and its indirect interest as guardian of the Indian lands. Within the year an unexpected burden was placed upon the Bureau when it was called upon to find a way to permit opening certain oil lands in Oklahoma without waste of the gas in the overlying sands. This was successfully accomplished, and a waste amounting to millions of cubic feet per day was stopped. In California large areas of presumably oil-bearing land are held for future use of the Navy and other branches of the Government service. The Geological Survey selected the lands and they are presumably well chosen. At the same time, there is no adequate knowledge of the probable effect on these lands of development on railroad and other tracts that exist within their limits, and introduction of water into the oil-sands by careless drillers may ruin the Government reserve. It is proposed to study the whole situation carefully to protect the Government's interest. At the same time, it is hoped that technical information of value to oil companies in general may be developed. In this connection the Bureau of Mines has made the following statement:

"In 1911 the total value of the petroleum produced in this country was $134,044,752; that of the natural gas usefully produced was $74,127,534. The magnitude of the petroleum industry, the increasing value of petroleum and natural gas as fuel, and the rapid decline of the yield from many fields emphasize the need of conducting inquiries concerning the mining, treatment, and utilization of petroleum and natural gas, with a view to economical and efficient development of these resources, as well as inquiries into the economic conditions that have developed in the oil and gas industries, with a view to the determination of the factors governing production and the means whereby supplies of oil and gas, especially those on public lands or on lands controlled by the Government, can be utilized to best advantage in promoting the public welfare. As illustrating the need for inquiries and investigations concerning petroleum and natural gas, with a view to economic development, it is pertinent to note the following extract from a recent report received by the Bureau of Mines regarding the Cushing field of Oklahoma: 'The maximum yield of oil from the Cushing field has never reached 30,000 bbl. per day. For a long period it has been considerably less than 20,000 bbl. per day. The average value of oil at the highest market quotation probably is below $20,000 per day. During this time there has been wasting from drilling wells not less than 100,000,000 cu. ft. of gas, while the waste from flowing wells is perhaps in excess of 200,000,000 cu. ft., making a total daily waste of 300,000,000 cu. ft., which at the domestic rate of 25c. per thousand, would be $75,000 per day in fuel, or a matter of perhaps $20,000 per day to the oil producer. It is not only possible to conserve this gas, but it also is possible in many cases to so manage the wells that they can furnish oil without allowing the gas to escape. The main purpose of the oil producer is to get the oil and let the gas escape.' There are other fields in the United States where enormous daily waste of gas occurs. Practically all of the oil purchased by the different branches of the service of the United States has been tested by the Bureau of Mines. This is particularly true of tests for the Navy Department, these purchases amounting during the past year to about 21,000,000 gal. of oil."

The proposed increase of $20,000 in the appropriation for mineral mining investigations is made necessary by the demand for work in the Western states especially. The Bureau has recently issued excellent papers dealing with 'Safety in Tunneling,' written by D. W. Brunton and John A. Davis; 'Mine Accident Prevention at Lake Superior Iron Mines,' by Dwight E. Woodbridge; 'First-Aid Instructions for Miners,' by Messrs. Glasgow, Randenbush, and Roberts; 'Possible Causes of the Decline of Oil Wells,' by L. G. Huntley; and similar subjects. It is to expand the work upon which such reports is based that the money is asked. The detailed estimates are as follows:

General expenses	$ 70,000
Mine accidents	347,000
Mine-rescue cars and stations	30,000
Equipment of testing plant	10,000
Testing fuels	135,000
Mineral mining investigation	120,000
Petroleum investigation	30,000
Inspection in Alaska	7,000
Library	2,000
Lands and leases for cars	1,000
Total	$752,000

Those interested in Alaskan problems are distinctly hopeful of some legislation at this session of Congress. The strong endorsement given by the President to the project for building government railroad lines in the territory is felt to insure some action. There is also hope that a beginning at least will be made in the task of revising the mining law. Probably this will take the form of an attempt to clear up the situation regarding petroleum lands. J. E. Raker, of California, has become interested and has been collecting data and opinions from the Geological Survey and other sources of information.

KALGOORLIE, WESTERN AUSTRALIA

Gwalia Consols, Lancefield, and Great Victoria Mines.—Fire Assaying Unreliable for Gold.—Better Developments at the Victorious and Horse-Shoe.—Geology of Kalgoorlie.—The Chaffers Mine.

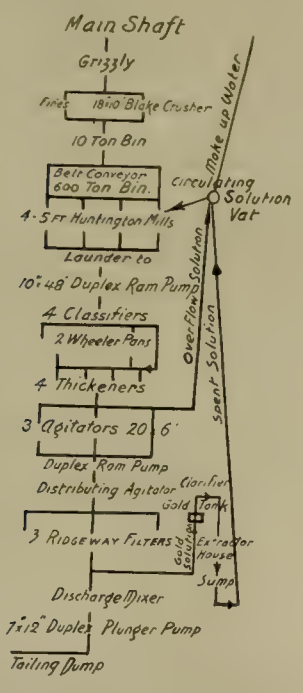
Owing to the final collapse of Ben Howe's volatilizing process, the directors of the Gwalia Consols and Lancefield mining companies have decided to go into liquidation and abandon the mines. The Gwalia Consols mine has produced $2,200,000 from 270,000 tons, and the Lancefield $4,150,000 from 540,000 tons, and neither has paid a dividend. Both mines proved unprofitable in the sulphide zone, the former chiefly on account of antimony, and the latter on account of graphite and arsenical pyrite. The lode in the Gwalia Consols is 40 ft. and in the Lancefield 25 ft. wide, and the grade is higher in the sulphide than in the oxidized zone, but cannot be treated at a profit. The Gwalia Consols company has lost $162,500 in cash working capital, and the Lancefield $412,500, and both concerns are in debt, with useless machinery, building, and stores as their assets. The situation of both concerns is certainly unfortunate, and it is not for the want of faith by shareholders and directors, or lack of good mining or metallurgical ability that hope has been abandoned.

Bewick, Moreing & Co. have taken a sampling option on the Great Victoria mine, near Southern Cross, on behalf of the Mountain Queen company. The Great Victoria was last year under option to the Great Boulder Proprietary Co., but was rejected after several months of development and prospecting. The mine is situated 12 miles south of the Mountain Queen, and, as the oxidized ore in the latter is nearly depleted and the value of the sulphide is doubtful, a new property is being looked for. The Mountain Queen

company owns the Transvaal mine, whose ore is heavily impregnated with arsenical pyrite, and a process for its treatment will probably be hard to devise.

The Federal Ore Co., of Victoria, the owners of the I. H. Niemann patent process for treatment of selenite ores, has just treated a test shipment from the Broken Hill Gold & Copper Co.'s mine, returning 4.2 oz. gold per ton, leaving 6% copper in the residue. It is alleged that similar ore previously treated at Footscray, near Melbourne, yielded only $5.36 and at Bendigo $4 gold per ton. Mr. Niemann states that selenium is as universally present in ores as sulphur, and volatilizes the gold, and consequently that even fire-assays are unreliable. This is important if true. Incidentally the cost of the Niemann process is said to be very little more than milling and the results surprisingly high.

The position of the Victorious mine at Ora Banda is improving, as the last 45 ft. driven east is in high-grade ore containing free gold and telluride, showing occasional high assays. The comparative gold content of the east drifts at two levels is as follows: No. 4, from 1 to 190 ft., $43.82, from 190 to 255 ft. $3.02; No. 5, from 1 to 27 ft. $2.16, 27 to 138 ft. $14.28, 138 to 220 ft. $4.56, and from 220 to 265 ft. $25.74 per ton. The station at No. 6 level has been started and cross-cutting for the lode will soon begin. If this level warrants it, Edwards roasting furnaces and



FLOW-SHEET OF VICTORIOUS MILL. THIS PLANT TREATS 8000 TONS OF ORE MONTHLY AT A COST OF $1.20 PER TON.

Krupp ball-mills will be purchased to replace the present Huntington mills. A peculiarity of the No. 5 level is that the ore is alternately oxidized and sulphide, and that where the ore is soft and oxidized the gold content is poor, and where it is hard sulphide it is rich in free gold and telluride. The next level will probably be all in sulphide ore. No winzes have been started below the fifth level yet. The shaft is quite dry and no water is found below this level. The future of the Ora Banda district depends on the next level of the Victorious, as the oxide ore in all of the mines has been proved by the government mill to be too low grade to make profitable properties.

The Golden Horse-Shoe Estates Co. has declared a dividend of $1 per share, or $300,000, which was rather unexpected. The Company started on January 1 with a credit balance of $178,000, and has since made a profit of $156,000. It, however, paid off $31,500 debentures in May, and has to redeem another $31,000 in November, besides paying the interest on the 375,000 debentures outstanding and redeemable within the next six years. However, the mine has been developing so well of late that before long the returns and profits should show a substantial advance and place the mine at the head of the producers. Not only is No. 4 lode on the boundary of the Great Boulder mine opening splendidly, but No. 2 and 3 lodes, which have hitherto yielded over 90% of the ore treated, are improving toward the south, where they were quite barren in the upper levels.

Malcolm Maclaren has not yet returned from Queensland to inspect the Associated. His report to the directors of the Kalgurli has, however, been published, and in it he states that the lodes having passed out of the quartz-dolerite into the underlying calc-schist, at a depth of 1750 ft., are barren, and likely to remain so. This was described in this journal of November 8, 1913. According to Mr. Maclaren, five other important mines are in the same predicament, besides several smaller mines. In fact, a calc-schist band, coming in from the east, has cut off all profitable ore. The western contact of the quartz-dolerite with the calc-schist is just outside the Ivanhoe western boundary, and this accounts for the western mines being barren near the surface. Mr. Maclaren argues that when the calc-schist has been left behind, and the quartz-dolerite entered, new and profitable ore-shoots will probably be found. On his recommendation, the Ivanhoe company, which holds a large area of ground on the west, intends diamond-drilling to test the ground at a depth of 2000 to 3000 ft. If his theory proves correct, a fresh lease of life will be given to the district on the west of the 'Golden Mile.' He states "that it is unsound mining business to sink deeper in search of ore-bodies that both the indications present and a wide experience of similar conditions combine in asserting to be non-existent." In spite of this advice, prospecting in the condemned area is still being continued, and the Lake View Consols management reports rich ore opened at a depth of 2100 ft. This mine is on the same line as the Kalgurli.

Since the reconstruction of the Chaffers company the manager has been working at the No. 16, and has now started at the No. 15 level, although the advice of John Morgan, of the South Kalgurli, to the directors of the Chaffers company 18 months ago, was "to explore further your mine to a greater depth, as the latest discoveries in the Golden Horse-Shoe mine prove that profitable zones exist in the deeper ground." At the time of Mr. Morgan's report, cross-cuts at No. 15, 16, 18, and 20 levels had proved that the Golden Horse-Shoe's No. 2, 3, and 4 lodes were unprofitable at these depths, and since then the cross-cuts at No. 16 level have been extended nearly 600 ft. west. At 427 ft., the west branch of No. 3 lode was cut, and followed south 150 ft. in ore assaying $28.32 per ton, and the face is within 70 ft. of the Hannan's Star boundary. Lode No. 4, Horse-Shoe No. 1, was cut 567 ft. west of the drift on lode No. 1, Horse-Shoe No. 4, and this lode has been driven on 326 ft. in ore assaying $6.96 per ton. No cross-cuts in any level either above or below have been extended nearly so far west, so that no connections can be made to secure ventilation. Nothing new has been heard of the projected treatment plant.

BAJA CALIFORNIA

PROGRESS IN SAN ANTONIO DISTRICT.—IMPROVEMENTS AT THE CIA. METALURGICA DE LA BAJA CALIFORNIA.—THE WEST MEXICO MINES COMPANY.

The mining industry of the San Antonio district is more active than it has been for some time, as is evidenced by the new work and the number of new denouncements. The combination of the Progreso Mining Co. with the Cia. Metalurgica de la Baja California, has made a great improvement as to output, and when the new power-plant of 400 hp. is completed, the results will be excellent. The power plant includes suction gas-engines and electric generators. This power will be distributed to the various properties of the Company, to drive hoists, pumps, and the old plant at Triunfo. This Company has title to many properties, some of which are big producers. Fernando Castanier is general manager. The operations of the San Juanes Reduction Co. are second in importance in this district. The big roasters are now running at capacity, and, besides cyaniding the roasted product, the Company

is treating a quantity of oxidized ore. The mines of this Company are reported in good condition, and the ore reserves are large. At the present time the Parral mine is producing the greater portion of the sulphide ore for the roasters. This ore is being successfully hauled from the mine to the plant by a 5-ton Pierce-Arrow truck. The Hardinge mill that was installed to regrind the oversize from the rolls is proving a success. Two large masonry tanks for leaching have been added to increase the capacity of the plant. Paul Knappe is the manager.

The addition of concentrators to the West Mexico Mines Co.'s mill will greatly improve the equipment. The Company is now awaiting the arrival of a separator and two concentrating tables to resume operations. The principal mine of the Company, called the San Lorenzo, is opening up in fine shape and a new find has been made in this property of a large orebody carrying over 2 oz. of gold per ton and some silver.

The properties belonging to the Brazilar y Anexas company are being worked under the supervision of Frank Lawrance. During the month of September a splendid shipment of oxidized ore was made from the Gausabe mine, which is one of three properties owned by the Company. Up to date over 3500 tons of ore, worth $50 per ton, has been treated, and all of this came from the Guasabe property. This mine also has a good grade lead-silver ore, shipment of which has been made to the Selby smelter.

There are several small operators in the San Antonio district at present, and many good prospects are being developed. One of the most needed and necessary requirements for this district is an up-to-date reduction plant for custom work. There is an abundance of ore, but the great difficulty is to get it treated.

NEW YORK

MINE TAXATION.—SMELTER SITUATION IN MEXICO.—GUGGENHEIM EXPLORATION.

It is a curious fact that important events seem to attract very little attention sometimes, and an instance of this is seen in the little comment evoked by the decision regarding mine taxation rendered on December 1 by the Supreme Court of the United States. When the United States began to tax the incomes of corporations a good deal of protest was made by some mining companies on the score that the difference between their gross returns and expenses does not represent net income, but is in large part a return of capital, since a mine is worked out in a comparatively short time. This theory so appealed to some companies that by using a suitable unit in computing the depreciation in the value of the mine per ton of ore extracted they were able to show no regular income. The Stratton's Independence instituted a test case, which has gone its way to the Supreme Court of the United States. This court held that the corporation tax law applies to mining companies, the proceeds from the ore mined are income within the meaning of the law, and the value of the ore in place may not be deducted from these proceeds in computing the income of the company. Mining companies are already taxed somewhat heavier in proportion than other forms of property, and there seems a certain degree of justice in the contention that the net proceeds of a mine do not represent the same sort of income as that from a railroad, for example. In some of the Western states, notably Arizona, tax laws have recently been enacted which assess mines at a very high valuation. It would seem as though the general subject of mine taxation needs a thorough overhauling.

Rumors were floating around last week that the American Smelting & Refining Co. had given orders to shut down all its Mexican plants. The rumor was baseless, but there was a certain amount of grim humor in it, for as a matter of fact only the smelter at Aguascalientes is now in operation, and that only at half capacity. The others have been compelled to stop because of interruption of communications and the disturbed conditions generally, but it is hoped that some of them will be able to start again at an early date. The earnings of the Mexican companies have been remarkably good, considering the difficulties of the past year. The Guggenheim Exploration has declared an extra dividend of 2%, bringing this year's total up to 37½%. Last year the Company earned 15.7% on its outstanding stock. In 1912 the Company disposed of 110,000 shares of its American Smelters Securities preferred 'A' stock, and $1,500,000, par value of its American Smelters Securities 6% bonds, and bought 65,246 shares of Yukon Gold stock, 69,500 shares of American Smelting & Refining, 97,750 shares of Chino Copper Co., and 121,200 shares of Ray Consolidated. As the result of placing Chino on a $3 per annum dividend basis and Ray Consolidated on $1.50 per annum dividend basis, the Guggenheim Exploration earnings from investment are now at a rate greater than last year's. The annual report for the year ended December 31, 1912, showed the Company with no bills or accounts payable and cash and demand loans of $10,303,299.

TORONTO, CANADA

ROYALTIES PAID BY COBALT MINES.—MOND NICKEL CO.'S NEW MINE.—NEW COMPANIES AT PORCUPINE.—JUPITER COM-

During the past year the royalties collected from the Cobalt mines by the Ontario Government amounted to $250,145. The following table shows the total paid by the mines up to October 1912 and that paid for the year:

	Royalties for 1912.	Total to date.
O'Brien	$72,071	$668,376
Crown Reserve	136,180	611,991
Hudson Bay	36,759	245,270
Chambers-Ferland	.....	26,260
Hargraves	.....	1,200
Waldman	.....	777
Wiandoah	123,123	1,422
Provincial	5,012	6,735
	$250,145	$1,562,031

The decreased earnings of several companies have influenced the Government to make a considerable reduction in the amount of royalties to be paid in future. The royalty paid by the O'Brien was reduced from 25% of the gross value of the ore at the collar of the shaft, to 15% of the net profits. Should other bonanzas be opened in future workings, the Government retains the power to restore the former rate. The Hudson Bay company pays 15% of the gross value of the output, but an allowance has been made to cover the cost of concentrating. In the case of the Chambers-Ferland and Hargraves, the royalty, which was originally 25% of the gross value, has been abolished entirely; but the right is reserved to impose a royalty not exceeding 15% of the net profits.

One of the most important deals in the Sudbury nickel range was recently closed when the Mond Nickel Co. purchased the Big Levack property for a price of approximately $650,000. The property was under option for some time, and the six diamond-drills which were at work are stated to have proved 2,000,000 tons of ore. The property comprises 1600 acres, and was first staked in 1882. A few years ago, the Mond company had an option on it at a much lower price.

The advent of the West Australian Gold Mines, Ltd., which is one of the subsidiary companies of Erlich & Co., in the Porcupine district, is responsible for a greater interest being taken in the surrounding properties. The West Australian company has taken an option on the North Thompson claim which adjoins the Hollinger on the south, and the McEnaney on the east, and it expects to get the extension of the No. 44 vein from the Hollinger, and also to get the dip of the Porcupine Crown vein. The Company already has two diamond-drills at work and has started sinking a shaft. The deal for the North Thompson lot, which was purchased from G. Von Polenz, and Norman Fisher, manager of the Temiskaming mine, was as follows: The West Australian company will form a company with a capitalization of 1,000,000 shares, par value $1, $525,000 will be left in the treasury, while vendors get $83,500 in cash and 150,000 shares of stock. In order to provide money for development and equipment, the Western Australian company will take treasury shares at par.

General Mining News

ALASKA

Cordova

During the season of 1913 the Valdez Creek Placer Mines Co. operated on a bank of gravel 110 ft. high and 200 ft. wide, and the clean-up gave an average of $1.59 per cubic yard in that part above the old workings. A ditch and pipe-line was completed during the year, and another long pipe to give an additional capacity of 5000 cu. yd. per 24 hours is being planned by the Company. On Lucky gulch, 7 miles above this property, there was recovered about $3000, some of the gold being in the form of nuggets worth from $5 to $60. A No. 4 Keystone and an Empire drill will be sent in by the Company at an early date to prospect the ground near here.

Fairbanks

With the proposed new mill on the Fish creek property there will be 14 stamp-mills in the Fairbanks district, and the miners expect that most of these will be running full time next summer. The mills which are already constructed are: Hudson brothers, a 2-stamp Nissen mill, on 4 Above, Ester creek; Soo mine, one small 3-stamp and one large 2-stamp mill, situated on upper Dome creek; Rainbow mine, Straub rapid stamp-mill; Furstenau property, a Little Giant stamp-mill, at the head of Fairbanks creek; Rexall mine, 2-stamp Hendy, situated at the head of Wolf creek; Chatham Mining Co., 4-stamp Hendy, situated on Chatham creek; Willis' property, 5-stamp Hendy, situated near Chatham Mining Co.'s mill; Rhoads-Hall mine, 5-stamp Hendy mill, situated on Bedrock creek; Chena mill, 10-stamp Hendy, at Chena; Fairbanks test mill, situated on Garden island; Newsboy, 5-stamp Hendy, head of Cleary creek; Tolovana, 2-stamp Nissen, Willow creek. The Newsboy crushed 400 tons of ore in October. A new scraper will be installed at the Ryan & Lundberg ground on 4 Below, Fairbanks creek, where prospecting has shown an average of $1 to $1.50 per square foot of bedrock. On 2 Below, operators are preparing for next season.

Juneau

During October the two 120-stamp mills at the Alaska United crushed a total of 38,906 tons of ore, yielding $74,488 by amalgamation and treatment of 848 tons of concentrate. The estimated profit was $18,062. Development in the Ready Bullion mine covered 194 ft., and 482 ft. in the 700-Ft. claim, the stocks of broken ore decreasing 1700 and increasing 1845 tons respectively.

Shushana

According to John E. Barrett, an old Alaskan prospector, Shushana looks as though it might make a big camp. James Ground produced $27,000 out of 39 box lengths, 12 by 14 ft. each, and it is only 3½ ft. to bedrock on this claim. This property is on El Dorado creek, the McClellan claim has richer ground than this on Bonanza creek. A. C. Baldwin, of the Alaska boundary survey, got $5.50 in three pans on McClellan's claim. The new winter sled road is now completed and staked over the Nizina and Shushana glaciers. Horses have gone through with 'double-enders' over the glaciers, and wagons are going from here to the Nizina glacier with 3600 to the load. Travelers are coming out from Shushana to McCarthy in 2½ days, and as soon as snow falls the trip will be made with dog team in 1½ days and with horses and loads in 4 days. The route is safe from snow-slides, as they have no side-hills to go along. Other prospectors have recently arrived at Cordova over the glacier trail and report that generally it is in good condition. There are at present 300 people in the camp, 17 of whom are women. Five steam boilers had arrived from Snag river, and from 300 to 400 men are waiting on the other side of the boundary line, waiting the freeze-up. Beef is selling at 65c. per pound. A full account of work done in locating and marking the new trail was given on November 25 by George C. Hazlet, who is in charge of the work, to the Cordova Chamber of Commerce. About 15 outfits, ranging from 400 to 16,000 lb., have passed over the glacier since November 1. The distance from McCarthy to the placer field is not over 75 miles. There are road houses for accommodation. When the rivers freeze, the cost of freighting should not be over 10 or 12c. per pound. A number of men are going in poorly equipped, and the U. S. Government should do as the Canadian authorities, that is, station a police officer at each starting point to see that every man is properly supplied before he leaves.

ARIZONA

Maricopa County

Between January 1 and October 1, 24,354 tons of ore was mined and milled at the Vulture. The average gold content of this ore was $20.54 per ton, and an average recovery of $17.40 was made. The production of bullion for that period was $276,772, and from concentrate $152,643, a total of $429,416 for the nine months. Under previous managements the Vulture produced over $2,000,000.

Pinal County

The three-compartment shaft on the property of the Calumet & Arizona Mining Co. at Superior has been completed to the seventh level, which will enable the Company to remove the ore in a more economical manner, and also handle a larger tonnage. The large pumps recently installed handle the water from the mine with ease, making working conditions better than heretofore. Seventy-five men are now employed by the Company.

Yavapai County

Good sulphide ore has been opened on the 300-ft. level of the Copper Queen mine, near Stoddard. An option has been taken on the Independence, near Kirkland, by Brooklyn men. Five 6-mule teams are hauling ore from the Commercial mine, in Copper basin, to Skull Valley station, and then by rail to the Copper Queen smelter at Douglas. Fifty tons per day of silicious ore, with 4% copper, from this mine is to be sent to the United Verde smelter at Jerome. At the Henrietta, 10 men are mining $40 ore, and more men will be engaged soon. The new electric motors have been installed.

Yuma County

A receiver has been appointed for the Swansea Consolidated Gold & Copper Co., whose mine and smelter are in the northern part of the county. Twelve miles east of Ehrenberg is a placer formation from 5 to 16 ft. deep, proved by numerous drill-holes to contain gold. A Colorado syndicate, headed by E. L. Burcamp, will treat this by a scraping system, which requires little water.

CALIFORNIA

Amador County

The management of the Plymouth mine has been authorized from London to proceed with development, which will include sinking the shaft from 1500 to 1800 ft., and then preparing for stoping the ore opened by winzes below the 1500-ft. level. A 300-ton mill is now being designed by Gelasio Caetani. Argument in the suit between the Kennedy Extension and Argonaut companies at Jackson, which was to have been started on December 8, has been postponed till January 8. At the Central Eureka, two miles from Jackson, development has opened a promising vein which is an extension of the old shoot, that yielded good ore in past years. A. Millar and W. H. Storms, of San Francisco, arrived in Sutter Creek recently to inspect the West Eureka mine. Mr. Millar has a large interest in a company that was recently formed to take over this property on a bond from local owners. A new shaft is to be sunk at an early date.

Butte County

Three dredges of the Oroville Dredging Co. yielded $4849 during the week ended November 1. A circular issued in London, by the Company, states that arrangements have been made for an extension of the time for the repayment of the loan from the Gold Fields American Development Co., and it is proposed to resume payment of dividends at the end of December at the rate of 10% per annum, the first quarter to be paid in February 1914. The remaining

indebtedness will probably be liquidated during the first quarter of the coming year. Profits from the Pato dredge, Colombia, returns of which are given on another page of this issue, have been excellent, and are relied on to justify the proposals given.

CALAVERAS COUNTY

Two St. Louis men who got control of the Reiner Mining Co. last week have not paid an assessment of 15c. per share on their holdings, and are seeking to prevent the sale on the grounds that this is not legal. Details of the position of this Company were given in this journal of August 9, 1913.

INYO COUNTY

Well-boring machinery is being delivered in the Panamint valley to test the potash claims under option to Eastern people. W. C. Bass is in charge for the Smith-Emery Co., of Los Angeles, who are to do the work by contract. He expects to sink 600-ft. holes in different parts of the valley.

LOS ANGELES COUNTY

The Los Angeles Chamber of Mines and Oil on December 11 exhibited at the German building the S. W. Clawson collection of Bisbee copper ores. These magnificent speci-

MUSEUM OF LOS ANGELES CHAMBER OF MINES.

mens have been purchased for the mining exhibit by Thomas Thorkildsen and J. O. Royer, and the specially designed cabinet was secured through the generosity of J. Ross Clark and Seeley W. Mudd. The collection is an object of unusual interest and of exquisite beauty.

SHASTA COUNTY

On January 5, 1914, the Hazel Gold Mining Co., owning the Gladstone mine near Kennett, will pay its twelfth dividend for 1912, equal to $108,000 for the year, making a total of $1,008,000 to date. In a few weeks a new electric hoist will be installed, and the shaft sunk deeper. At the Field process plant being erected near Redding rapid progress is being made. Rich copper ore has been opened in the Delta Consolidated, near Delta.

SONOMA COUNTY

The railroad being built by the Sonoma Magnesite Co. from its mines to the station at Watson, and there joining the Northwestern Pacific railroad, is now nearing completion, having only to go about 3½ miles. This Company is said to own the largest deposit of magnesite in the United States, and expects to make its first shipment to San Francisco about May 1, 1914.

TUOLUMNE COUNTY

A bond and option to purchase the Clio mine for $150,000 has been given Robert Grauer by the Oro Mining Co. The first payment of $5000 is to be made within one year and the balance within five years. The Clio mine is situated near Jacksonville and is looked on as a good property, but its development has been retarded by mismanagement and litigation in the past. Twelve men are working at the Santa Ysabel under C. E. Shafer.

COLORADO

Heavy snowstorms fell all over the state during the end of last week, and 15 ft. was piled up in the Cripple Creek district.

EAGLE COUNTY

There are 75 men employed in the Brush Creek district. The Lady Belle is shipping 16 to 20 tons of ore per day. The winze is down 70 ft., where a small vein was cut. Assays from ore in the North Dakota have been as high as 955 oz. silver per ton. Lady Belle No. 4 has been leased and an adit is being driven. Twenty-ounce ore has been opened in the Little Salem.

LAKE COUNTY (LEADVILLE)

In Lackawanna gulch, the Lackawanna Belle Gold Mining Co.'s mine is developing in fine shape, and rich ore has been opened in No. 1 ore-shoot. A cross-cut adit is to be driven in 600 ft. from Lake creek. In the spring a small mill will be erected. Akron, Ohio, people are interested in the property. At the New Monarch there are 22 different sets of lessees working, and most of them are doing well. The orebody in what is known as No. 5 stope of No. 2 adit of the Mt. Champion, is now 25 ft. wide. Of this, 5 ft. is smelting and the balance milling ore. This is the largest shoot opened in this property. Mr. Smith, the manager, has decided to run all of the ore through the mill, thereby saving the heavy cost of transportation and increasing the value of the concentrate.

LAS ANIMAS COUNTY

It is reported that the United Mine Workers officials have decided to submit to Governor Ammon's proposal to submit the question of a settlement to the strikers for a referendum vote. The suggestion does not include recognition of the union nor an increase in the wage scale, but is the one which has already been accepted by the operators.

TELLER COUNTY (CRIPPLE CREEK)

The accident in the Golden Cycle mine, referred to in the last issue of this journal, occurred on La Bella vein, about 600 ft. north of the main shaft, and the slide is said to have affected a mass 200 ft. wide and 1000 ft. deep. Thomas Henehan and James Stewart, state commission of mines and mines inspector, respectively, have inspected the mine and are assisting rescue operations. Wonderful results have been made by the men at this work, but there is little hope for the entombed men.

THE SAN JUAN

Production from the Rico property is being made from two faces of ores at the present time, shipments having been curtailed through lack of hauling facilities to the railroad. The Company has on hand and ready for shipment 6 cars of carbonate ore, 6 cars of copper rock, which will be consigned to a local smelting plant, and 15 cars of copper ore, which will be shipped to the Ouray smelter. In addition to this, there are being loaded one car of iron ore and one car of zinc ore. Shipments for December will aggregate at least 40 cars, with the probability that they will be greater than this. Conditions at the mine are reported to be satisfactory.

Rico ore shipments for October were as follows:

Mine.	Ore.	Cars.
Rico-Wellington	copper ore	29
Rico-Wellington	zinc concentrate	7
Rico-Wellington	lead concentrate	4
Rico-Argentine	copper ore	19
Rico-Argentine	iron ore	1
Rico-Argentine	silver-lead	4
Rico Mining Co	lead concentrate	5
Rico Mining Co	zinc concentrate	9
Carphathia Mining Co	silver-lead	1
L. Habermann	copper ore	1
Custis & Nixon	silver-lead	2
Hays & Krise	silver-lead	1
Total		83

Fire destroyed the tramway, terminals, ore-bins, stables, and all other buildings at the Sunnyside mine, near Silverton, on December 1. The damage is estimated at $50,000, and 120 men are without employment for the time being.

IDAHO

IDAHO COUNTY

A bond has been taken on the Yellow Pine group of claims on the south fork of the Clearwater river, 45 miles from Stites, by Norman Hooper and Ben Braham, of Kellogg.

and H. J. Rice, of Mullan. A 5-stamp mill is to be erected to treat the gold ores opened.

MICHIGAN

Houghton County

The eight-hour day for miners and stamp-mill employees went into effect on December 1 at all the mines of the copper district. The scale of wages on the new basis will be $3 per shift worked.

MISSOURI

St. Francis County

Details of the work of the Myers-Whaley shoveling machine operated in No. 11 mine of the Federal Lead Co., at Flat River, are supplied by the manager, H. A. Guess, as follows: The machine operates with two men, who sledge up the big rock, one operater, and one car-leveler. In addition, there is mule haulage to and from the machine, but that is really tramming and not loading. For October the machine shoveled 6962 tons and had delays as follows: moving machine, 648 minutes; off track, 895; repairs, 3220; total, 79 hours 23 minutes. These were the delays inherent in the machine. In addition there were delays incident to the mining operations as follows: cleaning and repairing track, 1156 minutes; breaking rock, 2130; scaling bluffs by safety miners, 1108; block out, 279; shifting cars, 3210; miscellaneous, 357; total, 8240 minutes, or 137 hours 20 minutes. There were 27 working days in October of two 8-hour shifts, or 54 shifts in all, so net running time for the shovel was 217 hours 15 minutes. Repairs are variable, but will average perhaps $60 per month, including labor and material. At the National mine the same machine has been given up as too costly. In low stopes where it cannot work to capacity it proves uneconomical.

MONTANA

Missoula County

After years of litigation, the Amador Copper & Gold Mining Co. is again operating its mine near Iron Mountain. A pump was kept working in the mine all the time and the flume kept in repair. The railway connecting with the Northern Pacific line cost over $5000 to put in order. A locomotive, constructed out of a 50-hp. gasoline engine mounted on a truck, and driving it by means of a chain belt, conveys the ore cars over this 10.5 miles of track. Several shipments of 12 to 15% copper ore have been sent to Tacoma since October. This ore comes from the 400-ft. level of the mine. On the dump is 20,000 tons of ore, and a mill will probably be erected to treat this.

NEVADA

Elko County

A lease and bond has been acquired by John C. Yore, acting for San Francisco people, on the Nevada-Anaconda Copper Co.'s claim, 20 miles from Elko, for $60,000. About $7000 has been spent on development in driving adits and other work. Ore shipments have netted up to $60 per ton, and that mined by the new people calls for a royalty of 15 to 20%. A shaft is being sunk on 8 ft. of ore. At the Carlin-Nevada claim adjoining, prospecting is under way, and surface ores have assayed from $3 to $38 per ton in lead and silver. Eighteen inches of $40 ore has been opened in the Diamond claim. The Sunrise group is opening in a promising way. In the Old Bullion district, near Elko, lessees are shipping rich ore from a 10-ft. vein to the United States Smelting company's plant in Utah. Sixty men are employed. In the Dolly Varden district there will probably be increased activity early next year, although at present a lot of development is under way.

Esmeralda County

The estimated production of the Goldfield Consolidated Mines Co. for November is as follows:

Ore mined, tons	28,927
Gross value recovered	$348,000
Operating expenses	180,000
Net realization	168,000

Development at the Blue Bull continues on the 500 and 700-ft. levels, and good assays have come from ore on the former level, containing gold, silver, and copper. Fifty tons of ore per day is being sent to the Belmont mill at Millers from the Florence mine, a distance of about 37 miles. The total cost of transport and treatment is $5.50 per ton. The Pioneer company has now an ample supply of water, supplied from springs two miles from the mine. The mill is again in operation.

Humboldt County

Near Imlay, the Imlay Mining Co. has opened a 12-ft. vein in the Judge claim, assaying 137 oz. silver and a little gold. The Company has made an assessment for further work.

At the Hines-Baldwin lease, at National, a well defined vein 3½ ft. wide has been opened beyond the fault. An adit will probably be driven on the west side of the Shilo group of claims. The National Mines Co. is working to the south in its lower levels, and the orebodies are increasing in size with depth. This Company is running its mill, which is situated at the portal of the No. 5 main adit. The Charleston National Mines Co. has started to cross-cut from its main shaft to the west, where it will cut the vein at about 300 ft. vertical depth. The main shaft is also being sunk at the same time. Considerable work is under way at the Charleston Hill, Indian National, and at Auto Hill properties.

Lyon County

The Nevada-Douglas Copper Co. reports the following results of operations in October:

Ore shipped to smelter, tons	4,529
Average copper content, per cent	6.44
Revenue	$55,112
Operating expenses	18,836
Taxes, depreciation, leaching expenses, etc.	7,733
Net income	28,543

Nye County

After working for eight months, and crushing 18,294 tons of ore yielding gold worth $67,190, the Manhattan Big Four 10-stamp mill has been shut down indefinitely. During the period from March to October the value of the ore decreased from $8.32 to $2.25 per ton, and it is now proposed to acquire adjoining property. Owing to defects in No. 2 battery foundation, an insecure rock-crusher, and small water supply, the plant's capacity has been greatly reduced of late, although recovery has been good. D. R. Finlayson is superintendent. Experiments are being made on base ores from the White Caps and Manhattan Consolidated mines at Oakland, California. An electro-cyanide process is said to have given good results. For the 10 months of the current year the White Caps mine has produced 3570 tons valued at $84,491, this being the largest yield at Manhattan. The initial mill run in the Manhattan Milling & Ore Co.'s 10-stamp mill, under the management of the operators of the Big Pine, Messrs. Mushett and Wittenberg, is under way. It is intended to treat ores from the Big Pine, Manhattan Dexter, Mayflower, and Gold Crater properties in this mill, the various properties being operated by Mushett and Wittenberg. Under the Brady management the mill treated 10,000 tons of ore of a gross value of $100,000 during 1913.

At Tonopah, the north cross-cut on the 950-ft. level from the new main shaft of the Extension has opened the Murray vein, which shows good ore.

On the 850 and 750-ft. levels ore has been driven on for over 250 ft., where it is from 5 to 14 ft. wide. Good progress is being made with the electric tramway from the new shaft to the mill. The plant is treating 15 tons of ore per day. On January 1, 1914, the Belmont company will pay 25c. per share, amounting to $375,000, and making a total of $5,618,000 to date. November bullion shipments totaled 11.46 tons. In a drift from the winze below 1050 ft. in the North Star, rich ore has been opened. According to S. H. Brady, the West End mine is looking exceptionally well, especially on the 600-ft. level, and stoping above the 500-ft. level. A new hoist is being installed with a speed of 1000 ft. per minute in hoisting ore. Another 10 stamps and one tube-mill are to be added to the mill at once. The south cross-cut, on the 615-ft. level of the Montana, cut the A. B. K. vein where it was 4 ft. wide and assayed $85 per ton. During the week ended December 6, mines at Tonopah produced 11,868 tons of ore valued at $280,355.

STOREY COUNTY

Last week the Starrett pump in the old Con. Virginia winze, on the 2500-ft. level of the C. & C. pumping shaft, was started, and in a few hours lowered the water 23 ft. below the winze collar.

WHITE PINE COUNTY

Thomas F. Cole, president of the Giroux Consolidated, and a director of the Consolidated Copper Mines Co., is inspecting these properties at Ely.

CANADA

ONTARIO

There is now being hoisted through the various shafts in the Sudbury district about 4000 tons of ore per day. Half of this comes from the Canadian Copper Co., and 800 tons from the Moose Mountain iron mine, about thirty miles from Sudbury, but which is, nevertheless, tributary to this district. The British American Nickel Co. is sinking a 3-compartment shaft at the Murray mine, which is down 400 ft. The Gertrude, Whistle, and Elsie properties are ready for development. The Victoria mine of the Mond Nickel Co. is down 2000 ft., and the 'glory-hole' at the Creighton is 300 ft. deep. At the Froude, 64 houses are to be built for employees. The vertical and incline shafts are down 400 feet.

Work has commenced underground on the Drummond Fraction at Cobalt, the section of land and water bought jointly by the Kerr Lake and Crown Reserve companies from Earle and Fasken before the incorporation of the old Drummond and Cobalt Comet, later the Caribou Cobalt. The property is being worked as a separate unit and under separate mine management. Before Kerr lake was drained, nearly all the Drummond Fraction, of 7.75 acres, was under water. Since then a promising vein has been uncovered. Mark Little is mine superintendent.

At a meeting held at Cobalt on November 28 the following mines were represented: Dominion Reduction, York Ontario, Crown Reserve, Nipissing, McKinley-Darragh-Savage, Cobalt Townsite, City of Cobalt, Buffalo, Hudson Bay, Beaver, Trethewey, and Cobalt Lake. It was decided to post notices immediately relative to the new schedule of hours going into effect on January 1, in accordance with the new eight-hour day law passed at the last session of the Ontario Legislature.

During October the Buffalo Mines treated 6662 tons of ore yielding 135,457 oz. silver. Dividend No. 55, of 7%, was paid on November 15, making a total of $2,507,000 to date. The township of Coleman has withdrawn opposition to draining Cobalt lake. Drifts at 100 and 200 ft. in the Tough-Oakes mine, at Karkland Lake, are still in high-grade ore, 230 and 110 ft., respectively, being opened.

During the four weeks ended November 4, the Hollinger, at Porcupine, treated 13,401 tons of ore yielding $15.07 per ton with 96.1% recovery. The profit was $124,495. There is 8 ft. of $17 ore at the bottom of the winze below the 425-ft. level.

COLOMBIA

Returns from the Pato dredge of Oroville Dredging, Ltd., are as follows:

	Gravel treated, cu. yd.	Gross gold yield.
To October 21	239,492	$140,617
Week of October 28	24,100	15,900
Week of November 4	26,370	17,500
Week of November 11	25,250	31,250
Total	315,212	$205,267

These returns give an average of 65.12c. per cubic yard, or more than double the estimated average of the tested area, this being 31.31c. per yard. The last weekly output averaged $1.23 from ground that one of the drill-holes gave only 34c. per yard.

MEXICO

HIDALGO

The fifth annual meeting of Santa Gertrudis Co., Ltd., was held in London on November 19, and results may be tabulated as follows:

Development, feet	17,000
Ore reserves at June 30, 1913:	
Positive and partly developed, tons	778,000
Probable, tons	269,000
Estimated profit from total reserves	$ 4,700,000
Ore treated, tons	263,554
Metal recovery:	
Gold, ounces	21,800
Silver, ounces	4,243,000
Net profit, depreciation deducted	$1,110,000
Dividends	1,060,000
Carried forward	38,000

The property is known to contain, besides the main vein, 11 other productive veins, six of which were discovered during the past fiscal year. On No. 16 and 17 levels, west of the San Francisco shaft, an ore-shoot 10 ft. wide and 150 ft. long, with limits undefined, has been opened. Development of No. 19 level was finished, showing a shoot of payable ore nearly 1635 ft. long, although it is narrower and of lower grade than on the level above. Since the end of the year, No. 20 level has been reached and driving started in ore. San Francisco No. 2 shaft is down 1760 ft., and new surface equipment installed, so that it is now convenient to produce 25,000 tons of ore per month, October showing 30,000 tons with a profit of $105,000.

SANTA GERTRUDIS MILL.

A cable to London on November 23 stated that, on No. 17 level the south cross-cut has passed through 21 ft. of $47 ore per metric ton. The formation is unusual, and it has not been proved whether the shoot is the vein or merely locally mineralized rock.

JALISCO

The Mexican Development Co., of Peoria, Illinois, which is developing the Quelitlan copper property in the Autlan district of this state, 18 miles from the Pacific port of Chamela, has let a contract for the sinking of the double-compartment shaft an additional 100 ft. The shaft is now down 110 ft. A Knowles sinking pump has been installed. Three ore-shoots have been opened so far and contain 10% copper, ₱10 to ₱20 per ton in silver, and considerable zinc. Plans have been arranged for a smelter and zinc separation plant.

SONORA

It is reported at Douglas, Arizona, that interests allied with the Southern Pacific railroad have taken over the Lampazos mine, held by the Bank of Sonora, under mortgage by Lopez Bros. for about $400,000. The property is 48 miles south of Moctezuma and 85 miles southeast of Nacozari.

Personal

Bertram Hunt is in London

J. H. Lidderwood is in London.

L. K. Houlton has gone to Arizona.

E. E. Somermeir is in San Francisco.

S. W. Para is in San Francisco this week.

Milnor Roberts is at Kennett, California.

T. J. Anderson is in New York from Nome.

Samuel W. Cohen was in New York last week.

B. Britton Gottsberger has returned to Miami.

Leo Von Rosenberg is in the Ray district, Arizona.

H. P. Henderson is now at 66 Broadway, New York.

Edmund Juessen has returned from western Arizona.

W. H. Aldridge is expected in New York December 10.

Thomas H. Leggett has been in San Francisco this week.

C. S. Herzig sailed for London on the *Lusitania* December 3.

F. Danvers Power was in New York and has gone to London.

Walter Currie will go to London from Bulawayo, Rhodesia, in January.

Ralph Arnold is returning from Venezuela and will be in New York today.

S. E. Bretherton spent last week in Shasta county on professional business.

A. J. Eveland will be in Colorado and Utah on professional work until the first of the year.

E. J. Schrader has been examining the property of the Brunswick Con. M. Co., near Empire, Nevada.

G. B. Lantz sailed last Thursday for the Philippines to accept a position with the Colorado Mining Company.

T. H. Oxnam, of Los Angeles, was in San Francisco this week attending the funeral of his brother, Charles Oxnam.

Leonard A. Baxter, of London, has gone to Northern Nigeria to take charge of the properties of the South Bukeru company.

H. Clarkson Fletcher, of Johnson & Fletcher, Bulawayo, Rhodesia, is in London and expects to remain there about three months.

Stanley C. Sears, consulting mining mining engineer and metallurgist, has opened an office at 705 Walker Bank building, Salt Lake City.

Robert C. Sticht, general manager for the Mt. Lyell Mining & Railway Co., Tasmania, will leave Melbourne, Victoria, in January for an extended tour of the world.

R. H. Richards has gone to Indianapolis in connection with the Wilfley table litigation. He recently gave the mining department of the Massachusetts Institute of Technology a hindered settling open-spigot classifier.

W. A. Farish, Jr., has succeeded M. Brown, of the firm of Miller & Brown, and will take an active part in the affairs of the new firm of chemists and metallurgists, which will be known as the Miller-Farish Co., with headquarters at 532 Commercial street, San Francisco.

Obituary

John McMahon, a former prominent mine operator of the San Juan district, Colorado, died in Los Angeles on November 16. He was born in Orange county, New York, and come in 1874 to Georgetown, Colorado, becoming associated with the Pelican-Dives mine. In 1876 he journeyed by horseback from Denver to Lake City, going by way of Cañon City, Salida, Poncho Pass, and Del Norte. In the fall of 1877 he undertook the management of the Aspen mine at Silverton and remained in charge until the following spring; from there he went to Leadville and returned to Lake City. He was appoitned special deputy to take charge of the notorious criminal Packard in 1884 and shielded him from the hands of mobs bent upon lynching. At various times he was in charge of some of the famous producers of the San Juan district, including the Humboldt in 1902. He was an honest man in his dealings, was fearless in his duties, and was held in highest esteem by all.

Decisions Relating to Mining

Free Use of Timber on Mineral Lands

A new set of instructions, under date of March 25, 1913, has been promulgated by the Secretary of the Interior with reference to the cutting of timber on public mineral lands. Anyone interested may read them in full in the advance pages of Volume 42, Land Decisions, page 30.

Mining Coal on Property Line.—Penalty

Where a statute provides a penalty of $500 to be paid by any person mining coal within five feet of the property line of another, in order to recover this penalty in an action at law it is unnecessary for the plaintiff to prove that he suffered any damage if he is able to show that defendant has mined coal within the prohibited space.

Selvey *v.* Grafton Coal & Coke Co. (West Virginia), 79 Southeastern, 656. Sept. 23, 1913.

Homestead Entry of Mineral Land

Where a homestead entryman made final proof and received a patent to his land after five years residence, and some eighteen months after receipt of patent made a coal lease thereon to prospectors who eventually developed a profitable coal mine on the property, the agricultural patent will not be canceled at the government's suit, in the absence of a showing of positive fraud on the part of the entryman, or the existence of such a state of facts as would have indicated reasonable probability, at the time final proof was made, that the land was more valuable for mineral than for other purposes.

United States *v.* Kostelak (Montana), 207 Federal, 447. August 4, 1913.

Mining Lease—Removal of Machinery

A mining lease contained a covenant that if there were any arrearages in royalties, machinery placed on the land by the lessee should not be removed without the lessor's consent. The lessee assigned his lease and in the assignment stipulated that his assignee should not be bound by the terms of the foregoing covenant. It was held that the lessor, not being a party to the assignment, was not bound by this stipulation, and, royalties being in arrears, could enjoin the removal of machinery placed on the land.

Freeman *v.* New Jersey Portland Cement Co. (New York), 207 Federal, 699. Sept. 16, 1913.

Cancellation of Patent

On application for a patent for six mining claims adjoining each other and lying lengthwise along a river in a forest reservation, notice was sent by the register to the superintendent of the reservation, who caused an examination to be made, and as a result there was filed in the General Land Office a letter from the acting forester, enclosing reports from the state geologist and a forest ranger, and recommending that a patent be denied on the ground that the claims were held for water-power and not for mineral purposes. The report of the geologist was to the effect that the claims contained very little ore and were of no commercial value for mining purposes, but were very valuable for the water power thereon. Three weeks after the filing of such papers a patent was issued to the applicant. It appeared that no hearing was had upon the protest of the forester, probably because it erroneously stated that no patent for the claims to which it related had been applied for. Held that, if the facts on which it was based were established, they would constitute grounds for refusing a patent, and that whether it was not considered through inadvertence, or whether, through mistake of law, it was deemed insufficient, the United States was entitled to a cancellation of the patent, that such questions of fact might be determined by the land department.

United States *v.* Lavenson *et al.*, 206 Federal, 755. June 13, 1913.

The Metal Markets

LOCAL METAL PRICES

San Francisco, December 11.

Antimony	10—10½c	Quicksilver (flask)	$40
Electrolytic copper	15½—15¾c	Tin	41—42½c
Pig lead	4.25—5.25c	Spelter	6½—6¾c

Zinc dust, 100 kg. zinc-lined cases, 7¼ to 8c. per pound.

EASTERN METAL MARKETS.

(By wire from New York.)

NEW YORK, December 11.—The copper market remains dull. The production of the Braden company for November is reported at 1,592,000 lb.; Arizona Copper Co., 2,800,000 lb.; Cananea Consolidated, 3,150,000 lb., and Mason Valley, 1,174,000 lb. Report from Lake Superior region states that fighting took place at Houghton yesterday between the striking miners and strike-breakers in which citizens of the city helped the authorities to arrest the strikers and troublemakers. The lead market is weak and spelter quiet. The stocks are generally quiet, with but few changes and little trading being done.

SILVER

Below are given the average New York quotations, in cents per ounce, of fine silver.

Date.		Average week ending	
Dec.	4 ... 57.75	Oct.	29 ... 59.98
"	5 ... 58.37	Nov.	5 ... 59.52
"	6 ... 58.62	"	12 ... 59.62
"	7 Sunday	"	19 ... 59.26
"	8 ... 58.50	"	25 ... 58.20
"	9 ... 58.25	Dec.	3 ... 57.22
"	10 ... 57.87	"	10 ... 58.23

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	56.25	63.01	July	60.67	58.70
Feb.	59.06	61.25	Aug.	61.32	59.32
Mch.	58.37	57.87	Sept.	62.95	60.53
Apr.	59.20	59.26	Oct.	63.16	60.88
May	60.88	60.21	Nov.	62.73	58.76
June	61.29	59.03	Dec.	63.38	....

COPPER

Quotations on copper as published in this column represent average wholesale transactions on the New York market and refer to electrolytic copper. Lake copper commands normally from 1-5 to 1-4c. per lb. more. Prices are in cents per pound.

Date.		Average week ending	
Dec.	4 ... 14.13	Oct.	29 ... 16.55
"	5 ... 14.13	Nov.	5 ... 16.25
"	6 ... 14.13	"	12 ... 15.54
"	7 Sunday	"	19 ... 15.08
"	8 ... 14.13	"	25 ... 14.62
"	9 ... 14.13	Dec.	3 ... 14.41
"	10 ... 14.13	"	10 ... 14.13

Monthly averages.

	1912	1913.		1912.	1913.
Jan.	14 0	16 54	July	17.19	14.21
Feb.	14.0	14.95	Aug.	17.49	15.42
Mch.	14.	14.72	Sept.	17.56	16.23
Apr.	15.74	15.22	Oct.	17.32	16.31
May	16.03	15.42	Nov.	17.31	15.08
June	17.23	14.71	Dec.	17.37	....

The Copper Producers' Association statement, December 7, shows an increase in production and stocks on hand. The details are as follows:

	Pounds.
Stocks of marketable copper of all kinds on hand at all points in the United States, November 1, 1913	32,566,382
Production of marketable copper in the United States from all domestic and foreign sources during November	134,087,708
Deliveries for consumption, November	48,656,858
Deliveries for export, November	70,667,803
Stock of marketable copper of all kinds on hand and at all points in the U. S., December 1	47,929,429

Recent changes in surplus have been as follows, in pounds:

	Increase.	Decrease.
November 1912	9,419,095	.....
December	19,148,523	.....
January 1913	17,885,770	.....
February	.....	896,134
March	.....	18,032,928
April	.....	28,720,162
May	.....	8,074,883
June	.....	14,569,619
July	690,339	.....
August	.....	15,280,908
September	.....	8,531,043
October	2,773,288	.....
November	15,363,047	.....

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.		Average week ending	
Dec.	4 ... 4.00	Oct.	29 ... 4.35
"	5 ... 4.00	Nov.	5 ... 4.20
"	6 ... 4.00	"	12 ... 4.19
"	7 Sunday	"	19 ... 4.18
"	8 ... 4.00	"	25 ... 4.13
"	9 ... 4.00	Dec.	3 ... 4.15
"	10 ... 4.00	"	10 ... 4.00

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	4.43	4.28	July	4.71	4.35
Feb.	4.03	4.33	Aug.	4.54	4.60
Mch.	4.07	4.32	Sept.	5.00	4.70
Apr.	4.20	4.36	Oct.	5.03	4.37
May	4.20	4.34	Nov.	4.91	4.16
June	4.40	4.33	Dec.	4.20	....

ZINC

Zinc is quoted as spelter, standard Western brands St. Louis delivery, in cents per pound.

Date.		Average week ending	
Dec.	4 ... 5.00	Oct.	29 ... 5.25
"	5 ... 5.00	Nov.	5 ... 5.13
"	6 ... 5.00	"	12 ... 5.09
"	7 Sunday	"	19 ... 5.05
"	8 ... 5.00	"	25 ... 5.08
"	9 ... 5.00	Dec.	3 ... 5.00
"	10 ... 5.00	"	10 ... 5.00

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	6.42	6.88	July	7.12	5.11
Feb.	6.50	6.13	Aug.	6.96	5.51
Mch.	6.57	5.94	Sept.	7.45	5.55
Apr.	6.63	5.52	Oct.	7.36	5.22
May	6.68	5.23	Nov.	7.32	5.09
June	6.88	5.00	Dec.	7.09	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California, being the largest producer The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending					
Nov.	12 ... 39.00	Nov.	25 ... 40.00
"	19 ... 39.00	Dec.	4 ... 40.00
		"	11 ... 40.00

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	43.75	39.37	July	43.00	41.00
Feb.	46.00	41.00	Aug.	42.50	40 50
Mch.	46.00	40.20	Sept.	42.12	39.70
Apr.	42.25	41.00	Oct.	41.50	39 37
May	41.75	40,25	Nov.	41.50	39.40
June	41.30	41.00	Dec.	39.75	....

TIN

New York prices control in the American market for tin since the metal is almost entirely imported. San Francisco quotations average about 5c. per lb. higher. Below are given average monthly New York quotations, in cents per pound.

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	42.53	50.45	July	44.25	40.70
Feb.	42.96	49.07	Aug.	45.80	41.75
Mch.	42.58	46.95	Sept.	48.64	42.45
Apr.	43.92	49.00	Oct.	50.01	40.61
May	46.05	49.10	Nov.	49.92	39.77
June	45.76	45.10	Dec.	49.80	....

Tin statistics for November show an increase of 2630 tons in the visible supply, the largest since May of this year, when the increase was 3888 tons. The total visible now stands at 14,470 tons, and the price at the end of November was £180, compared with 12,348 tons and £226 last year, and 16,630 tons and £204 two years ago. The price has since declined to about £175, or 38c. per pound. According to L. Vogelstein & Co., writing on December 4, the position of tin seems to be quite good and sound, the only unfavorable feature being the larger Straits' shipments. Information to hand is not that the Straits' production is increasing, but that the monthly shipments are swollen by the quantities of ore now being sent to the Straits from Siam, Australia, China, and Africa, to be smelted, instead of going direct to Europe. This material used to be absorbed without appearing in statistics, but now it does so under the head of Straits' shipments. Large Straits' shipments can thus easily create a wrong and bad impression. Considering the position, it is probable that there will again be a gradual decrease in the visible supply and a return to higher prices.

The Stock Markets

SAN FRANCISCO STOCKS AND BONDS

(San Francisco Stock and Bond Exchange.)

December 10.

Listed.	Bid	Ask	Unlisted.	Bid	Ask
E. I. du Pont pfd.	$ 84	—	Natomas Con. 6s	—	50
Unlisted.			Pac. Port. Cement 6s	99½	—
Ass. Oil 5s	$ 75	80	Santa Cruz Cement 6s	—	90
General Petroleum 6s	—	56½			

STOCKS

Listed.	Bid	Ask	Unlisted.	Bid	Ask
Amalgamated Oil	75	77½	Mascot Copper	—	2½
Associated Oil	38	—	Noble Electric Steel	2½	—
Giant	85½	—	Natomas Consol	4	—
Pac. Cst Borax, pfd	85	80	Riverside Cement	50	—
Pacific Crude Oil	—	35c	Santa Cruz Cement	—	45
Sterling O. & D.	—	1.60	Stand. Port. Cement	47½	—
Union Oil	—	56½			

NEVADA STOCKS

(By courtesy of San Francisco Stock Exchange.)

San Francisco, December 11.

Atlanta	$ .09	Mizpah Extension	$ .27
Belcher	.43	Montana-Tonopah	.93
Belmont	7.50	Nevada Hills	.45
Big Four	.10	North Star	.38
Cash Boy	.06	Ophir	.23
Florence	.25	Pittsburg Silver Peak	.38
Goldfield Con	1.50	Round Mountain	.32
Goldfield Oro	.07	Sierra Nevada	.07
Halifax	1.35	Tonopah Extension	1.60
Jim Butler	.69	Tonopah Merger	.55
Jumbo Extension	.08	Tonopah of Nevada	8.00
MacNamara	.08	Union	.15
Mexican	1.22	West End	1.22
Midway	.31	Yellow Jacket	.22

COPPER SHARES—BOSTON

(By courtesy of J. C. Wilson, Mills Building.)

December 11.

	Bid	Ask		Bid	Ask
Allouez	$ 32½	32¾	Mohawk	$ 38½	39
Ariz. Commercial	3¾	4	Nevada Con	14½	14¾
Butte & Superior	27	27½	North Butte	24¼	24¾
Calumet & Arizona	60¾	61	Old Dominion	48	49
Calumet & Hecla	395	400	Osceola	68	70
Copper Range	32½	33	Quincy	54	56
Daly West	2¼	3	Shannon	6	6¼
East Butte	9½	10	Superior & Boston	2½	2¾
Franklin	2½	2¾	Tamarack	28	28½
Granby	68¼	68¾	U. S. Smelting, com.	36½	36¾
Greene Cananea	29¼	29½	Utah Con	8¼	8¾
Isle-Royale	17	18	Winona	1¼	1½
Mass Copper	2¼	2	Wolverine	40	41½

NEW YORK CURB QUOTATIONS

(By courtesy of E. F. Hutton & Co. Kohl Building.)

December 10.

	Bid.	Ask.		Bid	Ask
Braden Copper	7¼	7⅜	McKinley-Dar.	1⅛	1¼
Braden 6s	148	152	Mines Co. Am.	2	2¼
B. C. Copper	2¼	2½	Nipissing	8	8⅛
Davis-Daly	1⅝	1⅞	Ohio Copper	⅜	½
Dolores	2	4	San Toy	15	20
El Rayo	1	2	Sioux Con.	1	1
Ely Con.	1	3	So. Utah	¼	⅜
First Nat.	2⅞	3½	Stand. Oil of Cal.	229	231
Greene Can.	5½	7	Tri Bullion	⅛	¼
Giroux	¾	1	Tuolumne	⅝	⅞
Iron Blossom	1⅛	1¼	United Copper	¼	¾
Kerr Lake	4⅜	4½	Wettlaufer	6	9
La Rose	1⅞	2	Yukon Gold	2	2¼
Mason Valley	3	4			

NEW YORK STOCK EXCHANGE

(By courtesy of J. C. Wilson, Mills Building.)

December 11.

	Bid	Ask		Bid	Ask
Amalgamated	70¼	70½	Nat. Lead	$ 43	44½
Anaconda	34½	34⅝	Quicksilver, com	1	2
A. S. & R.	61¾	62	Ray Con	17⅛	17¼
Calif. Pet.	16⅝	17⅛	Tenn. Copper	29¼	29⅝
Chino	37½	37⅝	U. S. Steel, pfd	104¾	105¼
Guggenheim Ex.	45¾	46	U. S Steel, com.	56⅜	56½
Mexican Pet	44	44⅜	Utah Copper	48½	48½
Miami	21⅝	21¾			

LONDON QUOTATIONS

(By cable, through the courtesy of Catlin & Powell Co. New York.)

December 11.

	£	s.	d.		£	s	d.
Alaska Mexican	1	7	6	Kern River Oilfields	0	6	3
Alaska Treadwell	7	18	9	Mexico Mines	5	7	6
Alaska United	3	5	0	Mosaina	1	8	3
Arizona	1	16	9	Oroville	0	11	
California Amalg.	0	1	3	Pacific Oilfields	0	1	9
California Oilfields	6	0	0	Rio Tinto	71	0	0
Camp Bird	0	13	9	Santa Gertrudis	0	17	1
El Oro	0	15	0	Stratton's	0	2	6
Esperanza	1	0	0	Tanganyika	2	0	0
Granville	0	11	3	Tomboy	1	7	6

AUSTRALASIAN

December 11.

	£	s	d.		£	s	d.
British Broken Hill	1	15	0	Mount Boppy	0	16	9
Broken Hill Prop.	1	13	9	Mount Elliott	4	0	0
Golden Horseshoe	2	15	0	Mount Lyell	1	5	0
Great Boulder Prop	0	13	9	Mount Morgan	3	1	9
Ivanhoe	2	15	0	Waihi	2	15	0
Kalgurli	1	12	6	Waihi Grand Junc.	1	6	3

Western Australian Gold Production

The September gold output of some of the principal mines with dividends paid are as follows, others having been published in this journal of December 6:

Name.	Tonnage.	Value.	Profit.	Dividend.
Great Boulder	18,089	$239,600	$126,100	$328,100
Fenian	2,860	44,500	21,500	.....
Golden Horse-Shoe	28,332	184,400	20,500	.....
Yuanmi	10,380	84,300	17,500	.....
Sand Queen	1,530	29,600	12,000	11,250
Boulder Perseverance	20,868	108,800	11,200	.....
Edna May	1,116	20,300	9,300	.....
Mararoa	2,650	24,500	7,400	25,000
Black Range	3,300	31,500	6,500	.....
Golden Ridge	2,644	22,500	5,500	.....
Mountain Queen	3,081	20,800	5,500	.....
Ida H.	1,403	17,600	5,300	.....
Ingliston Consols	1,940	19,000	4,500	.....
South Kalgurli Consols	9,406	53,600	3,900	.....
Kyara	903	11,600	3,800	.....
Menzies Consols	2,423	22,300	3,600	.....
Boulder No. 1	2,227	6,900	2,900	.....
Great Fingall	5,119	50,200	2,300	.....
Queen of the Hills	2,363	21,500	2,200	.....
Lake View Consols	7,980	7,200	2,000	.....
Burbanks Main Lode	1,888	20,300	1,600	.....
Commodore	750	7,300	1,600	.....

Share trading on the New York Stock Exchange during November totaled 3,725,886 shares, the lowest of any month since May 1897. Monday, November 24, was the dullest day on Wall Street since July 3, 1888, there being only 57,605 shares sold. Bond trading for the month was $33,691,000, the smallest since November 1907. On November 1 there was a shortage of 1842 freight cars on United States railroads, but on November 15 there was a surplus of 22,652 cars. Commercial failures in the country during the last week of the month numbered 356 as reported by R. G. Dun & Co. of New York, against 299 during the second week of the month, and 220 a year ago. The November liabilities total $16,274,809. Gold exports from New York for 11 months amount to $68,996,146, and silver $45,008,638, against $33,277,176 and $52,815,563 respectively in 1912. Imports of these metals total $24,127,486 and $9,982,220 in 1913, and $27,596,325 and $9,136,456 in 1912.

Gold movements in Great Britain from January to October, inclusive, were as follows:

	Imports.	Exports.
Unrefined gold	£39,571,189	£ 965,824
Bar gold, refined	95,658	20,918,215
Sovereigns	10,135,966	17,752,357
Foreign gold coin	40,247	602,496
Total	£49,816,369	£40,238,892

The totals in 1912 were £41,884,763 and £37,222,996, respectively.

Portable Burners

One of the many uses of portable burners is presented in the halftone, which shows the method of heating an end sill of a steel car with a Hauck portable fuel burner, previous to strengthening it. This little apparatus has come into a wide use in iron and steel repair work, and has greatly expedited work which formerly could only be accomplished by sending the broken parts to a well equipped repair shop, often at a distance of many miles. Among the many uses of the portable burner, it has been found to be a most valuable tool for the welding or straightening of locomotive frames and structural steel of

HEATING THE END SILL OF A STEEL CAR.

all kinds, shrinking of pinions on geared locomotives and hoisting engines, shrinking bands on cracked cylinders, straightening shafts and frames, rebabbitting engines, preheating for oxy-acetylene welding, brazing, and numerous other heating purposes. One of the interesting features of the Hauck burners is the clean smokeless flame that can be produced instantly without heating the burner. It is also to be remarked that this burner uses crude oil with better results than gasoline, which insures perfect safety. The ease with which it can be moved from place to place has created a wide field for its use, and it has been found a valuable adjunct in mine and smelter repair work. The apparatus consists of a steel tank of from 8 to 16 gal. capacity, 12 ft. of special oil-resisting rubber horse, 12 ft. of air hose, and the patented Hauck burner, which is made entirely of iron and steel. These burners are being distributed by the Pacific Coast branch of the Hauck Manufacturing Co., with headquarters at 111 Main street, San Francisco.

Commercial Paragraphs

H. W. JOHNS-MANVILLE Co. has opened an office and warehouse at Galveston, Texas.

The A. S. CAMERON STEAM PUMP WORKS reports that a recent addition to the staff of the centrifugal pump department is C. V. Kerr, the organizer of the Kerr Turbine Co., and later with McEwen Bros. of Wellsville, New York. Mr. Kerr delivered an interesting address with stereopticon views on 'A New Centrifugal Pump with Helical Impeller' at the monthly meeting, on November 11, of the American Society of Mechanical Engineers, at their rooms, in New York City.

ASBESTOS PROTECTED METAL Co., of Beaver Falls, Pennsylvania, reports that the Pennsylvania railroad has standardized asbestos protected metal for the enclosing of all buildings using sheet metal roofing or siding except those of a temporary character. Recent orders include a freight station at Harrisburg, freight sheds at Uniontown, dock buildings at Baltimore, Maryland, and pier 29, North river, New York. Asbestos protected metal is manufactured for the Pennsylvania railroad in special colors to match their standard color scheme, which is a buff ground with dark brown trim and relief. The Asbestos Protected Metal Co. is the only producer of colored asbestos felts in the United States at the present time.

The HARDINGE CONICAL MILL Co. reports that the Bunker Hill & Sullivan Mining & Concentrating Co., of Kellogg, Idaho, has ordered two more 6-ft. Hardinge pebble-mills, bringing its total installation to six units of this size. Other orders include two more sectionalized mills for the interior of South America, also two of the largest size 8 ft. by 30-in. mills for the Silverton Mines, Ltd., of Silverton, British Columbia, which company is installing the flotation system.

The DODGE MANUFACTURING Co. has received an order through Mine & Smelter Supply Co. from the National Copper Mining Co., National Station, Idaho, for the following equipment: 360-hp. Dodge American rope drive from motor to jack-shaft, 225-hp. Dodge American rope drive from jack-shaft to Harding conical main line, 180-hp. Dodge American rope drive from shaft to second main line. On the first drive, 260 ft. of Dodge 'Firmus' manila transmission rope will be used in 24 grooves on 72 and 36-in. sheaves. On the second drive, 700 ft. of Dodge 'Firmus' manila transmission rope will be required in 8 grooves for 60 and 81-in. sheaves. On the last main drive, 850 ft. of Dodge 'Firmus' rope is specified for 6 grooves on 60 and 81-in. sheaves.

Catalogues Received

SULLIVAN MACHINERY Co. Bulletin 66-H, 'Sullivan Rock Drills.' 55 pages. 6 by 9 inches. Illustrated.

A. LESCHEN & SONS ROPE Co., St. Louis. Catalogue. 'Leschen's Hercules.' 11 pages. 8 by 10 inches. Illustrated.

THE WM. POWELL Co., Cincinnati. Leaflet, 'The Union Composite Disc Valve.' 2 pages. 6¼ by 9½ inches. Illustrated.

NATIONAL TUBE Co., Pittsburgh, Pennsylvania. Leaflet, 'The Kewanee Air Pump Union.' 4 pages. 5 by 7½ inches. Illustrated.

NATIONAL TUBE Co., Bulletin No. 16, 'National Stationary and Marine Boiler Tubes.' 7 pages. 8½ by 11 inches. Illustrated.

CHICAGO PNEUMATIC TOOL Co. Bulletin No. 148, 'Hand Drills and Portable Compressors.' 15 pages. 6 by 9 inches. Illustrated.

NATIONAL TUBE Co. Bulletin No. 17, 'The Manufacture and Use of Shelby Seamless Steel Tubing.' 39 pages. 8½ by 11 inches. Illustrated.

THE HARDINGE CONICAL MILL Co., 50 Church street, New York. Catalogue No. 6, 'Hardinge Conical Mill.' 20 pages. 6 by 9 inches. Illustrated.

SULLIVAN MACHINERY Co., 122 South Michigan avenue, Chicago. Catalogue No. 68, 'Sullivan Stone Channelers.' 78 pages. 6 by 9 inches. Illustrated.

GOLDSCHMIDT THERMIT Co., 90 West street, New York. Pamphlet No. 12, second edition, 'The Thermit Process of Rail Welding.' 23 pages. 6 by 9 inches. Illustrated.

THE MCKIERNAN-TERRY DRILL Co., 233 Broadway, New York. Catalogue, 'Rotating Hammer Drills for Sinking, Stoping, and Drifting.' 11 pages. 6 by 9 inches. Illustrated.

CHICAGO PNEUMATIC TOOL Co., Fisher Building, Chicago. Bulletin No. 34-T, 'Class M Chicago Pneumatic Corliss Type Steam Driven Compressors.' 10 pages. 6 by 9 inches. Illustrated.

GENERAL CHEMICAL Co., 25 Broad street, New York. PACIFIC FOUNDRY Co., 18th and Harrison streets, San Francisco. Catalogue, 'The New Herreschoff Furnace for Roasting Ores.' 10 pages. 7 by 10 inches. Illustrated. A description of the operation of these furnaces appeared in this journal of November 1.

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EDITORIAL

LOWERING the water-level in the old Consolidated Virginia property on the Comstock from the 2500 to the 2700-foot level has been commenced by the United Comstock Pumping Association, of which Mr. W. C. Ralston is now president. This, it is hoped, will result in proving that there is such a thing as a mine 'coming back.'

MAKING proper outfitting for Alaskan trails a subject of government supervision, as recommended by Mr. George C. Hazelet in his report to the Cordova Chamber of Commerce, would undoubtedly result in minimizing the perils and hardships experienced by many on the Alaska trails. Whether the annual fatalities recorded are due to the ignorance of the 'cheechaco' or the overconfidence of the 'sourdough', such a regulation, acting as a safeguard on both, would be most effective. As pointed out in the article on 'The Glacier Trail to Shushana,' the method has been proved a success by our Canadian neighbors.

SMELTING complex sulphide ores so as to save all the metals has not heretofore been possible. At best, only a part of the zinc or of the silver and copper could be recovered where the three metals occurred together. On another page Mr. E. W. Hale, chief chemist for the Continuous Zinc Furnace Company, presents results of work done at Hartford, Connecticut, which, while accomplished on a small scale, is significant of possible results of wide interest in the West. The company with which Mr. Hale is connected is now building a three-ton furnace and is preparing to demonstrate that equally good results can be accomplished on a larger scale.

THE Order of Carabao, with its good ships *Fellowship*, *Friendship*, and *Piffle*, which were recently subjected to a broadside from the President, has voiced widespread sentiment among those familiar with Philippine affairs, as to the present policy toward the Islands. While time alone can prove the wisdom of the extremely liberal policy now in vogue, a large percentage of those who have, by years of association, come to know the native, are by no means optimistic as to the result of our present course. If the Filipino is capable of self-government, he should have it; if he is not, and such seems to be the verdict of that part of the army and navy which has been struggling with the Philippine problem in the field, it will have been a decided mistake to allow the solid foundations of good government, which have been established there, to become weakened.

AT the request of Mr. C. E. van Barneveld, chief of the department of mines and metallurgy of the Panama-Pacific exposition, Mr. Thomas T. Read will act as Eastern representative of the department. Intending exhibitors and others interested are invited to consult with Mr. Read regarding plans.

THE Sherman anti-trust law has found a new application in its relation to the coal-miners' strike in Colorado. A federal grand jury has recently returned indictments against the officials and members of the striking miners' organization for violating this law by organizing a conspiracy in restraint of trade. The attempt of the Secretary of Labor, Mr. W. B. Wilson, to bring about a renewal of settlement negotiations, is reported to have met with but little favor on the part of the operators, as was to be expected since his recent utterances have discouraged belief that an unbiased arbitration could be had at his hands.

GIFT of the sum of $1000 per year for ten years to the University of California by Mr. F. W. Bradley of the class of 1886, is for the purpose of aiding students in the College of Mining whose records and ability "seem to promise that they will be of material service in development of the mining resources of the state." Aid is to be given through loans, and repayments and interest, which is to be charged after graduation, are to be added to the original fund. If this gift proves the means of bringing into the industry even a few such men as its donor, it will have proved well worth while, and Mr. S. B. Christy, dean of the College, is to be congratulated upon this evidence of support and esteem among leaders of mining.

UNITED STATES Geological Survey reports on the mineral production for the calendar year of 1912 shows the output for the period to have been the largest in the history of the industry. The total was valued at $2,243,630,326, which is an increase of $316,098,198 over that of the preceding year. With few exceptions the year was a record one in all branches. The increase in the production of copper is the most notable, the total being 1,243,268,720 pounds valued at $205,139,338, as compared with $1,097,232,744 pounds in 1911, valued at $137,154,092. Comparing the statistics for the past 25 years shows that, while there have been periods of comparative depression, the general tendency has been upward, and in spite of occasional predictions to the contrary, the mineral industry is far from decadent. It is reasonable to suppose that the limit of production and exhaustion of resources is a matter still of many years to come.

COAL-MINING fatalities in the United States during the first nine months of the present year, according to statistics collected by the Bureau of Mines, numbered 1843. These figures, made public at a time when the Bureau of Mines is making an effort to expand its scope of operations and render a greater service in the cause of mine safety, are particularly significant and add weight to the President's recently expressed opinion that "the Bureau of Mines ought to be equipped and empowered to render even more effectual service than it renders now, in improving the conditions of mine labor and making the mines more economically productive as well as more safe. This is an all-important part of the work of conservation; and the conservation of human life and energy lies ever nearer to our interest than the preservation of our material resources."

METAL production of Mexico for the month of July as indicated by the export statistics compiled by the Mexican government, show a decrease of ₱2,837,246 as compared with the same month of the preceding year. Of this amount ₱96,000 was exported as coined gold. The total gold exported shows an increase of ₱354,787; while the silver exports showed a decrease of ₱708,245. The value of the silver bullion exported during July was ₱5,064,-111. The copper exports for July were valued at only ₱2,184,308, which is a decrease of ₱3,463,779 as compared with the same month of 1912. Among the other mineral exports antimony declined ₱250,-555, lead ₱49,495, and zinc ₱31,190; while asphalt showed an increase of ₱84,721 and petroleum an increase of $1,237,949. The total mineral exports during July showed a decrease of ₱2,837,246 as compared with the month of July 1911. These figures do not include exports made through ports in the hands of the rebels.

SHAREHOLDERS' interest in a strike is one phase of these industrial turmoils not generally considered as important by those who see only one side of the question at issue; namely, the desirability of shorter hours and higher wages. However, when it is realized that for the millions that have been taken from mines and paid in dividends there have been other millions put into mining investments and which have resulted in nothing more tangible than beautifully engraved stock certificates, it seems equitable that those who are taking the chances and making possible the comparatively small number of successful mining enterprises should be conceded to have some interest in the matter at issue. In the present strike in the Lake Superior copper region it has been estimated that the loss to shareholders will amount to almost $5,000,000 in this year's dividends alone. In addition there is also the loss due to the irregularity of operations as at present conducted, with its accompanying increase in production cost. If the shareholders should go on a strike for higher dividends and so tie up the mines, would their demands often be met by the miners?

LOUD outcry is frequently heard over the absorption of profits in mining, railway, and industrial enterprises by the financial houses that market their securities. The history of the New York, New Haven & Hartford railroad, recently published, shows that the relation is one that is capable of being abused. At the same time there is no denying the truth of the statement that "persons who decry the close relations existing between the bankers and the great transportation and industrial businesses fail to perceive that, as individuals require the advice of lawyers and physicians, so great enterprises require

financial diagnosticians who can give counsel as to the world's investment markets, as to what form of securities is best adaptable for any given time, as to what financial policy for the corporation is best calculated to command the confidence and the steady support of the investor," made in an open letter to the Pujo committee by J. P. Morgan & Company. Most enterprises that fail, and we include mining companies, do so because they are not soundly financed. Too much or too little capital is put into them, or the ratio of capitalization to earning power is wrongly estimated. We are constantly asked to assist someone having a mining property to find capital, and in the great majority of cases even a brief examination of the papers submitted shows that the business end of the project is unsound. It is regrettable that there is so much popular prejudice against bankers and others to whom the public should turn for advice in financial matters. The whole matter of currency reform could be easily settled if there was a sound public confidence in the disinterestedness of some of the extremely competent men who are offering advice. However, one or two such artistic jobs of wrecking and manipulation by the 'best people' as in the case of the New Haven, account for a mountain of prejudice.

Safety and Health First

In many of his writings, but especially in his 'Data of Ethics', Herbert Spencer has clearly indicated the total change brought about in human relationships when society advances from that stage in which war is a normal state to our present level in which war is a deplorable evil to be avoided so far as possible. With this advance comes a sweeping change in the whole viewpoint of mankind, and such great readjustments in the relationships of men to each other that we are only just coming to realize their full extent and importance. To forward-looking men, one of the most encouraging signs of the times and evidences of marked progress is the first International Safety and Sanitation Congress, held, under the auspices of the American Museum of Safety, in New York on December 10, 11, and 12. The subjects discussed were industrial accidents, accident prevention and the public, industrial hygiene, employer and employee, and the coming generation. Nearly a hundred speakers were heard, representing such large and important organizations as the Pennsylvania railroad, United States Steel Corporation, the General Electric Company, United Gas Improvement Company, Interborough Rapid Transit Company, Travelers Insurance Company, the National Consumers League, Carnegie Steel Company, Illinois Steel Company, New York Central Railroad, United States Department of Labor, Wanamaker's, Ohio State Department of Health, New York Industrial Commission, Illuminating Engineers Society, Brotherhod of Railway Trainmen, Industrial Relations Commission, Women's Trade Union League, National Association of Corporation Schools, Public Service Corporation of New Jersey, Pennsylvania Commission of Labor and Industry, New York City Bureau of Fire Prevention, and others too numerous even for mention. That such a variety of organizations does not argue a lack of unity of purpose was well brought out by Miss Leonora O'Reilly, who, speaking for the Women's Trade Union League, and with a force and fluency characteristic of her race, classified mankind into the working and the loafing classes, and pointed out that work is a natural expression of human energy and that the needs and aspirations of workers of all grades are fundamentally the same. On such a happy basis of unity the discussions proceeded, bringing out with clearness the modern viewpoint that in well conducted industry the energies of the worker must be released from combatting unfavorable conditions and employed only on useful and productive forms of work. The idea that the necessary risks of industry must be borne by the industry itself, and not shifted upon the worker or society in general, is now so widely accepted and has been so generally incorporated into recent legislation, that further discussion is unnecessary, except in so far as it relates to devising and improving methods of decreasing the risk and of carrying its burden. Thus Dr. W. Irving Clark, of the Norton Company, told of the good results attained through the preliminary and periodic medical examination of all workmen, whereby fewer accidents and less loss of time per month were benefits secondary to the fact that workmen suffering from hernia and heart disease were prevented from injuring themselves. Similar examinations are now the rule with many of the mining and smelting companies, the American Smelting & Refining Company, for example. An interesting feature of the work of the Illinois Steel Company is the employment of 'plant preachers,' who talk interestingly on the subject of accident prevention to their fellow-workmen during the lunch hour. The result of this and numerous other devices has been the saving from injury and death of many good men since 1906, corresponding to a decrease of 46 per cent in the number of accidents. The important effect of light on accidents is shown by the fact that in some lines of industry the number of accidents at night is double that in the daylight hours. The extra cost of illumination is often repaid by the more effective work thus rendered possible, making the saving in accidents clear gain. Ventilation is almost equally important, though a better understood subject, yet here also marked advance is still possible. The beneficial effect of pleasant surroundings has been so clearly demonstrated in the case of some companies which have surrounded their plants with recreation grounds and gardens, that it has been found worth while to lengthen the lunch period to 1½ hours so as to afford time for reaping the full benefits. This is not charity, it is good business, and yet it is also justifiable and commendable on highest grounds of humanitarianism. It is impossible to treat the subject more at length here, but we hope to give, later, some accounts of what has and can be done by mining companies. Plans are maturing for the consideration of work of this sort by the American Institute of Mining Engineers, and we are sure that much of benefit to employer and employee alike will result from its careful consideration.

The Rand Banket—Part VI Continued

By C. B. Horwood

The Distribution of the Gold.

(e) *Black-Edged Pink, and Milk-White Pebbles.*—About six and a half years ago, at the Star section of the Consolidated Langlaagte mines[296] the writer first particularly noticed white, gray, or bluish-gray black-edged lustrous quartz pebbles in the banket.

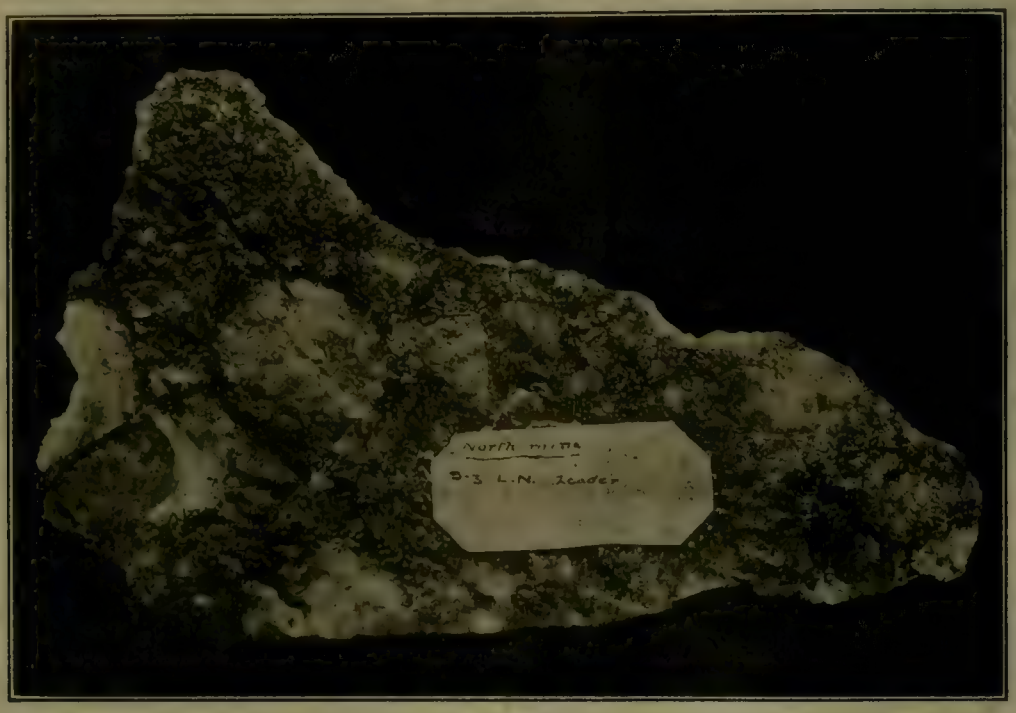


Fig. 28.

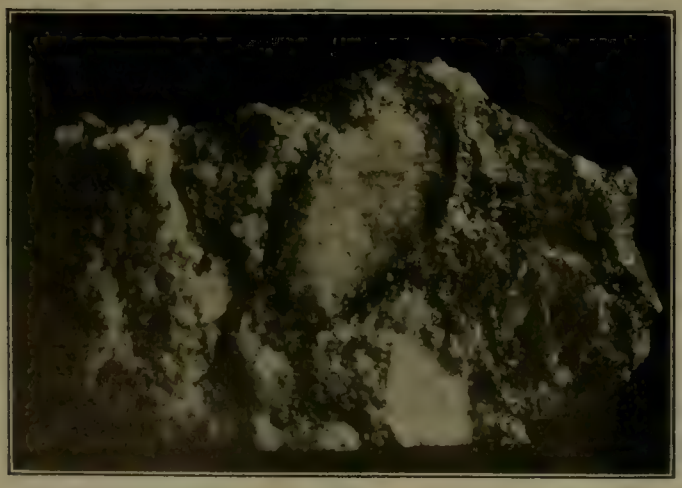


Fig. 29.

In these mines the South Reef series consists of either two or three leaders, generally three. There is an upper one varying in thickness from 8 or 10 in. to 18 or 20 in.; a middle one varying from about 3 to 5 in.; and a lower one varying from a single line of pebbles up to 2 to 6 in. thick. These layers of banket are separated from each other by a few inches of intervening quartzite.[297] The narrow lowest seam, as it carries nearly all the gold, is the profitable member of the series, and is known as the South Reef Leader. When typically developed as a single-pebbled layer the pebbles may be adjacent, or nearly so, but they are often one or two, up to as much as 5 in. apart; occasionally, they may be even a foot or two, or more, apart. Indeed, in the face of development drives[298] the banket is sometimes only represented by two or three pebbles; and sometimes no pebbles are to be seen, in which case one may be only able to judge from the appearance of the quartzite whether the face of the drive contains the line of the lode or not. This is often possible, by careful observation, because, as a rule, the South Reef Leader occurs in a dense black crystalline quartzite, and there is usually a sharp line of demarcation between this black quartzite and

[296]These mines are at Langlaagte, a township about 4 miles west of Johannesburg.

[297]This series, as it occurs in these mines, has already been described in the first part of this paper.

[298]The dip in these mines is about 35°. In advancing the

the whitish, comparatively soft foot-wall quartzite on which it rests. When present, the Leader generally rests immediately on, or, at the most,

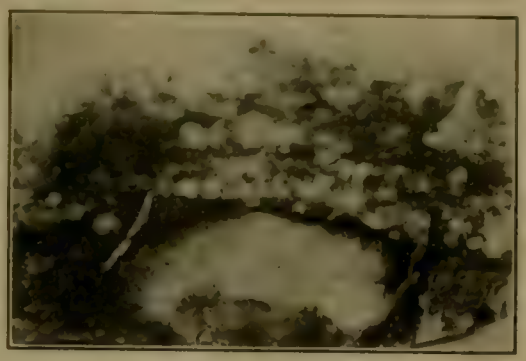


FIG. 30.

lies not more than a few inches above this whitish quartzite, which forms the foot-wall. When absent or represented merely by an occasional pebble, it is quite an easy matter for the line of the banket to be missed either in development work or in actual stoping. Thus the careful study of its characteristics, especially in mines where it is poorly developed, is of the utmost importance, since it is the main gold-carrier of this series;[299] and any peculiarity or distinctive feature that helps to distinguish it from other 'reefs' becomes valuable. In these particular mines its pebbles have well rounded contours; some are spherical in section; but a large number, probably the majority, are oval or oblong, and have their longer axes parallel to

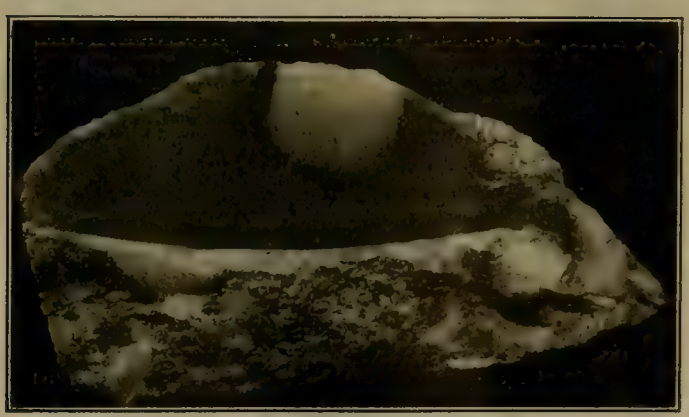


FIG. 32.

the dip of the strata; many are like the flat oval pebbles so frequently found on sea-beaches at the present day and give one the impression that they have not traveled far.[300] They vary greatly in length, from less than half an inch up to about 2 inches in greatest diameter. They are mostly translucent crystalline lustrous quartz pebbles, light to dark-gray or bluish-gray in color; in some of these the outer circumferential portion is black, forming a black edging; a few consist of black crystalline lustrous quartz; there are occasional amorphous milk-white quartz pebbles; also occasional rather resinous-looking pebbles which by candlelight underground exhibit a slight pink tinge.[301] In thin section under the microscope the latter were found by the writer to consist of quartzite. Long practical experience on these mines has proved that these pink resinous-looking pebbles in particular,[302] and also the black-edged quartz pebbles are an indication of good ore. This being so, it seemed to the writer that their color must, in some way, be connected with the agencies to which the bankets owe their gold.

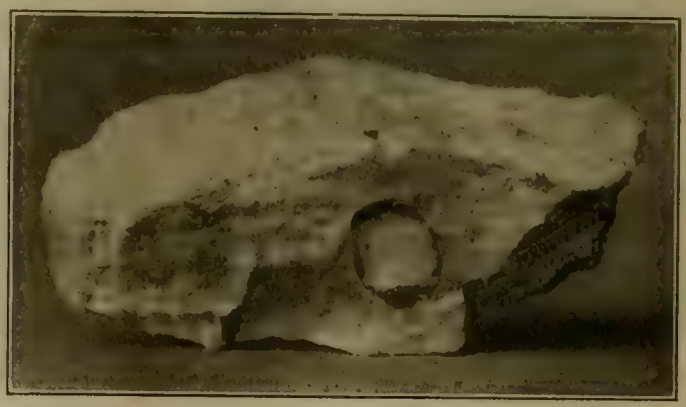


FIG. 31.

Origin of Black-Edged Pebbles

With regard to the origin of the black-edged pebbles, the writer soon observed that pebbles occurred in all stages from white to black. The gradations pass from pebbles with just a mere thin outer layer of black to those in which this layer is thicker; and, again, from these to pebbles that are almost entirely black except for a small white central portion; lastly come pebbles that are entirely black. Therefore, one of two processes must have taken place; either these pebbles were originally all black, and were finally converted into white pebbles through some process of decoloration that started from the centres; or they were originally white and the pro-

drives, which are usually about 6 ft. wide, it is customary to do so in such a way that the bottom of the banket it is intended to exploit is at about the height of a man's shoulder on the foot-wall side of the drives; so that when stoping begins the broken ore can be gravitated into the trucks in the drives below the stopes. [The word 'drive' as used by the author is the equivalent of the technical term 'drift.'—EDITOR.]

[299]Even when no pebbles are present, the line of the lode generally carries gold.

[300]This is rather exceptional; in most of the mines on the Rand the quartz pebbles are not flattish, but are very well rounded.

[301]It is seldom that these pebbles exhibit a pink tinge by daylight. When brought to the surface they appear a dirty yellow color.

[302]A. D. Bacon, formerly general manager of the Langlaagte Estate mines, informed the writer that his experience on those mines proved conclusively that these resinous-looking pink pebbles were an infallible sign of good ore.

cess of converting them into black ones has proceeded from the circumference toward the centre. It seems impossible to imagine how the first could have operated. It is sufficiently difficult to account for the physical conditions under which the second could have taken place. It has been shown that pyrite has replaced quartz in the pebbles and that

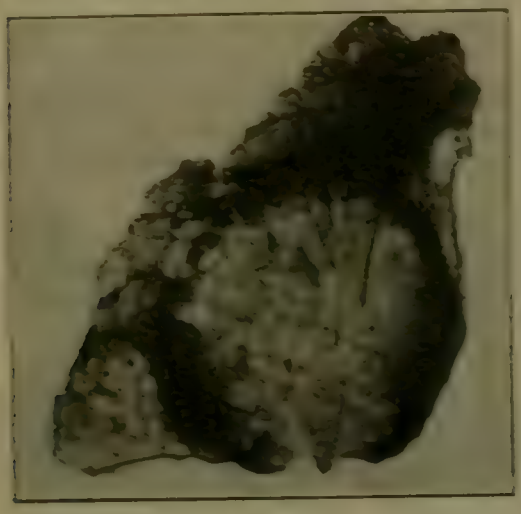


Fig. 53.

carbon has also to some extent done the same. The latter is capable of producing a black coloration. Probably also the former, and possibly even[1] manganese compounds and other elements, if in a sufficiently finely divided state may be capable under certain conditions of staining the quartz of the pebbles by being diffused through it either by replacing portions metasomatically in an extremely finely divided state, or by actually penetrating it without replacement or by insinuating itself between the in-

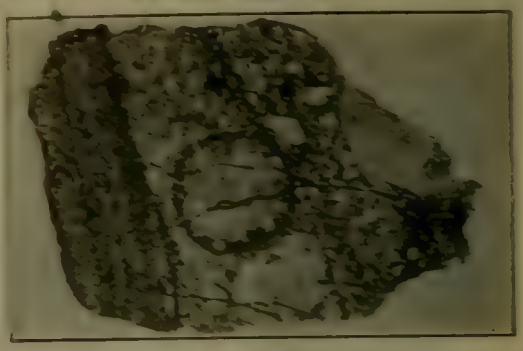


Fig. 54.

finitesimal irregular crystals of which it is composed. The higher the temperature of the solution (either liquid or gaseous) containing any of these elements, and the greater the pressure the more would be the physical and chemical activity and therefore the

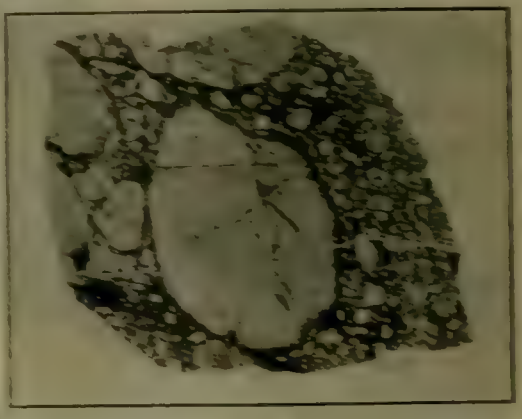


Fig. 55.

greater the [illegible] of the [illegible] more such changes would take

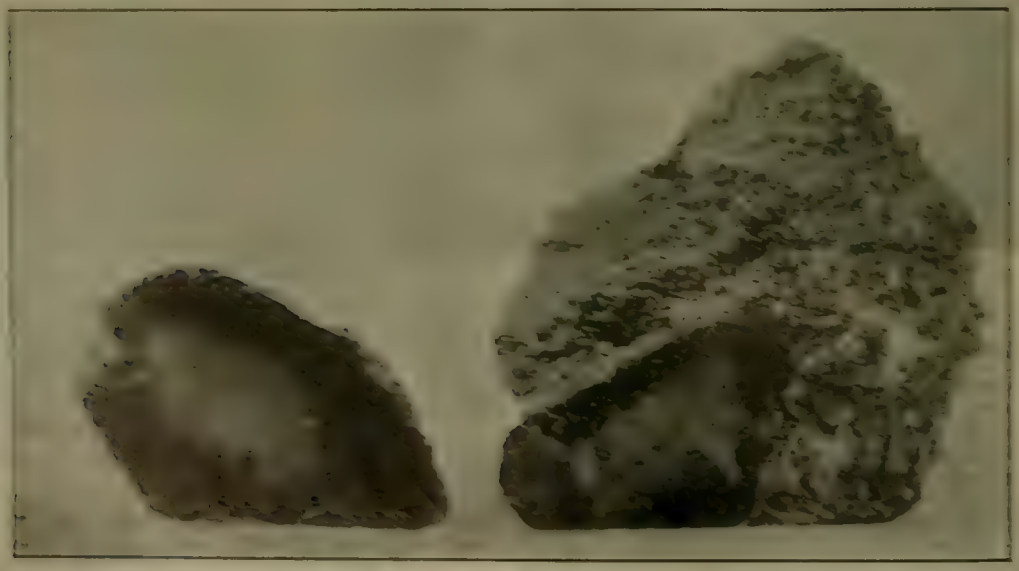


Fig. [illegible]

[1] Here it is interesting in connection with the black pebbles mentioned in some few of the sections to recall that a pure sulphate as in solution in connection with to transform gold with a similar blackish tinge. (See Ross Prentice) and also "The Bromide of Potassium Method" and Geology" by W. A. Ross (1912 published by Ontario Government & Son. In this process a certain salt is employed and gold is coated with lead or sulphuret for as practiced in these old books.

Later the writer studied the occurrence of similar pebbles at the Rietfontein mines, situated some 12 miles farther east. Here also he noticed that pebbles could be found in different stages from white lustrous quartz with a well defined black edge up to an entirely black lustrous quartz pebble. Quartzite pebbles with a pink tinge also occur, and experience showed that both were indications of good ore. Amorphous milky-white quartz pebbles are found, and they too are a sign of good ore. From the mode of occurrence of the latter there can be little doubt that they were originally translucent white crystalline quartz pebbles that have undergone subsequent alteration.[304] At the Rietfontein mines the writer sometimes noticed, near a dike, a change from the ordinary white lustrous crystalline pebbles to these amorphous milky-white quartz pebbles. Further, he has constantly noticed underground that where rock is shattered by blasting the ordinary lustrous light

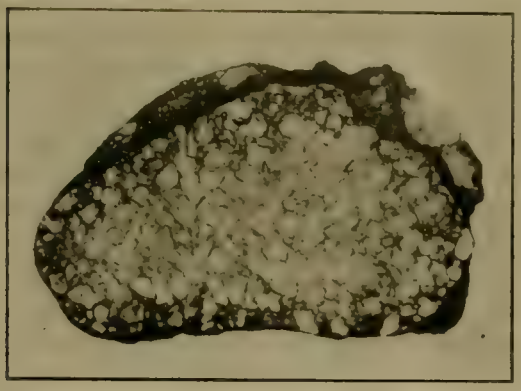


FIG. 37.

FIG. 38.

or dark-gray or bluish-gray pebbles are changed to amorphous milky-white ones.

Still later the writer studied the occurrence of pebbles similar to those described in the lodes of the various Randfontein mines, which are 20 miles west of the Consolidated Langlaagte. There again he found that practical experience proved that the pink pebbles, black-edged quartz pebbles, and black lustrous crystalline quartz pebbles are invariable signs of good gold contents. As at the Consolidated Langlaagte the black-edged quartz pebbles are a distinctive feature of the lode known as the South Reef Leader, so at the Randfontein mines black-edged quartz pebbles are one of the chief characteristics, particularly when the ore is rich, of that lode known as the Randfontein Leader,[305] which is the gold-bearing member of the series in which it occurs.

Pink Tinged Pebbles

Attention was first directed to these black-edges by the writer in 1910. At the same time he also called attention to the presence of pebbles with a pink tinge and to their close association with good ore.[306] Fig. 28 to 32 show the appearance of these black-edged pebbles. In Fig. 28 and 29 the outlines of the black-edged pebbles do not appear well defined, although they are clear in the original specimens. This is owing to the high-lights in the potographs. Fig. 29 is of a specimen that illustrates well the association of these pebbles with high-grade ore, as the other side of the specimen contains much gold, which is present in such a way as to remind one of the way butter is often smeared over bread. Fig. 30 is of one of these pebbles, about 3 in. long, from a thin 'leader,' underlain immediately by a dike, in the western section of the New Rietfontein mines. Fig. 31 shows a typical black-edged pebble from a drive; the pay leader has here so diminished in size that it is represented merely by this one pebble. Fig. 32 is a splendid example of a black-edged quartz pebble. A slice has been cut from this pebble, leaving a polished surface that helps to bring out the black edge of the pebble in sharp relief. Around the left side of this pebble there is a heavy edging of pyrite, which in the specimen, with the aid of a good magnifying glass can be seen embaying and fretting, and some of it enclosed in, the black circumferential portion of the pebble. This can even be seen in the figure with a strong magnifying glass.

Sections of Pebbles

The writer had many thin sections cut of these black-edged pebbles; and some of these are shown in Fig. 33, 34, and 35, from photographs in which they are all considerably enlarged from the original slides. Fig. 33 is of a thick section (varying from $^1/_{32}$ to $^1/_{16}$ in. thick), mounted on a slide without a cover-slip. It shows the black edge very distinctly. Fig. 34 and 35 are of two sections mounted in the ordinary way for examination under the microscope; they show the black edging of the pebbles very well,

[304] For example, at the Star mine in the Main Reef Leader, on No. 3 level, where the ground was disturbed and faulted, the writer found in one place right in the faulted ground, and where waters were still circulating, that some of the pebbles were milk-white and amorphous, and that others occurred in various intermediate stages between this and entirely translucent and crystalline forms. The occurrence was such as to suggest that the amorphous milk-white pebbles had originally been ordinary translucent crystalline white pebbles, and that the alteration was due to dynamic or chemical causes, or perhaps to a combination of both.

[305] The Randfontein Leader on this part of the Rand is the representative of, and can be correlated with, the South Reef Leader.

[306] 'The Mode of Occurrence and Genesis of the Carbon in the Rand Banket,' by C. B. Horwood, *loc. cit.*, pp. 67 and 74.

and also the surrounding matrix of the basket, and examination under the microscope indicated that the coloring matter had in the first place worked inward from the circumference by insinuating itself along the edges of the irregular interlocking granules of which the quartz mosaics of the pebbles consist and had then in places, diffused through the quartz itself. The writer was unable, however, even with a high power oil immersion lens to determine the dark dusty coloring matter. Fig. 36 shows, in enlarged form, two opposite ends of one of these pebbles, from the central portion of which five thin complete slices (right through it) were cut and mounted for microscopic examination. The black margin is distinct in this figure and the way it spreads inward, like the ragged edge of a black cloud is clear. In the one on the left, on the side nearest the edge of the plate the way the pigment works round and between the granules can be seen, and also how it then diffuses inward toward the central portions of the individual granules. Figs. 37 and 38 are of photographs taken by transmitted light of two of the thin sections cut from the black-edged pebble shown in Fig. 36 and mounted on glass for examination with the microscope. Although the black edge and its extent is plain in the original sections (which are much enlarged in the figures) it is not clear in the illustrations, owing to the strong light behind them when they were photographed. These two figures show the manner in which the dusky coloring matter has insinuated itself between the quartz granules of the pebbles and how it then diffuses into these granules. The photographs also illustrate beautifully the mosaic structure so typical of the quartz pebbles of the banket. The structure is due to the numerous small irregular interlocking granules of which the quartz is composed. From examination of numerous sections under the microscope and from these figures, it is manifest that the agencies to which the black coloration of these pebbles is due possessed extraordinary powers of penetration and diffusion.

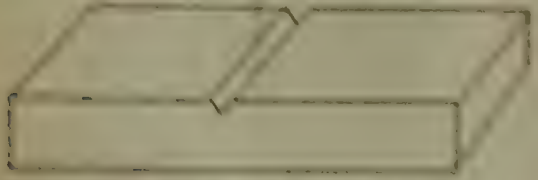
Diffusion of Metals

It may, therefore, be well at this stage to touch briefly on some aspects of diffusion, especially at high temperatures. The great diffusive power of certain gaseous substances and of vapors in spite often of extreme attenuation, is well known, and also the ability possessed by even minute traces of certain vapors to produce coloring effect. This quality of diffusion [illegible] molecular mobility, a good example of this being furnished by the great mobility with which mercury will penetrate a bar of tin.[1] Thus, if a tin bar of the [illegible] square and 4 in. to 5 in. thick[2] a notch say ¼ in. deep be cut and 4 slits across it as shown below, and this be filled with mercury, the latter will quickly soak through the tin and the bar can then easily be broken, owing to the fact that the mercury has diffused between the crystalline grains of the tin. This is a case of the diffusion at ordinary temperatures of a mobile metal (which is liquid at ordinary temperatures) through a solid one. Roberts-Austen[3] pointed out that where diffusion is concerned small variations of temperature may be of great importance, the diffusibility being greatly increased by a rise of temperature, and that Graham[4] was of the opinion that the effect of high temperatures is "to assimilate diffusibilities" of different salts.

Thus it will be readily understood that metals and other substances if existing under high pressure and temperature conditions as pneumatolytic vapors would have their diffusive qualities greatly enhanced. Good examples of coloration produced by pneumatolytic vapors is furnished by some of the tin deposits of the Bushveld area of the Transvaal. At the Roosberg tin mine, some 40 miles west of Warmbaths, the cassiterite occurs as an actual replacement and also as an impregnation in those sandstones and quartzites now known as the Roosberg series, of the Waterberg formation. It is found in various forms such as (1) replacements and impregnations of the country rock, (2) lenticular-shaped deposits along bedding planes and (3) in rich pockets of almost pure cassiterite. In all these cases the deposits can be traced to fissures. One of the characteristic features of these pockets is a concentric structure. This consists usually of a light gray ring of secondary siliceous matter and beyond this another ring produced by the deep red coloration of the adjacent quartzite, which has undergone feldspathization. Between these two rings there are often layers of tourmaline.[5] At the Zaaiplaats tin mine, about 20 miles northwest of Potgietersrust, the cassiterite, so far, has mainly occurred in small pipes in the Red granite. The author particularly noticed that the color of the granite immediately round the pipes was often of a much deeper red, and that a great deal of tourmalization had taken place. In each case the red coloration and its close association with the presence of cassiterite and tourmaline point to its being one of the effects of that pneumatolytic action to which the presence of those two minerals must be ascribed.

Analyses of Black-Edged Pebbles

As regards the black-edged pebbles, in order to see whether chemical analysis would disclose the coloring matter,[6] several were collected and separated as carefully as possible from the matrix, but



[1] "On the Diffusion of Metals," by Sir W. C. Roberts-Austen, Phil. Trans. A, Roy. Soc. (1896), see pp. 383-415. The reader in particular is recommended to carefully read this paper, as well as certain papers on diffusion in the Proc. Roy. Soc., Vol. 47, No. 287, (1890).

[2] Graham, Phil. Trans. Roy. Soc. (1861), pp. 183-224.

[3] For this description of the occurrence of cassiterite at Roosberg the author is indebted to E. R. Sheck, the manager of the mine.

[4] In addition, the writer tried blow-pipe tests on small particles of the black-edging. With a borax bead the presence of iron was indicated. With a bead of equal parts of sodium carbonate and potassium nitrate the presence of manganese and chromium was suggested. These reactions were not well marked and were therefore unsatisfactory.

for the most part, it was found impossible entirely to free the surfaces from a small amount of adhering matter consisting of a little iron pyrite, free gold, and carbon. In the process of separating the pebbles from the matrix the former were mostly broken into pieces, which were collected as carefully as possible. In several pieces the black coloring matter could be seen spreading inward in jagged tongues from the circumference of the pebbles; and, in one instance, by the aid of a strong glass it could be seen surrounding some of the individual crystalline granules of which the quartz pebble was composed. In these pebbles the black edges varied in thickness from a thin streak round the circumference up to about one-sixteenth, and in one place up to about one-eighth of an inch thick. At the same time ordinary white or light-gray lustrous quartz pebbles were collected, and separated as carefully as possible from the surrounding matrix. These seemed to have a still greater tendency to break during the process of hammering and chipping the surrounding material of the banket, and so the pebbles after isolation were only obtained in broken pieces; unlike the black-edged pebbles, there was little closely adhering foreign matter and it was found possible to clean them far better than the former. The small amount of adherent matter still remaining consisted of a little iron pyrite and a little greenish-looking substance that appeared to be a decomposition product from pyrite. The pebbles in both cases were obtained from one of the Randfontein Leader stopes of the North Randfontein mine.[312] This stope-face was about 200 ft. long, and its average assay-value at the time was about 13½ dwt. over a width of 52 in. These two samples were carefully analyzed,[313] with the following results:

	A, %	B, %
SiO_2	96.10	97.40
Al_2O_3	0.69	trace
FeO	1.29	1.08
Fe_2O_3	0.25	0.20
CaO	0.35	0.47
MgO	trace	trace
K_2O	trace	trace
NaO_2	0.42	0.25
MnO	nil	nil
TiO_2	trace	trace
FeS_2	0.93	0.11
P_2O_5	0.10	trace
CO_2	nil	nil
Carbon	trace	trace
Combined water	0.02	0.05
Moisture	0.18	0.15
	100.30	99.71
Gold expressed in dwt. per ton (of 2000 lb.)	145	8
Total weights of samples in grammes	78	77
Specific gravities	2.66	2.65

Column A gives the analysis of the black-edged quartz pebbles; and column B gives that of the ordinary white or light-gray quartz pebbles.

Coloring Material of Pebbles

These analyses show, as one would expect with quartz pebbles, that the silica percentage in each case is very high. The most notable differences in them are that the black-edged pebbles contained 18 times as much gold as the others; 0.8% more iron pyrite, with 0.69% of alumina and 0.1% of phosphoric acid, as against traces in the other case. Each sample contained traces of carbon and of titanium; but no manganese was detected. The evidence thus obtained merely suggests that the coloring matter may be due to traces of carbon or possibly titanium; or to the presence of mineral matter such as gold or pyrite, or possibly both, in a finely divided state.

It has already been pointed out that carbon, and probably pyrite, gold, manganese, chromium, and other metals, under certain conditions and in a sufficiently finely divided state, or in a state of diffusion, are capable of producing a coloration. Sollas ascribes the black color in flints to a carbonaceous pigment, the last residuum of the living protoplasm once present in the chalk.[314] It is now generally admitted that the coloring matter in the so-called moss agates is an iron compound deposited in the silica in dendritic form.[315] In the cyanide process for the extraction of gold, the latter is thrown down in a finely divided state as a black powder on the zinc shavings in the extractor-boxes. The typical black color of much of the Black Reef quartzite is probably due to manganese that has been leached out of the overlying dolomite.[316] As already stated, minute traces of certain metals are sometimes sufficient to produce strong coloring effect; for instance, a very little of a cobalt compound fused with borax is sufficient to produce a blue coloration; the same effect is produced if a small quantity of one of its salts is added to ordinary potash-glass while the latter is in a molten state. Amethysts owe their color to manganese; rubies and sapphires to chromium compounds. Again, the resulting color seems often to depend on the degree of fineness of division; for example, although the precipitated gold in the extractor-boxes is black, finely divided gold may be purple by reflected and green by transmitted light.[317] Gold thrown down from a solution of gold chloride by the action of sunlight is of various shades of iridescent brown. The greenish blue color of the London clay has been ascribed to finely divided pyrite. The difference in color exhibited, under varying conditions, by the same substance is well exemplified in the case of water. When pure, and seen in moderate quantity it appears to be colorless; but when viewed through a stratum of considerable thickness it presents a beautiful greenish-blue color. Aitken has shown that the presence of extremely finely divided suspended matter in water will give the liquid a blue color. Thus in tanks where water

[312] These pebbles were from the north face of 9.3 Leader stope.

[313] The analyses were made for the writer by E. H. Croghan of Johannesburg.

[314] J. W. Sollas, *op. cit.*, p. 142.

[315] For the information with regard to amethysts, rubies, sapphires, and moss agates, the writer is indebted to Prof. John W. Judd, who also informed him with regard to the latter that Thomas Davies, an able mineralogist who did much work in the arrangement of the specimens in the British Museum, thought at one time that in spite of the dendritic simulations there were real 'fossil mosses' in some of these agates; and he tried to separate the two forms.

[316] 'Notes and Analyses of Typical Transvaal Rocks,' by C. B. Horwood. *Trans.* Geol. Soc. So. Af., Vol. XIII (1910), p. 37.

[317] 'Gold, Its Geological Occurrence and Geographical Distribution,' by J. Malcolm Maclaren, p. 22.

is being softened by milk of lime, after most of the precipitated chalk has settled and only the finest particles still remain suspended in the water, the water often appears to be of a rich blue color. The water of many Swiss lakes has a wonderful blue color, which is partly due to this optical phenomenon, as well as to the actual color of the water itself. The writer has often noticed, in places, the true greenish-blue color of water in the Swiss glaciers, when the frozen snow, or ice, is broken in such a way that the light is reflected from side to side of small crevices, or of crevasses.[318] From the above it will be clear that minute traces of a substance are often sufficient to produce strong coloration in a material, and that the physical state of a substance may affect its color; and in any particular substance it is often an extremely difficult matter to determine the coloring matter.

Experiments on Black-Edged Pebbles

In the chemical analyses of the black-edged and of the ordinary quartz pebbles, a trace has been entered in each case against carbon, but in a covering letter from the analyst it was explained that carbon could not be detected by any quantitative method. The evidence was purely a qualitative one based on the physical appearance of the silicic acid precipitate. Several trials were made with fresh portions of the sample, and in every case a gray-colored product was obtained, which still remained on drying at 150° to 160°. On ignition, however, the color disappeared, leaving the product perfectly white. In these tests there was no contact with organic matter of any kind, and the chemicals used were quite pure. Comparative tests were then made under exactly similar conditions with silica prepared free from organic matter, and the silicic acid precipitate obtained after treatment of the fused product with acids, washing, etc., gave a perfectly white product. The gray coloration obtained from the samples of the pebbles suggests the presence of some organic matter. These analyses, while interesting and suggestive, do not conclusively prove anything. Owing to the impracticability of obtaining the pebbles absolutely free from any adherent matter, minute traces of carbon may have been present merely on the surface of the pebbles. The author wished to see if acids or high temperature had any effect on the pigment responsible for the black edging of these pebbles. He therefore had several thin slices cut from one of these pebbles[319] and treated them with acids; and also exposed them to high temperatures in a muffle-furnace. No effect was produced after digesting them for five days with hydrochloric acid, or by similar treatment with *aqua regia*. He then treated one of them with a mixture of nitric acid and potassium chlorate, which is a solvent for carbon. It was first heated on the hot plate for about 5 hours and then put away and allowed to cool for 5 days. After that, as there was no appreciable result, it was heated on the hot plate for about 7 hours per day for 3 days, still with no result. It was then put away and left until it had been in the mixture for 34 days, and as it still showed no change, the experiment was discontinued. Another slice was treated in a mixture of sulphuric acid and potassium bichromate, which is also a solvent for carbon, and for 3 days it was heated for 7 hours with the mixture on the hot plate, with the result that the black-edging seemed to be very slowly disappearing. It was then allowed to cool and left until it had been in the acid mixture 23 days. When examined it was found that the coloring matter had for the most part disappeared; but as there were still places where the black-edging remained, it was put back again into the mixture. Six days later it was again examined and still more of the color had disappeared. It was then washed and put into a fresh mixture of sulphuric acid and potassium bichromate from which it was removed after 17 days, when still more of the black coloration had disappeared. He then heated a thin slice of one of these pebbles[320] on a Morganite cupel in a muffle at a temperature of about 900°C.[321] for about 4 hours. When removed it was found that the black color had entirely disappeared. On cooling, the pebble assumed a milky-white color similar to that already mentioned, of pebbles often found near a dike, or assumed by pebbles in ground that has been disturbed or shattered by blasting. Another effect of the heating was that the pebble showed a distinct tendency to separate from the surrounding matrix and was, in places, no longer in contact with it. The experiment was repeated with another thin section of one of these pebbles heated for about 2 hours at about 1000°C. At the end of this time it was found that the black edging had entirely disappeared; the pebble had, as in the previous case, lost its vitreous lustre and had assumed a milky-white color.[322]

Results of High-Temperature Tests

The high-temperature experiments suggested the possibility of the presence of some form of hydrocarbon that had been driven off on heating. On the other hand, the prolonged tests with carbon solvents did not altogether confirm this indication, since the nitric acid and potassium chlorate mixture had no effect on the black coloration. It, therefore, seemed to the writer that a more decisive method of investigation would be by spectroscopic analysis. If the spectra form (1) a powdered specimen of the black-

[318] For these details regarding the color of water, see 'Inorganic Chemistry,' by G. S. Newth (1912), p. 213.

[319] These slices were cut from a gray lustrous black-edged quartz pebble of ellipsoidal shape and about $^{9}/_{16}$ inch in greatest diameter. The average thickness of each slice was about $^{1}/_{16}$ in.; and the black-edging averaged about $^{1}/_{16}$ inch in width and was very well marked and distinct.

[320] The slice used was from a gray lustrous quartz pebble of ellipsoidal shape; and the major and minor axes were 1⅝ and ⅝ in. long. The black-edging was about $^{1}/_{32}$ in. wide and very distinct and well marked. The thickness of the slice varied from $^{1}/_{32}$ to $^{1}/_{16}$ of an inch.

[321] As measured with an optical pyrometer.

[322] As spectroscopic analyses, which were being made, had by this time disclosed the presence of manganese it occurred to the writer to see whether dendritic markings underwent change at high temperatures. He therefore exposed a specimen of rock with dendritic markings on a scorifying dish to a temperature of about 900°C. in a muffle-furnace. He also put some manganese dioxide in another scorifying dish and had it in the muffle at the same time. After 2¼ hours the dendritic markings were unchanged, but the black manganese dioxide had been converted into a dark brown earthy substance, which was presumably the tetroxide (Mn_3O_4).

edging, (2) from the interior white or light-gray portion of one of these pebbles, and also (3) from a powdered specimen of an ordinary white quartz pebble were obtained and placed below the other in such a way that the lines common to both were continuous with one another, then any lines peculiar to, or much more strongly developed in, the spectra of the black-edged portion should at once be apparent. first taken of a small thin splinter from the black edge of one of these pebbles. This spectrum showed no lines that were not also present in the spectrum given by the poles alone. In this experiment the spark seemed to pass round the small splinter of the pebble instead of through it, which doubtless accounts for the negative result. Some of the black edge of one of these pebbles was then powdered and

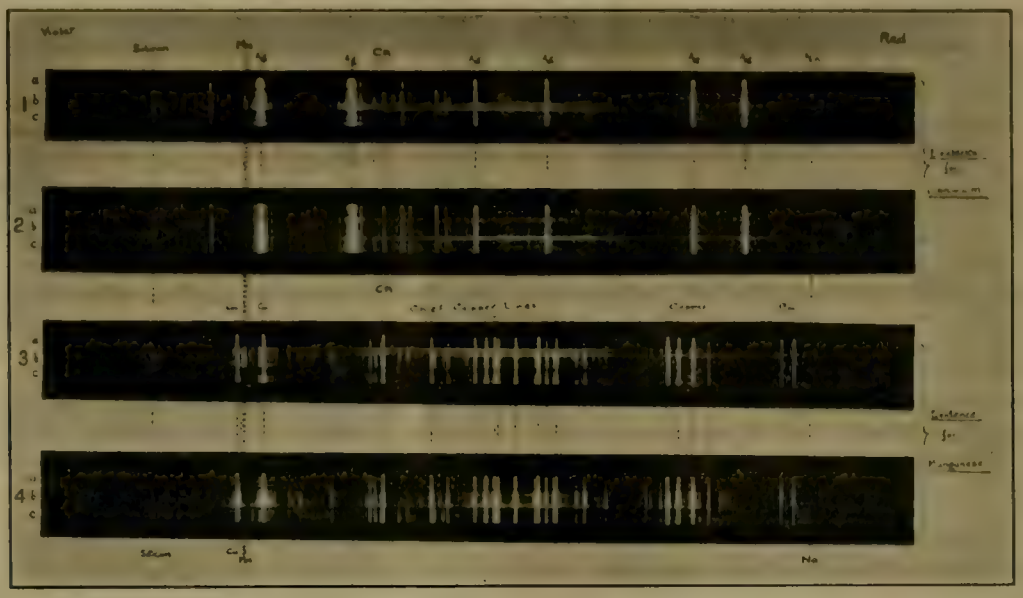


FIG. 39.

SPECTRA TO DETERMINE THE PIGMENT IN THE BLACK-EDGING OF QUARTZ PEBBLES IN THE BANKET.

1. a. Arc spectrum of silver.
   b. (do) + (black-edging).
   c. (do) + (interior portion of black-edged pebble.)
2. a. Arc spectrum of silver.
   b. (do) + (ordinary white quartz pebble).
   c. (do) + (do) + (black-edging).
3. a. Arc spectrum of copper.
   b. (do) + (black-edging).
   c. (do) + (interior portion of black-edged pebble).
4. a. Arc spectrum of copper.
   b. (do) + (ordinary white quartz pebble).
   c. (do) + (do) + (interior portion of black-edged pebble).

Careful spectroscopic analyses[323] were made at the Solar Physics Laboratory at South Kensington,[324] with the following results: A spark spectrum was

an arc spectrum on silver poles was taken in the usual way. This gave no evidence of carbon being present; but it revealed the presence of manganese and chromium, which had not been detected in the chemical analysis. In the case of chromium the evidence was decisive, as there was no trace of this metal in the spectrum given by the silver poles alone. In the case of manganese, the silver poles[325] were found to contain traces as an impurity. A check experiment was therefore made, copper poles free from manganese being used. By comparing the spectrum given by the copper poles alone with that given by the powder on these poles, the presence of manganese in the latter is at once apparent. Four series of spectra are shown in Fig. 39. The two top series are evidence of the presence of chromium, and in doing them silver poles, free from chromium, were used. The two lower series are the evidence for the presence of manganese; and copper poles free from manganese, were employed.

Spectrum Analyses

In series No. 1 the top spectrum marked *a* is that of the silver poles alone; the next, or *b*, is of the powdered black edging on the silver poles; and the

[323] The black-edged pebbles used for these arc experiments (both with silver and with the copper poles) was a fine specimen from the Robinson-Randfontein mine (from 3.7 Leader stope). This pebble was oval with well rounded contours; the major and minor axes were about 1¼ and $^{12}/_{16}$ in. long respectively. It was associated with plenty of gold, which was visible in the immediately surrounding fine-grained dark-gray matrix. Gold and pyrite could be seen, in places, in immediate contact with the black edge and occasionally actually within it. The white or light-gray portion, from the interior of a black-edged pebble, which was used in these analyses was from the interior portion of this same pebble; although of a light-gray color, it was rather darker than that from an ordinary white quartz pebble used in order to compare their spectra. The specimen of an ordinary white lustrous quartz pebble was from a portion of the white quartz pebble with a jagged edge, which is seen on the extreme left of the specimen in Fig. 28. The specimens were, of course, in each case finely powdered before being used.

[324] These analyses were done by C. P. Butler, who took a keen interest in this research work and to whom (as well as to Mr. Boxandall, for measuring the wave lengths) the author is greatly indebted. It was through the kindness of J. W. S. Lockyer and with the permission of the Director, Sir J. Norman Lockyer, that the writer was able to have this work done; and he takes this opportunity of recording his thanks to them.

[325] These poles were of special purity (consisting of 99.84% of silver); and were obtained from the Royal Mint.

lowest of the three, or *c*, is of the light-gray interior portion of the black-edged pebble. In series No. 2, *a* is a spectrum of the silver poles alone; *b* is of a powdered portion of an ordinary white lustrous quartz pebble on the silver poles; *c* is the spectrum of the powdered black edging superimposed on the powder used for *b*, on the same poles. The most striking result of these analyses is the presence of chromium lines in *b* in No. 1 and in *c* in No. 2, that is, in the two spectra of the black edging; also the presence of manganese lines in the spectrum of the black edging in No. 1, while they have not come out in that of the silver poles, or of that of the interior portion of the black-edged pebble. Turning now to No. 3 and 4; in the former *a* is a spectrum of copper poles alone; *b* is one of black edging on the copper poles; *c* is of the interior light colored portion of the black-edged pebble on the same poles. In the latter *a* is a spectrum of the copper poles alone; *b* is that of ordinary white lustrous quartz pebble on the copper poles; and *c* is of the interior portion of a black-edged pebble superimposed on the powder of the ordinary white quartz pebble, on the same poles. The outstanding feature of these analyses is the presence of manganese lines in spectrum *b* of the black edging in No. 3, and their absence in the other cases. The silicon line, of course, stands out in all these, except in those of the poles alone; and, also in *c* of series No. 3 in which the spectrum has not extended far enough to include this line. The black edging shows no trace of the lines of gold or silver. In the case of iron, the lines occurred just as strongly in the spectrum of the silver poles alone as in that of the black edging on the same poles, thus giving no evidence of its presence in the black edging. The spectra on silver poles suggest the presence of aluminium and strontium in the black-edging; and that it contains these in greater amount than the interior portion of the black-edged pebbles. In comparing the spectra of the black-edging with that of an ordinary white lustrous quartz pebble the only striking difference is the conspicuousness of the chromium lines in the former, there being only the slightest trace of them in the latter. Using copper poles, the spectra of the black edging show the lines of manganese, iron, aluminium, and chromium, none of which are present in the spectrum of the poles alone. The same lines are present but are very weak in spectra of the interior light-colored portion of the black-edged pebbles, showing that these elements predominate in the black-edging. Although the spectrum of the black-edging when silver poles were used seemed to indicate the presence of strontium, this was not supported by the spectrum on copper poles, which showed no trace of strontium lines.

Summary of Tests

The outstanding feature of these differential spectroscopic analyses, confirmed by the employment of both silver poles and also copper poles, is the presence in the black edging, of chromium, manganese, and aluminium;[326] and of these, the coloration would doubtless be due to the first two.

The study of the mode of occurrence of these pebbles clearly demonstrates that they are associated with the presence of gold. The microscopic examination of thin sections reveals that the coloring matter has introduced itself into the pebbles from without by insinuating itself between the irregular-shaped granules of the quartz mosaics of which the pebbles consist; and then commenced to penetrate, and diffuse within, these granules. Such great power of penetration and diffusion points to the agency of a fluid so mobile that it probably existed in the gaseous state and under pressure. If the pigment is a condensation product from pneumatolytic vapors, then under ordinary atmospheric pressure, it might be capable of being re-vaporized if exposed to a sufficiently high temperature; and the muffle experiments have shown that the color actually is destroyed when exposed to a high temperature. The spectroscopic investigations indicate that the pigment is due to manganese and chromium compounds. Weed[327] has recently drawn attention to the phenomenon, often previously noted, that "in many gold deposits manganese oxides and gold are intimately associated and without doubt have been precipitated together," and that this association is by no means uncommon. The study of these black-edged pebbles leads, therefore, to the following conclusions: (1) The coloring matter owes its existence in the pebbles to the same agencies to which the gold in the banket is due; (2) the coloration is the result of the presence of manganese and chromium, or their compounds, and also possibly of iron; (3) these latter have been introduced under pneumatolytic conditions.

(*f*) *Black Crystalline Quartzites.*—The presence of black, crystalline, lustrous, and dense-looking quartzite is generally indicative of the ore being of good grade. For example, it has already been pointed out that the quartzite matrix of the South Reef Leader is much darker than the foot-wall quartzite on which it rests. The latter is of a schistose character and has undergone sericitization, while the former has undergone intense silicification; the foot-wall is light-gray in color, while the quartzitic matrix of the Leader and the quartzite in which it is immediately imbedded varies in color from dark-gray to black.

Influence of Igneous Intrusion

Sometimes the banket and the quartzite have been blackened owing to the influence of a neighboring igneous intrusion. The writer has, in a previous paper,[328] described a good example of this at the North Randfontein mine, where the West Reef[329]

[326]The presence of alumina, coupled with the great amount of silicification to which the bankets have been subjected, suggest that the manganese and chromium may have formed complicated aluminium silicates. The close association of chloritoid with the gold, and the fact that what may well be considered a variety of it (that is, ottrelite in which manganese takes the place of magnesium) is a basic silicate of aluminium and ferrous iron, lends support to this idea. Apparently a trace of iron is also present and may have played some part in the coloration.

[327]'The Enrichment of Sulphide Ores,' by W. H. Weed, U. S. Geol. Surv. Bull. 529 (1913), see pp. 128-132 and 166-167.

[328]'The Mode of Occurrence and Genesis of the Carbon in the Rand Bankets,' *loc. cit.*, p. 72.

[329]Which is correlated with the Main Reef series of the Central Rand.

is immediately overlain by an intrusive diabase dike, which forms the hanging wall of the lode. This dike has had a marked effect on the West Reef; the banket and quartzite being blackened, greatly indurated, and exceptionally pyritic. The upper portion of the ore near the dike contains more gold than the lower portion, while in the adjacent Robinson-Randfontein mine, where the dike is only poorly developed and is generally absent, the reverse is the case. The undoubted connection between the blackened color of the quartzite and richer ore indicates, as in the case of the black-edged and the pinkish pebbles, that the color is due to the mineralizing solutions, liquid or gaseous, to which the banket owes its gold contents.

This blackened quartzite strongly resembles the very hard, black, crystalline quartzite which in many places[330] is a very characteristic feature of the Black Reef formation. It has already been stated that the color of this latter quartzite is probably due to manganese leached out of the overlying Dolomite. The frequent and well known association of manganese with gold and its presence together with chromium in the black-edging of the pebbles just described suggest that the black coloration in the case of the quartzites associated with the bankets is due to manganese, or chromium, or to both.[331]

Summary of Parts V and VI

The distribution of the gold in the auriferous conglomerate of the Main Reef series has now been described. Why this particular series was chosen by the mineralizers as the main channels of circulation and of deposition for their mineral and metallic contents has been explained. The fact of the unusual and seemingly wonderful persistence both along the strike and in depth not only of the lode but of that which is of such world-wide economic importance, its profitable ore, has been brought into deserved prominence. It has also been shown that, once the nature of the deposit is rightly understood, such extension of good ore is only a natural result from channels having existed that afforded free circulation, throughout many miles of their length, owing to the fact that the walls were kept apart throughout that length by the intervening pebble beds. It was pointed out that the boundaries of the profitable areas of gold-quartz mines can generally be represented in front elevation by inverted triangles, rarely much elongated in comparison with the length of their bases, sometimes approaching equilateral shapes and often squat. To expect the height of such an inverted triangle to be only one-fiftieth of the length of its base would be altogether unreasonable. Thus, when one considers that the Rand goldfield consists of adjacent mines (most of which are twin mines, working two parallel lodes) stretching for some 55 miles along the strike; and further realizes that a vertical depth of 5500 ft. is less than a fiftieth part of this length; and again that it has been shown in the case of this particular and abnormal type of deposit, that the limits of its profitable ground should be represented, in section or front elevation, by a rectangular figure and not by a triangle (in other words, its extension along the direction of the strike should be practically as great in depth as at the surface) one can then imagine the enormous possibilities of the deep-level ground and begin to form a clearer idea of the extraordinary extent of the mineralization.

The distribution of the gold among the various banket seams of the Main Reef series, and why it is principally concentrated in certain ones has been discussed. The way the gold contents fluctuate between the two subdivisions of the series has been indicated, and it was shown that this is also quite a usual phenomenon in the case of parallel gold-quartz lodes of normal type. It was demonstrated that shoots do occur even in this deposit, in spite of the free and open passage that was offered throughout to the mineralizers, as compared to an ordinary vein or lode. Also, instances of the influence of dikes on the gold tenor of the lodes were given. Then local indications by means of which relatively good ore can be recognized were summarized and described. The first of these, or the presence of relatively large pebbles, has previously been used as an argument in favor of the theory that this gold deposit is of placer origin. It was shown that it certainly forms an equally good argument in favor of the auriferous banket being an abnormal type of lode deposit. Other indications such as the presence of much pyrite, the so-called pyrite 'pebbles,' carbon, black-edged, black, pink, and milk-white pebbles, and dense black crystalline quartzite have been shown to be due to agencies that have operated after the conglomerates were laid down, such as those with which one is familiar as having often operated in the formation of normal veins or lodes.

The reader who has read all the preceding portions of this paper and has carefully considered the facts and arguments advanced in part V and in this present part will probably have arrived, with the writer, at the conclusion that the facts admit of no other explanation of this enormous stretch of auriferous banket than that it owes its pyrite and gold, in fact its mineralization generally, to those same agencies with which one is well acquainted in the case of normal fissure-veins.

Finally, in the subsequent portion of this paper the genesis of the gold and pyrite will be more particularly considered; and also the agencies that were responsible for the introduction of the mineralizers into the banket. The paper will then conclude with a discussion as to whether the gold in the bedded quartz veins of the Dolomite formation in the Northern Transvaal; in the banket and in the horizontal quartz reefs of the Black Reef formation; and in the banket of the much older Witwatersrand system, is due to more than one or to only one great period of mineralization.

[330] For example, in deepest borings on the far East Rand, where it forms one of the hardest rocks encountered by the diamond-drills. In the hand specimen, this quartzite is black in color, heavy, crystalline, granular, compact, and possesses a somewhat saccharoidal texture and breaks with a lustrous fracture. As pointed out by Sir A. Geike (Text Book of Geology) (1913), Vol I, p. 250), a lustrous fracture, observable in many quartzites, is doubtless due to the exceedingly firm cohesion of the component grains, which break across rather than separate, and the consequent production of innumerable minute clear vitreous surfaces of quartz.

[331] Iron may also be one of the coloring agents.

The Glacier Trail to Shushana

The trip inland to Shushana has been one fraught with hardship and difficulties, as is the case in the development of every new district in the north country, and to those who blaze the way and make easier the burdens of travel, special credit is due. A record of the expedition which located and marked the trail across the Nizina and Shushana glaciers is contained in a report made by George C. Hazelet, who was in charge of this expedition, to the Cordova Chamber of Commerce.

Nature of the Trail

The distance from McCarthy to the Shushana 'diggings' does not exceed 75 miles, and that distance can be reduced at least 5 miles when the ice is in the Nizina river, which will be about January 1. The trail at present leaves McCarthy and crosses Sourdough hill to the Nizina river, thence up that river to the glacier. Later, when the river is frozen, the travel will be down the Kennecott river to its junction with the Nizina river. The trail has a water grade from McCarthy to the Hill and McLeod road-houses. From this point it crosses the glacier and the grade averages from 3 to 5% for the next 10 miles. The next mile has a grade from 6 to 8%, and for the following 3 miles the grade does not average 4%. At the end of this last bench of ice the heaviest grade on the route is encountered. There is about 300 ft. of 10% grade, then 1000 ft. of 4% grade, then 450 ft. of 15 to 16% grade, then 300 ft. of 8% grade, and lastly about 2000 ft. of 5 or 6% grade. From here on to the summit, a distance of two miles, the grade does not average 4%. The grades on the Shushana side are better than on the Nizina, because the Shushana river has its source in higher altitudes than the Nizina. The grade for the first 7 miles down from the summit varies from 2 to 5%. A few short heavy grades are found in the next 2 or 3 miles, but nothing a 'rough-lock' will not hold over.

Twelve miles from McCarthy on the Nizina river is the first road-house, known at Clarkin's, and from this point there are road-houses at intervals as far as James Clark's in Pleasant Valley. Beyond Pleasant Valley the expedition established relief tents, which are furnished with stoves and afford shelter. Another house is to be established at 'The Lake' in the last timber at the foot of the glacier, 5 miles from Shushana city.

The relief tents are second-hand tents and somewhat worn, and should be replaced by new tents of 16-oz. duck, the size should not exceed 10 by 12 ft., and the relief tent on the Shushana side should be placed within 2 or 3 miles of the summit instead of where it is now, as there will be a road-house in the near vicinity. These tents are for use only in case of emergency or by persons going and coming from the 'diggings' who are traveling light. It is presumed, of course, that persons freighting will have their own camps. If freighting into the country it is advisable to establish a camp at Mrs. Hill's road-house, the point at which the glacier travel begins, and freight all supplies to Pleasant Valley, 9 miles distant, then move camp to the foot of the summit, taking a sufficient supply of food for the time required. Send the teams to Pleasant Valley in the forenoon, and put these loads on the summit in the afternoon. When all supplies are on top, break camp, pick up freight on the summit, and drive with the whole outfit to timber on the Shushana side, a distance of possibly 20 miles.

All single tripods or stakes are on the right hand side of the trail, going north or into the 'diggings, consequently they would be on the left hand coming out; the trail follows them closely, being from 2 to 4 ft. distant. Where there is a turn made or any danger whatever of crevasses, stakes or tripods were set opposite each other, and the route lies directly between. If this is kept in mind, one can travel as safely over this route as over any trail in the country. Where ice was found the stakes were tripoded, tying them together at the top and setting the butts in the ice. Where enough snow was found to hold the stakes, single stakes were used. All stakes are 8 to 12 ft. long and of green willow.

In regard to weather conditions on the trail during November on the glacier, there was no weather or indications of weather equal in ferocity to that on Thompson pass, Marshall pass, or in fact any of the upper regions of the Copper river. Undoubtedly storms sweep over this summit as they do over all summits, but there is no reason why they should be worse here than elsewhere. In fact, it would seem that there is a very good reason why they should not be; this is an interior summit, the temperature is about equal on each side and not subject to extreme fluctuation as is a ridge reaching down to the sea on one side and the interior on the other. However, storms must be expected and a sensible man will prepare for them and not try to move freight or travel when they are on. Every Alaskan knows what is meant, and the 'Cheechaco' will learn.

Many go over the trail with absolutely no equipment. Some come out from Shushana and some go in who have neither food, bedding, snow-shoes, nor even proper clothing. It is only natural that some of them get frost-bitten and report an awful time on the trail. Some have even attempted to travel without bed or snowshoes.

Proper Outfits

What the Government should do, but never has done on any trail, is what the Canadian Government does, place a police officer at each one of the starting points, and see that every man is properly equipped before he is allowed to leave. This would largely avoid the loss of life and prevent much suffering. There has always been a loss of life and much suffering on every new trail; it is a penalty the pioneer pays, but he does not hesitate at that any more than one stops going to Chicago because men freeze to death there. Therefore it is expected that some will lose their lives, others will be frost-bitten, and others will have a terrible time, but if they do, it is all owing to their own carelessness or lack of preparation and good judgment, for there is absolutely no reason why men with common sense, properly equipped, cannot go through to the 'diggings' quickly, safely, and cheaply over this route.

Prospecting Conditions in Peru—II

By Charles S. Haley and C. A. Rodgers

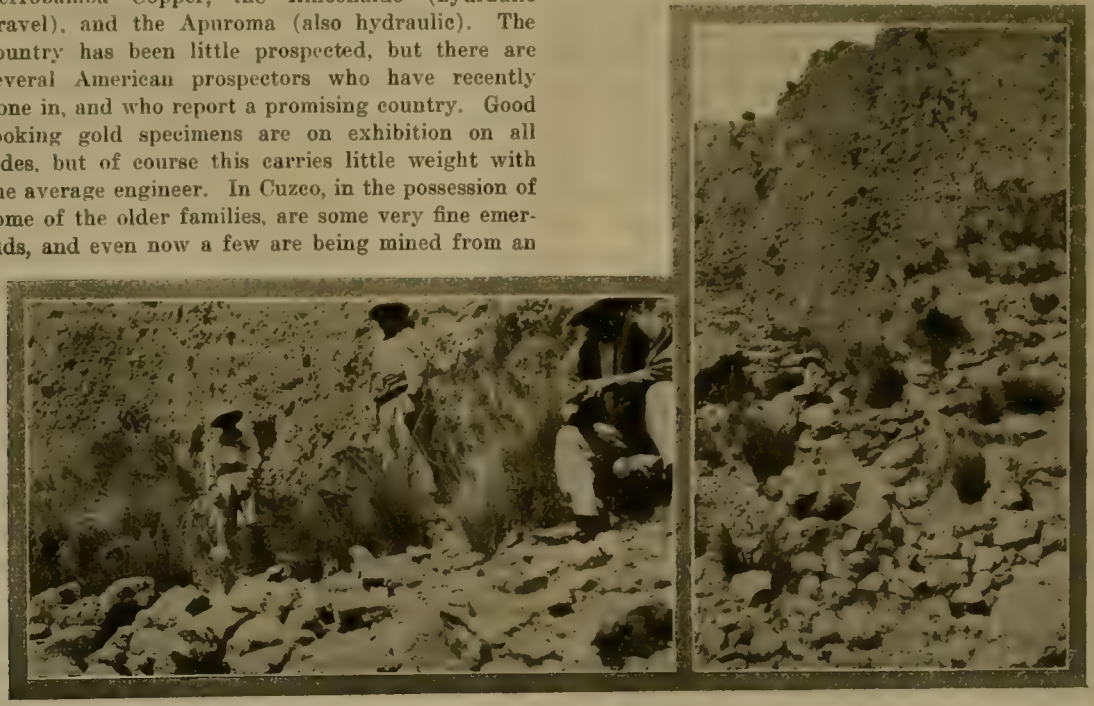
The general distribution of the mining districts in Peru seems to include practically the whole country. In the north, near Paita and Eten, a large English company is busily engaged in developing an oilfield which promises to be one of the largest and most profitable in the world. The oil is high grade, with a paraffin base, is easy to refine, and seems to be very abundant. One company has a concession for exploiting about six hundred thousand acres. Also, in northern Peru, about three days' journey from Trujillo, a French company, capitalized at several millions, has undertaken the development of a large silver and copper deposit. In the same country, Peruvian engineers speak of a network of parallel silver veins, and, a little to the north and west, six-foot seams of anthracite coal, with ninety per cent fixed carbon.

Central Peru

In central Peru, the Cerro de Pasco company is developing large copper properties. Farther south, among the sedimentaries again, there are large bodies of coal, more especially within one or two day's ride of the port of Pizco. To the east of this, again, lie large deposits of low-grade copper. All of the information on this country is very indefinite, and it is hard to get detailed statements, or anything but glittering generalities, from the average Peruvian official. Even their official bulletins share this same tendency.

To the south, in the provinces of Cuzco, Carabaya, and Sandia, lie the ancient gold workings of the Spaniards. Here are in actual operation very few companies, notably the Inca Mining Co., the Ferrobamba Copper, the Rinconaldo (hydraulic gravel), and the Apuroma (also hydraulic). The country has been little prospected, but there are several American prospectors who have recently gone in, and who report a promising country. Good looking gold specimens are on exhibition on all sides, but of course this carries little weight with the average engineer. In Cuzco, in the possession of some of the older families, are some very fine emeralds, and even now a few are being mined from an ancient working of the Spaniards in that province.

In going into the country to look for mining property, however, it will save the engineer much trouble if he does not permit his purpose to be known in the larger cities. In this respect, it is necessary to call attention to a trait not to be commended among the Peruvian engineers. After graduation from a technical school, the average young engineer considers that his career is made, or at least marked. The idea of manual labor, and the four or five years of apprenticeship at the practical side of actual mining and milling, which we consider essential, does not enter into his calculations. Neither does he care for the hardships of prospecting and developing his native country. The great majority of them try to enter the service of the government as soon as possible, and aim to get as attractive a post, in as civilized a locality, as they can. As a result, whatever prospecting is done is either carried on by foreigners (mostly Americans), or the native miners of the interior, who prospect with a view to making their own living out of the results of their operations. The natives of the south seem to be far superior in industry and intelligence to the sheep-herders of the north, and many of them have sufficient initiative to do what the engineers and mining men of the country should do in a more intelligent and effective manner—to prospect properly their own country. As denunciation of a prospect entails a yearly tribute to the government of fifteen soles per pertinencia (200 metres square), and also serves to attract public attention to the location of the property, these native miners are



NATIVE PERUVIAN PROSPECTORS. AN ANCIENT DITCH.

usually careful to say nothing of any knowledge that they may have. They cannot afford to pay the tax themselves, as they work only on the smallest scale and in the crudest manner, and they do not care to have some local village magnate grab the property.

On the other hand, they have more faith in the honesty of a visiting engineer of English or American blood than they have in their own countrymen, and it is easy to win their confidence. In fact, all that most of them would ask in payment for guiding one, in case of success in finding anything, would be a matter of a hundred pounds or so, and, of course, in case of failure, one would be out nothing but the expense of going on a wild goose chase; something which has to be expected in nine out of ten prospecting expeditions.

Mine Speculators

The engineer, then, if he is really anxious to put in his time to best advantage, will avoid the attractive offers made him by the Limanian and Arequipanian speculators, and go into the country for himself, and make his own acquaintances. In the use of the word speculators, reference is made to a rather peculiar class who seem to abound in these two cities. They are usually local merchants, who keep one or more men in the field all the time, with instructions to denounce property. Almost anything will do, if it is in a country to which interest has been attracted on account of some bona fide operations. The idea seems to be to get hold of some ground, on the chance of disposing of it, in wild-cat fashion, to the Englishman or American, who is supposed to be made of money. To this end, attractive commissions are freely offered to engineers, with the object of a favorable report. Invariably a large cash payment down is expected on property of this class. If the property is examined, it will often be found that the original locator is in considerable doubt as to the limits of his denunciation, has not been on the property or put up a single boundary mark himself, and is prepared to pivot or slide his claim all over the country.

Of course, a sensible man does not care to waste his time in this manner, but they are often so well vouched for, and can furnish such convincing proof of the validity of their claims, that it is hard to decide what to believe. The best way, then, is to believe nothing until you have seen it with your own eyes, and to go into the country and get acquainted with the men who actually know it and have prospected it with their own labor. For this reason, it is advisable that a man have a fair knowledge of both Spanish and Quichua. However, if he can get in touch with the white men who are prospecting the country it will often save him much time and trouble, as most of these are experienced miners from the States, and do not get as excited over a little free gold as the natives.

The great drawback to prospecting is the lack of transportation, the lack of capital, and the constitutional lack of enterprise of the native Peruvian. It is very evident that all development of the natural resources of this magnificent country must come from the outside, and foreigners will, of course, then reap the greatest of the rewards to be gained.

The general geology of Peru has been very little worked out, and what meagre information exists is largely confined to the government reports. To one who has been accustomed to the thorough and systematic work of our own Geological Survey, these reports and bulletins seem woefully general and insufficient. This state of affairs is, of course, due both to the lack of money to support and pay parties in the field, and to the before mentioned distaste of the Peruvian engineer for the hardships of camp life.

In a general manner, it may be said that the coast region of Peru consists of sedimentaries; sandstones, shales, slates, and, in some cases, limestone. In southern Peru, toward the interior, the erosion by the rivers of the thick bodies of slate has made tremendously steep gorges. These slates show that deposition must have lasted over thousands of years of submergence. To the north, the great batholiths of the Andes are exposed in many of the river courses for miles, and seem to range from granite to diorite. As a result, the overlying porphyries show all degrees of acidity. Columnar basalt lies over weathered phonolite (often mistakenly called tufa in the government reports); and andesite flows, over stream beds, have made lava conglomerates of tremendous size and extent. Quartzite and limestone occur in large bodies. The working out of the details and relations of the eruptive and sedimentary rocks of Peru is a gigantic task, yet one which will be facilitated by the exposures of the formation visible in the wonderfully steep and deep river cañons. In any particular part a person of even moderate geological experience can work out the general relations from mule-back, while riding down the trails through the cañons. The task of working out the formations of the whole country, however, or even of the more prominent mineral districts, is one for the government.

Climatic Conditions on the East Slope

The general discussion of climatic and aqueous conditions in the foregoing has been practically confined to the interior and higher mountain country of Peru. As one goes down from the province of Aymares along the Challhuanca and Pachechaca rivers to the Apurimac (which is one of the headwaters of the Amazon), there is a great change to be noticed. Dropping down off the windswept, bleak pampas above to the precipitious slope of the Challhuanca, an immediate change in climate is noted. Sheltered and protected from the wind and cold by the steep gorge of the river, trees and foliage become more abundant. Parrots fly about one, uttering their raucous cries. Farther down the river, at its junction with the Pachechaca, wide areas of bottom land, carefully planted and cared for, bloom forth into serried ranks of sugar cane. *Haciendas* offer their charming hospitality at convenient distances apart. At Abancay, in the province of the same name, one comes again in reach of the telegraph.

The latter institution, in the interior, is a fearsome and wonderful affair. In the first place, most of the interior lines are the property of the state, and all government business, no matter how routine-like, has the right of way over all private business,

no matter how urgent. From Sandia, about four hundred miles south of Lima, to the latter place, the average time of sending and receiving a message in reply is just about ten days. Messages from Challhuanca to Lima sometimes went through in four days. A certain amount of this delay is, of course, due to the natural *manana* spirit of the native operators. Crossing over to the Apurimac from Abancay, the journey is enlivened by pleasant *haciendas* to Limatambo. Here begins another climb up to the pampas of Cuzco, and once on top the going is level and easy until arrival at the latter place.

At this point, memory of an experience beyond Abancay makes a slight digression necessary. Beware of American canned goods and wire nails in Peru. In the one will lurk ptomaine; in the other profanity. For some reason or other, the cast-offs of American trade seem to land in these out of the way localities. An experience with ptomaine poisoning, alone in a little village four hundred miles from a hospital, with no white men or even Spanish-speaking natives around, at the beginning of an examination trip, is not a thing that one cares to have repeated often.

Cuzco

Arriving at Cuzco, one instantly perceives why it has been aptly named the dirtiest city in the world. In a city of forty thousand, without a sewage system, life is not the pleasantest thing imaginable. You will do well to see that your rooms are at least fifteen feet above the ground level. Cuzco is an interesting city, because of the Inca history that centres thereabouts, but as this is a description of prospecting conditions rather than travel, it is sufficient to say that it attracts many of the better-informed class of tourists. A narrow-gage railroad runs out from here to Sicuani, there to connect with another line—the Ferrocarril del Sur, which runs from Sicuani to Mollendo vit Juliaca and Arequipa. In buying a through ticket to Mollendo, by some freak of Peruvian railroad law, you will pay more than by buying to a point slightly beyond Sicuani and then getting out and buying another ticket from that point to Mollendo. This seems strange, but it is true.

Pucara and Tirapata, some distance beyond Sicuani, are the entrygates for supplies for the provinces of Sandia and Carabaya, and, beyond that, the great rubber country of the Madre de Dios. The Inca Mining Co., as before stated, has a wagon-road which runs for nearly a hundred miles to the northeast, and from the end of this road it is possible to go by trail and mule-back clear down to the newly built railroad which comes up through Brazil from Porto Velho. This connection made, the journey across the continent is practically accomplished, as far as difficulty is concerned.

Striking northward from the railroad at either of these points, it is necessary to cross the Cordillera once more. Before reaching Cuzco, the elevation has been over ten thousand, and the country is level pampas, with narrow cañons between low hills to break the monotony. Sheep raising is the principal industry, and the *haciendas* are far apart. However, after crossing the Cordillera somewhere in the vicinity of Poto, an immediate and precipitous descent is made for some six thousand feet toward Cuyocuyo, on the headwaters of the river Sandia, which in turn empties into the Inambari and the Madre de Dios.

From this locality downward you are in a well watered country, with tropical vegetation and frequent and heavy rains. Also, you are in one of the oldest gold-producing districts of Peru. From the stream and glacial gravel deposits of this country came a large proportion of the gold which the buccaneers fought so hardly and so treacherously to gain, during the days of Spain's colonial empire. Worked by slave labor, and with ground-sluicing methods, many of these deposits, though low-grade, paid well. With labor in its present state of unreliability and freedom of a sort, it behooves the engineer to calculate closely.

Wages in Southern Peru

In southern Peru wages are much higher than in the more remote mountain country formerly discussed. *Sindoros*, or trail cutters, who are absolutely necessary to a careful examination of any property, usually cost two soles per day. Skilled quartz miners often run over this figure, and ordinary labor will bring from eighty cents silver to one sole. However, the labor seems to be more efficient and less child-like than that of the higher mountains, save in one respect. That is in regard to alcohol. Frequent religious *fiestas* and holidays give them all the excuse in the world for drunkenness, and although they will contract to work for longer terms than their brothers of the pampas, during certain seasons of the year you cannot get them to work for love or money. Yet, among the better class of natives, there are many shining exceptions, whose faithfulness and diligence in the performance of their duty brings feelings of affection and regret to the mind when leaving them. There is one of this class now in Tirapata who is faithfully anticipating the return of his *Americano patron*.

Sandia, capital of the province of Sandia, on the headwaters of the Inambari, is a centre for outfitting expeditions with mules and men. Food supplies can also be purchased here as cheaply as they can be carried in. The native flour, manufactured by rolling whole wheat between rounded stones, makes a coarse brown bread which when fresh is palatable, and when stale is very durable. On the other hand, white flour, such as is brought from the rolling mills at Callao, costs about three times as much in the interior as the native flour, and does not make a much more wholesome bread, though a little of it for the sake of variety is acceptable.

During the rainy season—the summer months—the rivers in this district are swollen. A river may be a small stream in the morning and then become a roaring torrent before evening. As the principal bedrock of this country is a homogeneous slate, the erosion is marked, and the river cañons are steep. The grade of the rivers is rapid, and, for purposes of hydraulicking, ditches need not be too long. Some of the ancient river channels, of enormous extent and quantity of gravel, are on the edge of cañons cut by present-day streams, with a sheer

declivity of many hundreds of feet. Many of these channels show traces of work done in colonial days by Spaniards, and the ditches dug in those times, sometimes eight or nine miles in length, are still in good repair and need little more than cleaning out to make them available for the use of monitors. Some of these tremendous bodies of gravel show fair prospects, on the surface of the exposures made by the Spaniards. There are also many of the old quartz workings accessible, but they are difficult to prospect or sample, as they need cleaning out and unwatering.

Roads and Trails

The roads and trails in this portion of the country are none too good, especially during the rainy season. Most of them are relics of the old colonial days, and show that in the past a great amount of labor and care has been spent upon them. Winding down the cliffs of the Rio Sandia and the Inambari, on the San Juan del Oro trail, the way rises and falls over many miles, in the aggregate, of painfully built stairs made of slabs of slate placed carefully one above the other. This method of taking grades seems to be acceptable to the mules of the country, though in the rainy season, when the stairs are wet and slippery, the rider risks his neck continually. Heavy packing over this trail is impossible, and a llama can carry much more than a mule in proportion to his size, as he is much more sure-footed.

Further on, one of the cross-country trails leading to the gravel deposits before mentioned, the road is carefully paved with cobbles, all slippery and rounded with age. Each one of these appears to have been carried up from the rivers, in many cases thousands of feet below the trail. The present method of repairing trails seems to be by means of corduroy, made of a heavy palm-like wood that grows all over the mountains in scattered clumps. Climbing up a stairway of this sort is a feat for a toe-dancer, but not proper for a mule.

At intervals along the main routes the present government has caused to be constructed what are called *tambos*. These are rude resting places for the traveler, consisting of a heavily thatched roof mounted on a framework of uprights. In the rainy season they are a welcome sight, although filled with a motley crowd of Quichuas, Aymaras (for this is not far from the Bolivian frontier), and traveling Peruvians.

Feed for one's animals is abundant in this district, and the hills on either side of the main trails are impassable without trail-cutters to carve a way through the tropical growths.

There is quite a variation in the quality of gold that is brought in for examination. Ounce and half-ounce pieces appear to be common in some parts of the country, denoting, of course, pocket conditions, and still, in channels of another age a few hundred feet above, the gold seems to be fine and flaky. The same variation is noted in quartz specimens.

There are several American prospectors in southern Peru, many of whom have prospected all over the United States. They all seem to be enthusiastic over the possibilities of the country, but deprecatory of facilities for operation.

They all refer to the necessity of outside capital, because they realize that, beyond the expenditure of a few soles per year to hold claims for speculative purposes, it is useless to expect the local capitalists to do anything. In this respect the Peruvians differ greatly from their neighbors of the south. Many of the Chileans of moderate means own and operate their own mines. There is a difference in the temperaments of the two races; the more enterprising, on the south, having two railroads to the Peruvians' one.

Almost as much interest has been taken in the mining field of western Bolivia, in the past few years, as in southern Peru. For this reason, it may be well to add a discussion of this country and the means of reaching it. Leaving Mollendo, on the extreme southern end of Peru, about noon, one arrives at Arequipa about seven in the evening, and is glad to rest over night there at any one of the hotels, after a dry and dusty journey. Arequipa is at an elevation of about seven thousand feet. Leaving here in the morning, one arrives at Puno, on Lake Titicaca, at somewhere around ten thousand feet, at seven in the evening. The same evening you go to bed on the steamer, which lands you at Guaque, on the other side of the lake, and on the Bolivian frontier, early the next morning. The train for La Paz leaves shortly after the arrival of the boat, and you arrive there the evening of the second day from Arequipa.

In going up from Guaque to La Paz, you pass through pampas all the way, and reach a height of 15,500 ft. Then you drop gradually down, until you reach Alco, 500 ft. above La Paz.

La Paz

The approach to La Paz is particularly beautiful. As the train bears you across the pampas, it seems as if you were heading straight for the rocky barrier of the Cordilleras. Of a sudden, the pampas drop away, and you see the town, with its red-roofed houses and shining white walls, directly beneath you in the river valley five hundred feet below. The last stage of the journey down the grade from Alco is accomplished in an electric train. To the south of La Paz stretches another pampas beyond which are the mountains. Another means of access to Bolivia is the road from Antofagasta, in Chile, built to metre gage, but now being widened to standard. This road also connects by branch lines with Oruro and Potosi. Still another road is now under construction from Arica.

La Paz has an elevation of twelve thousand five hundred feet. There are some small sheep and cattle raisers, but the principal industry of the region is agriculture and mining. Tin mining is predominant, although there are some gold mines; notably, the Chuchuguilla and Hoja de Oro. Ancient irrigation systems from La Paz and Chuchuguilla rivers are the principal support of agriculture, the principal products being vegetables and barley.

The real capital of Bolivia is Sucre, some distance off the railroad, but the government offices and principal officials are in La Paz. Most of the business of the country is conducted there. It is one of the cleanest towns in South America, and quite the prettiest in site and appearance, though not very

large, as it has a population of only about fifty thousand. There are good hotel accommodations. The general attitude toward Americans is friendly, as it is in Peru. The principal English speaking population is made up of English and Germans.

There are many of the old Spanish mines in the neighborhood, but few of them are being worked. There seems to be as much profit in quarrying as there is in mining, one company is blasting boulders in the Chuchuguilla river to supply the demand for crushed stone. Wood is scarce, and is largely supplied by the Yumas Indians, who bring in fruit and firewood from three hundred miles back in the mountains, packing it on the backs of llamas.

With the exception of a few eucalyptus trees that have been planted near La Paz, there are no trees growing. As these thrive there, it seems as if it should be a profitable industry to plant eucalyptus for firewood. At present, the principal fuel consists of peat and llama dung.

Bolivian Mining Districts

The principal mining districts of Bolivia are Oruro, Cochibamba, and Potosi. Oruro, to the south of La Paz, is reached from Biachi, on the Antofagasta line. It is nearly a thousand feet higher than La Paz, and is in the heart of the mountains. Most of the mines are tin and copper. The copper mines are near the town, but are mostly small. Oruro is the best town to outfit in, in the country. Goods come up directly from Antofagasta, and do not have to be transshipped, so are cheaper than in any other place. Mules are rather high, costing from twenty to forty pounds.

Potosi is reached from Rio Mulata, between Oruro and Antofagasta. As there is only one hotel here, with four rooms, it behooves the wise traveler who has to stop over night to engage accommodations in advance. A train runs to Potosi three times a week. The road is at present run by the contractor who built it, as his grades were too high for the Antofagasta people to accept it. The altitude of Potosi is 14,000 ft. It has rather a cold climate. Potosi hill is famous for the number of mines that have been worked there. At present there are some two hundred and fifty in operation. They are mostly small concerns, working the old dumps for tin. There is also much copper and silver in the ores.

The principal source of labor is found among the Aymaras, or Bolivian Indians, who much resemble the Quichuas of Peru in facial characteristics and in disposition. The dress is similar, consisting of the inevitable *poncho*, short tunic, trousers, and leather sandals. One marked difference from the Quichuas is the trousers, slit to the knee, the result of an ancient pledge to wear them so until the race should be free from alien domination.

In character, the Aymaras are generally peaceable, bovine in temperament, disposed to get drunk, and hold religious festivals even to a greater extent than their Peruvian brethren, the Quichuas. They speak an entirely different language from the latter.

Summary of Mining

In summing up the general situation with regard to the mining industry of this part of South America, a few brief generalizations may advantageously be drawn. In the first place, there is no question but what an immense store of wealth has already been taken from the countries mentioned in the past four hundred years, mostly by the crudest of methods. For this reason it seems that improved methods and machinery should bring forth even more notable results. On the other hand, it should be remembered that most of the deposits were worked by slave labor, and that because of this an element which must enter into modern calculations to no slight degree was altogether lacking in the expense accounts of the Spaniards.

It is also said that the Spaniards, holding the country for so long, worked out the best of it. The falsity of this assumption, however, is apparent on the surface to anyone who has seen how superficially some of the *antiguas*, and, in fact, the larger number of them, have been worked.

As yet, very little information is available as to the possible mineral resources of this vast mountain country. Owing to the poverty of the governments dominating it, and the natural inertia of the people as a whole, a beginning has not been made in the prospecting of it. From the time of the independence of the colonies, near the beginning of the nineteenth century, the traces of Spanish operations have been gradually eroded and hidden from view by nature, in many cases supported in her efforts by a prodigal vegetation. Railroads are few, roads fewer, and trails in many cases all but impassable. Jungle growth and mountain torrents impede investigation of one of the most promising districts—that of southern Peru. To the north, the lack of water is as great a drawback as it ever was to the prospecting of Nevada.

Still, the dominant genius of the Anglo-Saxon is meeting these obstacles today, and with the guarantee of a stable government and full protection for invested capital, will continue to meet them with increased vigor. Whether the Latin races who control the country will sufficiently take pattern to develop their own resources for themselves is hard to say; they have not done so in the past. There is one Spanish word which is much used in editorials and political discussions, but whose meaning seems to be lost sight of in acutal practice—*aprovechar*—to take advantage of. Peru, now one of the poorest governments, is potentially, by reason of her immense mineral resources, the richest of the Andean countries, but cannot take advantage of them.

The country is all right. It is destined one day to be one of the richest in the world. What it most needs now is wise exploitation, scientific prospecting, and the careful expenditure of capital. Wild-cat dredging schemes have already threatened to do infinite harm to the reputation of a good gravel country.

Speculators of all nations, unscrupulous and avaricious, await the footsteps of the intending investor in this as in all countries. These should be absolutely avoided, and careful personal investigation of the country should be made even before sending out examining parties. In this way, one man, or two, can often save the waste of time and traveling expenses of eight or ten. The game is worth the

candle, in this, one of the last of the world's great treasure houses.

As an illustration of the Latin temperament, in Sandia, last January, the mule which carried out the weekly mail to Pucara, on the railroad, was overloaded, by his too ambitious master, with way freight. He fell down on the trail between Sandia and Cuyocuyo, and had to return to the former place. On hearing this, I remarked, with regard to a letter of some importance, "Well, I suppose that the mail will not get out till the morning."

Turning his surprised and reproving gaze upon me, an old gentleman remarked, reproachfully, "*No, senor, no es possible que partira el correo manana. La mula necessita descansar una dia o mas.*" (No, sir, it is not possible that the mail will go out tomorrow. The mule will have to rest for a day or more!)

An Electric Time Fuse

By E. Le Roy

In reading the interesting article on 'Electric Blasting,' by Charles H. Hurter, in the issue of the *Mining and Scientific Press* of November 8, I call to mind an electric fuse I have frequently employed in drift as well as in shaft work, and as the idea is, I think, original with me, and may be of use to others, I will give a description of it. The electric time fuse, as described herein, consists of a short piece of ordinary fuse, with an electrical

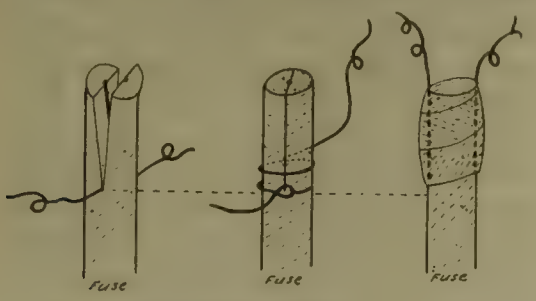


Fig. 1, 2, and 3.

means of ignition, and is made by splitting the ends of the fuses in the usual way, and each to the same depth, and into the bottom of the cut drawing tightly a short bit of either iron or german silver wire of small diameter. The former is as good or even better if a lighting current be available for blasting, but if a blasting machine is to be used, the german silver wire is better. Allow the excess powder in the split portion to fall over it, and take a half-hitch or loop around the fuse just below the bottom of the cut, leaving about two inches extending to connect with the copper leaders, which can be double cotton covered and paraffined annunciator wire, double conductor bell wire, or any insulated copper wire of from No. 18 to No. 22 gauge. Loop the other end around the fuse in the opposite direction and just above the cut, or say ½ in. above the first loop, and be sure that the loops do not touch each other at any point (this loop is, of course, on the opposite side to the former one, as in Fig. 1 and Fig. 2). Next connect the copper leaders very close to the fuse, taking notice that the loops are not short-circuited by them; that is, that one leader does not come in contact with both loops. Cut the fuse to the desired length, and wrap tightly with electrical tape; adjust detonator, and the fuse is complete, as in Fig. 3.

In adjusting for length, allow one-third to one-half inch for every fuse, or every series of fuses, if it is desired to have all the holes of a series go together. The shortest one of the round should be two inches over all. If used in very wet ground, or with water tamping, it is a safer plan to dip fuse, cap, and a few inches of the leader in P. & B. paint or some similiar waterproofing paint that will dry quickly.

The above description, like that of many simple things, sounds somewhat complex, but the fuse is vastly easier to make than to describe. In fact, after a few hours trial, a miner will make 20 complete fuses per hour, and with more experience an even larger number will be turned out. All that can be said, as regards safety, of the ordinary electric fuse, applies equally with these, and, besides, these have the advantage of permitting any order of firing that the miner desires, and with perfect safety, which is the great thing in their favor. In cost, too, they are no more expensive than other forms of firing. In fact, they are even less expensive, for, when properly made, there are no missed holes to dig out and blast again, with the necessary loss of time.

As the loops are short-circuited upon themselves, the only part of the resistance wire to become heated on the closing of the firing switch is the very short piece passing through the fuse from one lead to the other. If a lighting circuit is available for firing, an almost unlimited number of holes can be fired simultaneously; that is to say, ignited simultaneously, and fired in accordance with the length to which they have been cut. In using a firing magneto (often called by the miner a 'battery') not quite so many holes can be fired as the rating of the machine would indicate, even though very fine german silver were used.

With a variation of one-half inch in the lengths of the fuses, the reports follow at about the right intervals for easy counting, and with perfect accuracy as regards this interval.

The Government of India has appointed a commission to consider the standardization of Indian weights and measures, an operation which, if carried out successfully, cannot fail to be of great assistance to internal trade. Its desirability is shown by the fact that the maund* of sugar weights 48½ seers in Cawnpore, 40 in Muthra, 72½ in Gorakhpur, 40 in Agra, 50 in Moradabad, 43¼ in Saharanpur, 50 in Bareilly, 46 in Fyzabad, 48½ in Shahjehanpur, and 51 in Goshangunge.

The mineral production of Massachusetts in 1912, consisting mainly of stone, clay products, and lime, amounted to $6,654,514. The value of the stone produced, 60% of which was granite, was $3,663,279.

*A maund is a weight used in India, Persia, and Turkey, and varies from under 19 to 163 lb. avoirdupois. The Indian government standard maund is 82.28 pounds.

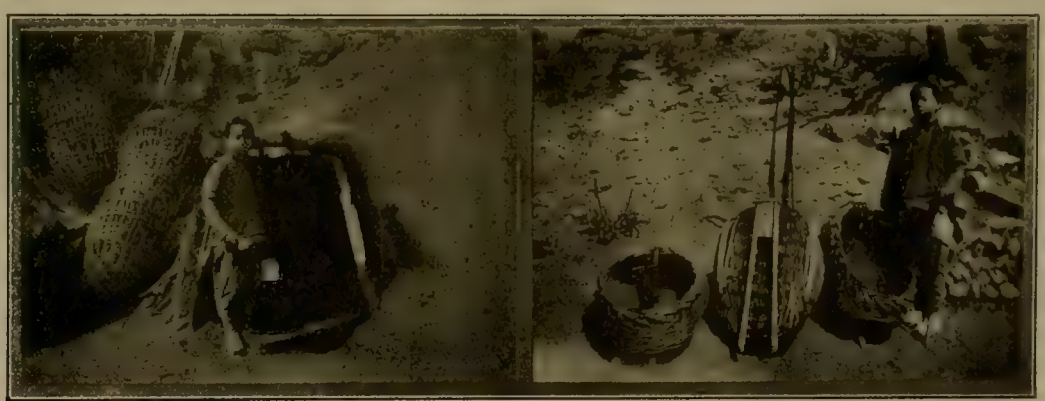
Transporting Coal in China

The illustration on the left shows a typical scene at the mouth of a coal mine in North China. The coal is being sorted and loaded for distribution by carts and pack-animals; some of the output of this mine is transported over 200 miles in carts. Every bit of the coal is sold, and there are no slack dumps. Most of the fine coal and waste is crushed, mixed with mud, pressed by hand into the shape of balls, and dried in the sun. This has been done from time immemorial, and is undoubtedly the first form of briquettes ever employed. The first use of this form of fuel is commonly, and erroneously, ascribed to the French. The central illustration shows a train of pack-mules, loaded with anthracite coal, entering a ferryboat. Rivers are numerous and swift in the mountainous regions of North China, and where the streams are too deep for fording, recourse must be had to flatboats, which are secured by a cable fastened in the middle of the stream, and swing, like pendulums, from bank to bank. The right-hand illustration shows an empty pack-train returning to a coal mine. The paved roadway indicates the amount of care which has been expended in constructing trails, usually following the courses of streams, in the mountainous country.

The lower illustrations show the mouth of a typical native mine; the baskets which serve for the underground transport of the coal are seen at the right. Wherever possible mining is done through entries, the seam being followed down until the amount of water encountered becomes too great to be handled by bailing it out. In some cases a series of niches is cut in the foot-wall, the water being scooped up in gourds or baskets and thrown into the next niche above. With a series of men, one at each niche, a large quantity of water can thus be removed daily. Where less water occurs it is carried out to the surface and in some places the coal is only mined in the dry season when there is but little water to contend with. The coal is broken down by cutting it with a pick and is loaded into the sled-like baskets, which are drawn to the surface by a line attached to a head harness, much like a 'tump-line.' The workings are kept as small as possible to save the expense of timbering, and progress through them is difficult to the uninitiated, especially as they frequently extend for thousands of feet. The basket is sometimes shod with steel runners, as in the illustration, but is more frequently simply provided with bent pieces of the hard outer bark of the bamboo. The man pulling the basket leans over, touching the floor lightly with his hands, and travels with astonishing rapidity. The boy is about 12 years old, and it will be noted that the roof is just the height of his shoulder.

Uranium pitchblende containing 30% of oxide is quoted in Germany at 81c. per pound.

Mineral output of Maryland in 1912 was valued at $10,916,671.



Copper Matte and Base Bullion From an Electric Spelter Furnace

By E. W. Hale

In smelting the complex zinc ores of the Western states, the possibility of securing retort residues valuable enough to pay for a second smelting by reason of the lead, copper, silver, and gold left in them, is always kept in mind. Roughly speaking, 60% of the lead and silver, and 75% of the copper and gold present in the raw ore, may be found in the residues if care be taken in treatment. This offers an attractive margin of profit in some ores, and in others may even determine their marketability as zinc ores.

An anxiom of retorting practice is 'the lower the zinc assay the higher the zinc loss.' Certain figures are fairly well fixed as losses incurred in smelting and that cannot be avoided. It can be readily seen how a low-grade ore offers small attraction to the smelter, as this fixed loss represents more and more of the total percentage of zinc present as that percentage decreases. But low-grade ores may often become attractive by reason of their lead, silver, copper, and gold content, and may show a profit to the smelter in spite of excessive zinc losses incurred in their treatment. For this reason it is sometimes difficult to say just where a zinc ore ceases to be a zinc ore and becomes a lead-silver ore, judging merely by commercial potentialities.

Complex Sulphides

The advent of the complex Western sulphides into the retort plants of the Middle West used to treating the high-grade Joplin ores containing about 60% zinc and 2% iron, brought with them many changed conditions. Retort consumption that had for years rested comfortably upon a daily average of five or six to the furnace, jumped to 20 and 40 when these ores carrying 35% zinc and 25% iron were introduced. The zinc losses in treatment doubled or even trebled over the old Joplin figures. But in spite of these apparently staggering wastes, the smelting of these ores was highly profitable from the start, helped out in no small degree by the value of the residue. Time and experience gradually brought the process more within the bounds of reason, a condition that proved of advantage to the miner as these ores became more sought after. No recoveries on these high-iron ores were ever made, or for that matter are ever likely to be made, in a retort that compares with the old Joplin practice. Their lower tenor of zinc must always act as a bar to this.

To obtain a return from his residues the smelter was confronted at the outset by a fixed cost that ran about as follows:

Freight to re-treatment smelter (Colorado)	$2.00
Treatment charges	3.00
Cost of handling	0.50
Total cost per ton	$5.50

Adding to this the penalties for whatever of excess silica, zinc, or sulphur might be present enabled him to figure his possible profit.

In order to enhance the value of the residue, many measures were tried. The residues coming from the retorts contain, as a rule, 30% of carbon in the form of unburned coal. Freight and treatment charges upon this ingredient is, of course, a needless expense. Screening out the coarser particles, which removed about 40% of the bulk even though it took away some of the metal, was the first step, and is the one most generally used even today. Crushing and jigging or tabling the residues, or merely washing out the coal, have also been tried. Another method much used is to 'heap roast,' in which treatment the carbon is burned off and the bulk decreased by blowing a current of air for a month or six weeks through a large heap of cinders. Although most of these methods show a profit due to the enhanced value of the residue, the fixed charge of freight, plus treatment, plus handling, remains stationary and has to be met by each ton of material finally shipped for its second treatment.

A composite sample of slag from 104 taps and representing 16.9 tons of material in the period June 1912 to June 30, 1913, on complex lead-silver-gold-copper-zinc ores shows:

Copper	0.065%	electrolytic assay on a 5-gm. sample.
Silver	0.500 oz.	on a four assay-ton sample.
Gold	0.010 oz.	on a four assay-ton sample.
Lead	0.050%	wet, on a 5-gm. sample.
Zinc	5.250%	

Samples of matte and bullion made in the same period and the ores from which they were obtained are:

	Copper matte.	Base bullion.	Ore.
E. F. 24, run 2....	9.67% Cu	.....	2.25% Cu
	6.12 oz. Ag	.....	0.48 oz. Ag
E. F. 25, run 1....	4.40% Cu	.....	0.62% Cu
	14.00 oz. Ag	.....	2.10 oz. Ag
E. F. 25, run 2A*.	.....	98.70% Pb	14.10% Pb
	.....	0.72% Cu	1.81% Cu
	.....	0.00% Zn	15.60 oz. Ag
	.....	138.20 oz. Ag	.....
E. F. 25, run 2B*.	25.00% Fe	98.50% Pb	13.70% Pb
	13.00% Pb	1.00% Cu	1.70% Cu
	15.90% Cu	114.80 oz. Ag	15.60 oz. Ag
	24.00 oz. Ag	1.20 oz. Au	.....
E. F. 25, run 2C*.	22.00% Cu	97.60% Pb	3.50% Pb
	21.80% Fe	0.60% Cu	0.25% Cu
	9.00% Pb	96.00 oz. Ag	.....
E. F. 25, run 3....	19.80% Cu	98.50% Pb	11.75% Pb
	31.00 oz. Ag	40.00 oz. Ag	1.68% Cu
	.....	0.02 oz. Au	31.20 oz. Ag
	.....	.....	0.48 oz. Au

*As runs 2A, 2B, and 2C are but periods of the same run, it was impossible to make a sharp metallurgical cut-off, hence part of the copper, lead, and silver charged in the second run was not recovered until during the third, although charged against the second.

In order to obtain all the metals present in one smelting and in one furnace by aid of the electric current, certain details of construction and operation must be introduced that are at a decided variance with the older retort practice. The formation of a copper matte in the furnace necessitates

the presence of a certain amount of sulphur depending upon the amount of copper and iron present, and does away with the necessity for a 'dead roast' prior to treatemnt. The fact that sulphur is a necessity is a decided advantage over the retort process. The iron present is not an enemy to be feared any longer, but a useful friend for forming slag, and the lead settling to the bottom of the furnace carries with it the silver and gold. The copper matte resting above this base bullion separates cleanly from the slag which lies above it.

The unavoidable waste of residues occurring in 'blowing out' the retorts, screening, loading, and transporting the shipped material when they are sent to a second smelter for treatment must be considerable, although no figures can be available. The electric furnace accounts for everything put into it, and, as the expression has been used, 'is metallurgical addition instead of subtraction.' It is quite within the bounds of probability to treat an ore in the electric furnace that would be desirable in no other, one that would carry a penalty for zinc if sold as a lead-silver ore, or a penalty for lead if sold as a zinc ore. The idea of a metallurgical scavenger thus feeding upon the undesirable ores of the far West and turning out the different metals collected, separated, and in marketable form is appealing quite distinct from the rather unattractive simile.

Hoisting at the North Butte Mine, Montana

An electric hoist with a capacity of 300 tons per hour from 2000 ft., and 200 tons from 4000 ft. depth, and one of the largest in the world, is to be installed at the new Granite Mountain shaft of the above mine. The present depth of this shaft is 2900 ft., and skips holding 7 tons of ore each will be used.

The system of control and power equalization used will be that commonly known as the Ilgner system, in which a fly-wheel driven by the motor-generator set is permitted to give up some of its stored energy to supply the peak load drawn by the hoisting motor. In order to reduce the fly-wheel losses to a minimum, the fly-wheel will be encased in a smoothly finished steel housing, and provided with special type of self-lubricating bearings.

The hoisting drums, which will be 12 ft. diameter, will be driven by a direct-connected electric motor running at a speed of about 71 r.p.m. Power will be supplied to this motor from a motor-generator set equipped with a 50-ton fly-wheel to secure elimination of the peaks that would be drawn from the power line during period of starting and acceleration. The hoisting motor will be of the type used in steel mills, of very heavy construction, and will have a maximum intermittent rating of 4500 hp., and the motor-generator set will be driven by an induction motor having a continuous normal rating of 1400 hp. The difference between these ratings represents approximately the amount of energy that will be supplied by the fly-wheel momentarily, during starting. The installation is so designed that the draft of power from the power-line will be practically constant throughout any cycle of hoisting. Hoisting with this equipment will be done in balance, but it is large enough to take care of unbalanced hoistings. Round rope, 1⅝ in. diameter, will be used, and the engine is designed for a normal rope speed of 2700 ft., with a maximum of 3000 ft. per minute.

A number of special safety devices are included in the equipment, including electrically released brakes; automatic slow-down devices to prevent skip or cage going through head sheaves and a special controller to limit the speed when hoisting men. The electric plant alone will weigh over 250 tons. Some high economies have been guaranteed on this installation by the Westinghouse Electric & Manufacturing Co., and this installation will be watched with interest, particularly with a view to comparing its economy with that of the pneumo-electric hoisting system designed by Bruno Nordberg, being used at ten of the Anaconda mines, at Butte.

Preparation of Primers

A recent publication of the Bureau of Mines states that miners should cut off and throw away an inch or two of the fuse before inserting it in the detonator, for gunpowder easily gathers moisture, and the end of the fuse may have become damp enough to quench the burning powder or prevent the ignition of the detonator. Insist that this cut be made squarely across the fuse with a sharp cutting tool; if the cut is diagonal the point may curl over the end of the fuse when it is inserted in the detonator and thus prevent the spit of the powder from reaching the mercury fulminate in the detonator. If the tool is dull, the powder grains in the end of the fuse may be spilled during the cutting, thus weakening the force of the spit into the detonator and possibly preventing its ignition. The free end of the detonator should be crimped around the fuse tight enough to hold the detonator and the fuse together, but not tight enough to cut off the powder train in the fuse. For this purpose use nothing but the proper crimping tool. After crimping, the detonator should be buried in the end of the stick of dynamite with its axis parallel to that of the stick and its top flush with the top of the dynamite. If the detonator is buried deeper, or if the fuse is laced through the cartridge, the explosive is liable to become ignited from the side-spitting of the fuse before it is properly exploded by the detonator. This not only reduces the efficiency of the explosive, but creates a larger volume of gases which are dangerous to the men who must breathe them. Detonators of sufficient strength should be used. Although No. 5 detonators are considered strong enough for straight nitroglycerin dynamite, the less sensitive gelatin dynamite requires a much stronger detonator to explode it properly. For this reason nothing weaker than No. 6 detonators should be used with gelatin dynamite. Universal experience has been that better results have been obtained with all dynamites when strong detonators are used.

Minerals carried by all railroads in Great Britain totals over 400,000,000 tons yearly.

Discussion

Readers of the MINING AND SCIENTIFIC PRESS are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The editor welcomes the expression of views contrary to his own, believing that careful reasoning is more valuable than casual compliment. Insertion of any contribution is determined by its probable interest to the readers of this journal.

Geological Survey of China

The Editor:

Sir—In your issue of November 8, F. Lynwood Garrison, reverting to your editorial of June 28, emphasizes the need of a Geological Survey in China. This step I consider premature.

There is a far more pressing need, in that country, for an increased internal revenue, and the time would now appear opportune for China to follow the counsel of her able foreign advisers. China should revise her mining laws, and establish an efficient department of mines, so as to attract foreign capital to that country, thereby creating a source of revenue which could, eventually, be devoted to defraying the heavy cost that a geological survey would entail.

But, as one who has resided many years in that country and is well acquainted with all classes of Chinese, I fear it is too much to hope for a revision of the mining laws favorable to foreigners, as the anti-foreign feeling which, for the moment, is dormant, will again awaken, as soon as any laws framed to benefit the foreigners are contemplated, and no permanent good is likely to result to the nation so long as the people remain suspicious, not only among themselves, but of foreigners in particular.

HENRY BRELICH.

London, November 27

Pachuca Tanks

The Editor:

Sir—I read with interest Mr. Irwin's letter in your issue of November 22, in which he shows that Pachuca tanks can be started up without trouble after a long shut-down. I find that some complain of difficulty in starting the agitator in these tanks. The only explanation I can think of is that they are not installed properly.

Pachuca tanks were first used by me (1903) for agitating tailing dredged from a river and reground in a tube-mill, and as all the natural slime had been washed away from the tailing by the action of the river and the regrinding did not produce much actual slime, the material was very difficult to agitate. The process employed was decantation, and after each agitation the charge of 50 tons was allowed to settle 12 to 20 hours and agitation was always started up again within a half hour, and by dropping a lead weight attached to a cord, to the bottom of the tank, it was found that no sand was lodged on the sides of the cone after the agitator was well started.

The severest test in my experience that a Pachuca has had, was in agitating concentrates. A tank 37 ft. by 7 ft. 6 in. was used. About 50 tons of concentrate was put into the tank and allowed to stand for 10 days. I succeeded in getting the charge into perfect agitation in about ¾ hour.

The chief advantage of the Pachuca, or at any rate one of its strong points, is that if it is correctly designed for the ore to be treated, and properly installed, it is always a simple operation to start it up, no matter how long the charge has been allowed to settle.

F. C. BROWN.

Boise, Idaho, November 25.

Professional Ethics

The Editor:

Sir—Mr. Lilligren's solution of the ethical problem given in your issue of November 22, I regard as wholly sound and satisfactory. It agrees with what I had in mind in writing the second paragraph under 'Complications and Embarrassments' in my article on professional ethics in the *Transactions* of the American Institute of Mining Engineers, Vol. XLI, page 559.

Now Mr. Lilligren is so clear in "sweeping aside technicalities and doubts," I should like to have his view regarding the succeeding paragraph of the above-mentioned article. It reads (page 559):

"The right to sell information to another, where the first employer has hopelessly failed to pay his bill, raises a fine point; and this is further complicated if a small advance payment on account has been made. The law and the equity might conflict."

I once had the following experience: Several men were jointly interested in an examination which I made, but they were not the owners of the property. One of them paid his share of the bill, one-third, and received the report. The other partners did not pay and were insolvent and irresponsible. Later another party was anxious to get the information, and the mine was not accessible for another examination. The man who had paid his part refused to pay, or to guarantee, the balance of the bill, and, at the same time, refused permission to sell the information to others. Was I justified in saying that he should do either the one or the other?

VICTOR G. HILLS.

Denver, Colorado, November 28.

Electric Smelting of Copper Ores

The Editor:

Sir—We have read with interest your editorial in the *Press* of November 1, on the 'Electric Smelting of Copper Ores.' Four main questions are brought up for discussion in the editorial which deserve comment: (1) the effect of power cost upon the adoption of electric smelting in the metallurgy of copper; (2) the heat efficiency of the electric furnace as compared with the blast-furnace; (3) the impossibility of using refractory linings in the construction of a copper blast-furnace, because of the necessity of frequent barring down of crusts; and (4) the volatilization loss of 1% of the copper present in smelting native copper concentrates containing about 30% copper.

The Bureau of Mines is gathering data and experimental results upon questions (1) and (2), namely, power cost for electric furnaces and heat effi-

ciency, which it hopes to publish as soon as the required information is made complete.

In reading your statement regarding the incompatibility of the use of refractory linings in a smelting furnace where it is necessary to bar down crusts as in the copper blast-furnace, we feel that there is an inference that a water-jacketed shaft would not be used in the electric furnace as in the ordinary blast-furnace. To clear up any doubt on this question, we quote from our paper on 'The Smelting of Copper Ores in the Electric Furnace,' page 2139 of the August *Bulletin* of the American Institute of Mining Engineers, where it is stated: "To begin with, let us assume that our furnace is similar in construction to a modern copper blast-furnace, and that the upper part of the furnace, including the tuyeres, is practically identical with the same. Below the tuyeres the furnace could be constructed as shown in Fig. 3. By referring to this, it will be noted that there are electrodes extending down into the crucible, the arrangement of which along the sides of the crucible, can be noted by referring to the plan of the furnace in Fig. 4." The shaft of the electric shaft furnace proposed by us for copper smelting, is thus water-cooled and made of water-jackets as in the blast-furnace. This shaft is set over a crucible, as is the case in the Swedish electric pig iron furnace; but differs from the Swedish furnace in that it is rectangular rather than circular in cross-section. Only the crucible of the proposed furnace, described in our paper, is lined with refractory material, and is also covered by a roof of refractory material at the sides. The walls of this crucible could be made of water-jackets, if the electrodes were insulated from the shaft walls and crucible walls by a roof of refractory materials. There is, however, no need of adding this complication to the electric furnace, as no crusts could possibly occur that far down in the furnace. The refractory lining of the crucible would easily stand the ordinary wear on it, as has been found to be the case at Trollhättan. In the electric furnace used in ferro-alloy and calcium carbide manufacture, there is a tendency for the material to freeze on the refractory lining to such an extent that eventually the charge itself really forms the lining of the furnace. Furnaces have been run for two years without being relined. In some works, when the charge does not chill enough to form a protective lining, a water spray is played on the steel shell of the furnace, or in some cases the crucible is water-jacketed, but in most plants this practice has been discontinued on new furnaces, which are designed with the electrodes at sufficient distance from the walls to keep the material frozen on the walls of the crucible.

On page 2124 of the paper above referred to, we have stated in conclusion: (2) "The percentage of copper in the slag need not exceed 0.25, with a slag of proper composition. The loss in the slags should not exceed 0.5% of the total copper charged. Other losses should not exceed 1%, giving a total loss of 1.5% of all the copper charged." In your editorial you state that the loss of copper by volatilization was 1% of the copper present. The 1% representing "other losses" does not consist alone of a volatilization loss. It includes volatilization, oxidation, hangings of partly fused ore and dust loss, which includes both the fine material lost in mechanical handling of the fine concentrates at the furnace, and the dust blown out of the furnace by the gases. In the operation of a small furnace there is considerable mechanical loss by hanging and blowing out of fine material by the gas. In our experimental work these two factors seemed to be the chief cause of copper loss, and we found it impossible to separate these losses, because of the small working scale of the experiments.

We appreciate very much the friendly criticism expressed in your editorial, and merely wish to correct any mistaken impression which may have been given in reading our paper. We hope in a short time to present the detailed results of the experiments which have been carried out to date.

DORSEY A. LYON.
ROBERT M. KEENEY.

Pittsburgh, November 10.

[We are glad that our editorial comment has evoked such interesting additional information of the points of leading interest to the operating metallurgist. The important data and experimental results on the efficiency and power cost of electric smelting which are promised will be awaited with keen interest by all.—EDITOR.]

Work at Cucaracha Slide, Panama

Dipper dredge *Mindi* and ladder dredge *Marmot* are operating steadily on the slide. The hydraulic excavating system which has been sluicing material from the top of the slide north of Gold hill, back into the valley to the east, away from the canal, since June 16, has been extended, so that the monitors may cut through a saddle south of Gold hill and assist in handling some of the material involved in Cucaracha slide. A relay station on the southeast slope of Gold hill at elevation 425 ft. above sea-level was placed in trial operation on November 6, and has since been supplying a monitor on the east slope of the saddle with water at a pressure of 150 lb. per square inch. The flume from the Cucaracha saddle disposes of the spoil in a valley with a general elevation of about 250 ft. above sea-level. The outer edge of the slide at this point is about 565 ft. above sea-level, 1800 ft. east of the centre line of the canal, and it is estimated that between 1,000,000 and 1,500,000 cu. yd. of material can be sluiced away from the Cucaracha slide area. After the limit of practicable outward sluicing has been reached, the equipment may be used to wash material from the face of the slide down into the canal, to be handled by pipeline suction dredges, and clean away the loose earth until a firm face of rock is exposed.

Total excavation by Americans in the Canal, to November 1, 1913, was 212,625,216 cu. yd., and ground remaining to be removed amounts to 19,727,784 cubic yards.

Recovery of copper at the Great Fitzroy mine, Queensland, by flotation is 87%, and of the gold, 72 per cent.

Concentrates

Most of these are in reply to questions received by mail. Our readers are invited to ask questions and give information dealing with the practice of mining, milling and smelting.

Hoisting men in mines should not be done at a greater speed than 1000 ft. per minute.

Building or mine timber which has been seasoned by natural processes lasts longer and is more reliable than that seasoned artificially.

Gatun lake, in the Canal Zone, lacked 6½ ft. of its normal height of 85 ft. on November 17, and it is expected that this figure will be attained by the end of the current year.

Telephone, telegraph, and power transmission poles in the United States are procured from forests of northern white cedar, western red cedar, chestnut, yellow pine, and juniper. An acre of forest gives an average of 40 poles.

When using a pump during shaft-sinking, the disposal of the exhaust air or steam sometimes causes trouble. To overcome this, and have a quiet shaft and less annoyance to the miners, it is a good plan to exhaust into the water column going to the surface or elsewhere.

To prevent tools or other material lying around the collar of a shaft from being kicked down and perhaps injuring men below, toe guards should be provided. At many iron mines in the Lake Superior district all platforms are completely protected with this simple device.

Connected with the Copper Queen reverberatory furnaces is a dust chamber of 1200 sq. ft. cross-section and 132 ft. long, from the roof of which are hung 30,000 wires. During a period of 13 months only 9 tons of dust was recovered from the chamber. The chamber connected with the McDougall roasting plant is 1370 sq. ft. in cross-section and 144 ft. long, there being 42,000 wires hanging from the roof. So far the dust recovered is 6% of the charge roasted.

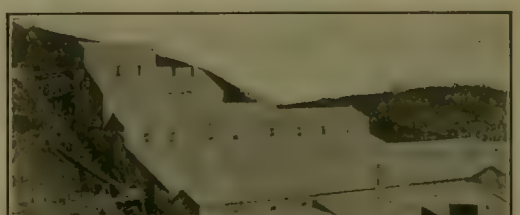
Regarding the type of material used in belt-conveyors, it may be said that for flat belts to handle dry material which is not of an abrasive nature, balata belts are very satisfactory; for troughing belts, to handle rough, sharp, or wet material, experience has proved that a good rubber belt with plenty of rubber cover on the carrying side is most suitable. This is due to its flexibility and, when constructed with proper rubber cover, to its abrasion-resisting qualities.

An aerial tramway 37½ miles long is to be constructed from Mariquita to Marrizares, across the Andes mountains, South America. It will be an extension of the ropeway operating from Ladorado to Mariquita. There will be 12 sections, every two sections to be motor driven, power to come from a new hydro-electric plant near Mariquita. Steel towers, varying from 40 to 125 ft. high, will carry the rope. The altitude will be 11,000 ft. above sea-level. Structural material is being made in the United States, and steel cables and power equipment in England. Sir Douglas Fox, of London, is the designing engineer.

Concrete laid in the Panama canal locks and auxiliary works up to November 1, 1913, was as follows:

Gatun locks	2,050,193
Gatun spillway	230,443
Gatun hydro-electric station	7,295
Gatun duct line	1,919
Pedro Miguel lock	911,851
Miraflores locks	1,487,650
Miraflores spillway	73,497
Pedro Miguel-Miraflores duct line	4,616
Total	4,767,464

Cyaniding on a commercial scale was first accomplished at the Crown mill, Karangahake, New Zealand, in 1889. The ore from that mine contains gold and silver, the total output to September 1913 being $4,130,000. At present the mill is only treating about 1400 tons of $8 ore per month. An interesting system of treating the battery pulp is in operation, the ore being crushed in cyanide solution by stamps, then further reduced in a tube-mill, the pulp flowing in a launder to a series of vats 22 ft. in diameter. These are fitted with the usual filter bottom. The pulp is run into a vat until full, and then diverted to another until full, and so on, several being charged in rotation, and by the time, say, No. 5 was full



CROWN MILL, KARANGAHAKE, NEW ZEALAND.

the first one would have settled. The clear solution is siphoned off from each in order, then more pulp added to the series, four or five times being sufficient to fill a vat with 40 tons of ore to 3 ft. depth. During this time, a drain cock under the filter is left open, to carry off solution filtering through to the bottom of the vat, this solution being saved, of course. Each charge of mixed sand and slime in the vats is given a strong cyanide solution, then weak washes and water, these being helped by the aid of vacuum pumps and solution cylinders. Rich solutions are filtered and run through zinc-boxes as usual. Time taken in treatment occupies up to 5 days, and contents of vats are sluiced out. This process has given satisfactory results, and may be called a crushing in solution-decantation-leaching system. The mill is driven by a Pelton water wheel.

Special Correspondence

LONDON

ORE TREATMENT AT THE GEEVOR PLANT.—CARN BREA AND BOTALLACK

Cornish mining has been very much to the fore again this week, and a number of incidents have attracted attention. Among the profession, the incident that caused greatest interest was the attack made by Oliver Wethered on Horace G. Nichols, at the meeting of the Institution of Mining and Metallurgy. Mr. Nichols had presented a paper describing the results obtained at the Geevor tin-dressing plant, near Land's End. Mr. Wethered is chairman of the Geevor company, and is a financier who has introduced considerable London money into Cornwall, beginning with the Dolcoath twenty years ago. After the details of Mr. Nichols' paper had been discussed at the meeting for two hours, Mr. Wethered, who was present by invitation and not by right, got up and denounced Mr. Nichols for unprofessional conduct in that he had written the paper without his permission; not only so, but the plant described had been swept away by the board of directors and Dolcoath practice substituted. This incident was taken by the meeting as a dramatic denouement, and, as neither the president nor Mr. Nichols had the presence of mind necessary in time of crisis, down came the curtain. But in justice to Mr. Nichols, the matter must not be left there, and I will give the facts of the case, with an outline of the paper.

Mr. Nichols had been commissioned by the directors of the Geevor company last spring to ascertain the results obtained by the plant, which had been designed by R. Gilman Brown and W. C. Madge. Mr. Brown was technical director of the Company. These engineers had desired to try modern inventions connected with grinding, classifying, and concentrating, with the object of testing the principle of step-grinding and step-classification as applied to tin ores, hoping thereby ultimately to increase the percentage of recovery, which is admittedly low in Cornwall. The paper presented by Mr. Nichols gave the results of his investigations, but it does not cover the whole ground, seeing that his description of the operations ceases with the production of the first lot of concentrate, and does not describe the roasting and subsequent second set of concentration operations. The plant erected under the advice of Messrs. Brown and Madge included Hardinge mills, Richards-Janney classifiers, Callow dewaterers, and Deister tables. Readers of Mr. Nichols' paper wondered why treatment on Frue vanners is included in the scheme. It must be explained that a large amount of plant was already on the spot when the engineers took charge, and that the directors desired that use should be made of it. Mr. Madge, at the meeting, stated that these limitations interfered with his plan of crushing and concentration, and that the plant as at work did not meet his ideal by any means. It is notable that Mr. Nichols gives an assay of every product and accounts for all the ore and all the cassiterite contained in it, a proceeding rarely, if ever, adopted in Cornwall.

The tonnage was 100 tons of ore per day. Three Holman air-cushion stamps were kept working at 142 drops per minute, crushing through No. 32 Cornish mesh (diameter of aperture 0.053 in.) perforated screens. The pulp, after passing an automatic sampler, was lifted by the first bucket-elevator, traveling 283 ft. per minute, and passed to the Richards-Janney classifier, in which the first spigot gave 300 discharges per hour, the second 225, and the third 150. The first spigot discharge passed through a small dewatering tank to the Hardinge tube-mill and thence back to the elevator. The second spigot-discharge was the feed to the first row of three vanners, which were speeded to about 3 ft. belt-travel per minute and dropped 5¼ in. at the tail end. The third spigot-discharge was the feed to the second row of Frue vanners, speeded to about 2½ ft. per minute, with a 4½-in. drop, and the overflow from the classifier passed to two small Callow tanks, from which the underflow formed the feed to the third row of Frue vanners, which were run as nearly level as possible and speeded to pull a not too clean concentrate in order to get a tailing lean enough to run to waste. The overflow from these Callows passed to three 8-ft. Callows. The tailing from the first two rows of vanners was reground in the grinding-pans, and with the slime vanner-tailing (third row) was elevated, passing to the two-compartment Richards-Janney classifier, from which the two spigot-discharges respectively fed the two Deister sand-tables, producing a concentrate only, and a tailing run to waste, while the overflow also passed to the 8-ft. Callows. The underflow from the Callows fed four Deister slime-tables. The overflow passed to two more pyramidal thickeners, the underflow feeding the fifth slime-table and the overflow going to waste. The five slime-tables produced a concentrate, and a tailing which was run to waste. The middling all passed to a dipper-wheel which elevated it to two small thickeners in parallel, the overflow from which passed to a larger pyramidal thickener. The underflow from this dewaterer was returned to the dipper-wheel, and the thickened middling

STAMPS AT GRENVILLE, CORNWALL.

was fed to a sixth slimer, the middling of which was close-circuited by passing back to the dipper-wheel. Thus the slime-tables ultimately produced only a concentrate, which was sent to the calciner.

Out of the 100 tons of ore treated per day, the concentrate weighed 2.631 tons, averaging 48% black tin or 32% metallic tin. The tailing contained 7.7 lb. black tin. The percentage of recovery was 78.6%. In order to get a higher-grade product suitable for the smelters, roasting and reconcentrating would be necessary, and the percentage of recovery as quoted by Mr. Nichols would be reduced by losses in these further operations.

One of the points raised in the discussion was in connection with the initial fine crushing, and some speakers argued that a coarser first product should be obtained. Mr. Madge, however, said that the grains of cassiterite are so small as to require this fine grinding, and that it was necessary even to regrind the first spigot discharge of the classifier. The question was also asked why this reground product was returned to the same classifier, to which Mr. Madge said that it was necessary to have the particles fine enough to pass over to the second compartment, and there was no special reason why a separate classifier should be used. I ought to add that Mr. Nichols did not act without the consent of the board, as Mr. Brown, the technical director, who had the whole matter in hand, gave this consent, considering that the figures ought to be publicly put on record.

As to the Carn Brea & Tincroft, incidents in connection with which I mentioned two months ago, I have now to record that the Carn Brea section is to be closed and efforts are to be concentrated on the North Tincroft, which is the most promising at present. E. S. King has not been able to find profitable ore, and the Company is short of money for development and mining. Before proceeding

further with the new mill provided by Lord Clifden, it was felt that independent advice should be obtained, and consequently W. H. Trewartha-James was asked to make a thorough underground examination. His report is not yet published, but his view is indicated by the decision as recorded above. The Botallack, after years of struggle and after the repeated provision of new capital, is on its last legs, and stoppage may be announced at any time. Wheal Jane, belonging to the Falmouth Consolidated, under the control of the Schiff group, after going into the hands of a receiver three months ago, was shut down this week. The Dolcoath returns of concentrate have recently been showing ominous drops, and unless the side lodes recently cut prove to be valuable, shareholders will have some anxious moments before long.

NEW YORK

COLOMBIAN MINING CONCESSIONS.—ESPERANZA AND SANTA GERTRUDIS.—DIVIDENDS.

There has been much interest lately in foreign companies, and the Pearson contracts in Colombia have come in for a good deal of discussion. The quietus to the reports of international politics being a large factor in this matter was given by Francisco Escobar, the Colombian consul in New York, who has made an official statement that the canceling of the concessions resulted simply from popular opposition in Colombia. The Pearson interests had denounced many thousand acres in the ordinary way, but when the title was about to be confirmed, following the usual procedure, great opposition developed in the national legislation of Colombia on the ground that it was dangerous to the best interests of that republic to have so large a part of its area in the hands of a single foreign financial group. Under the circumstances there was nothing else for the Pearsons to do but withdraw. While speaking of Colombia, it may be noted that the Colombian venture of the Oroville Dredging Co. has also evoked much recent comment. The announcement that a dividend would be paid in January and that recent returns would have averaged 65c. per yard, rising for one week to $1.23 per yard, has been given full publicity, but has been met by the rejoinder that the payment of a dividend at this time is only possible through deferring the repayment of the £228,000 advanced for the development of the property, and that even if the present unexpectedly high profits are maintained it will be more than a year before the Company will repay its cash advances, not to mention the note issue held by the Oroville Dredging Company. It is also remarked that since present returns are much higher than expected, subsequent ones may be lower than expected and the present jubilation bears the aspect of whistling before getting out of the woods. It is reported, by the way, that important New York interests are considering taking over a large area of alluvial ground south of Pato, and some interesting announcements may be made later.

The report of the Esperanza for the quarter ended on October 1 has been given out, and shows that the mill crushed 23,355 tons of ore, and treated 34,417 tons of tailing at an estimated profit of £21,819. Godfrey Doveton has made a report, and it is stated that, as a result of his work, a better recovery on the refractory San Carlos ore will be made. There was no interruption of freight service between the mine and the smelter of any importance, but the congested condition of freight at the ports of entry remains unrelieved. This makes slow delivery of all freight, and has caused some delays in the installation of equipment on the upper levels of the mine by the non-arrival of necessary parts of equipment. The management hopes that operations at the end of the year will not show much loss, in spite of the disturbed conditions. At the Santa Gertrudis, the mill crushed 87,137 tons during the quarter, and the receipts from bullion were $700,000, corresponding to an operation profit of $295,000. The profits show an increase since working costs were reduced and the tonnage handled increased. The labor supply at the mine is excellent.

Some of the mining companies are prospering even though general business is slack. Phelps, Dodge & Co. has declared an extra dividend of $2.50 per share, coincidentally with making a larger output of copper than in any preceding year, and the Hedley Gold Mining Co. has declared an extra dividend of 12% in addition to its regular dividend of 3%. The mathematicians of the share market have computed that the Anaconda Copper Mining Co. will earn its regular rate of dividends this year in spite of the lower average price at which its copper has been sold. The Anaconda production for the year is estimated at 270,000,000 lb. of copper. The keen interest in Anaconda is due to the fact that it is the 'milch cow' for the Amalgamated, which is one of the favorite speculative issues in the share market. The Amalgamated has large holdings in other companies, but only derives about $300,000 per year from its International Smelting & Refining stock, and still less from its other holdings.

Amalgamated Copper has $12,527,000 notes outstanding, and its accounts payable aggregate $7,737,000, a total of $20,264,000. Against this, according to the report of 1912, there was due for copper delivered $3,757,000; due from smelting and mining companies, $8,440,000; and $1,182,000 cash, a total of $13,380,000.

BUTTE, MONTANA

OPERATIONS AT THE DAVIS-DALY, WEST STEWART, BUTTE & LONDON, AND TROPIC MINES.—ORE-BINS AT ANACONDA.—TAXING MINERAL LANDS.—ANACONDA AND BALLAKLAVA SUIT.

The Davis-Daly Copper Co. is now shipping nearly 300 tons of ore per day to the smelters, this being mined from all points between the 1200 and 1900-ft. levels.

The scale of operation at the mines of the Anaconda company can be realized when it is stated that the capacity of the mine ore-bins is now 50,000 tons. The bins were recently enlarged to this total capacity to prevent a shutdown in the cold weather, when the smelters have trouble handling the daily production. With the increased bin capacity, most of the mines could run several days without depending on the smelters to keep the bins empty.

The West Stewart mine will be closed for a period of three months pending repairs in shaft, machinery, ore-bins, etc. The Butte & London property is being equipped with a 425-hp. electric hoist, with which the shaft will be deepened from the 100 to the 1600-ft. levels.

The Supreme Court of Montana has rendered a decision to the effect that the mineral reservations made in deeds for land from the Northern Pacific railway are taxable. This is an important decision, and will affect the mining industry in Montana in several ways. For one thing, if the decision is upheld, the railroad company will not be so prone to make indiscriminate blanket reservations in its deeds if it is to be taxed accordingly. As things stand today, a purchaser of a provisional title to Northern Pacific lands is not eager to prospect any mineral showings on his land, as the railway company might step in and lay claim to it.

The Tropic shaft of the Anaconda company is now down to the 700-ft. level, where good oxidized copper ores have been opened. The Tropic lies east of Silver Bow creek, near the property of the East Butte Copper Mining Co. Favorable development at the Tropic will be encouraging to neighboring properties. The deep oxidized zone in the Tropic is characteristic of all veins on the flat west of the Continental fault, although water-level is not as deep as in the mines on the hill.

Butte capital is heavily interested in the Rocher de Boule Copper Mining Co. in the Hazleton district, British Columbia. A heavy outlay has been necessary to place the property on a profitable basis. A gravity aerial tramway over 3 miles long is to be erected, and a hydro-electric plant to furnish power to the mine has been installed. The operators are very sanguine about the mine, as several veins have been developed, one of which is 9 ft. wide and contains over 12% copper.

The amicable adjustment of the litigation between the Anaconda Copper Mining Co. and Butte-Ballaklava Copper Co. meets with general approval at Butte. Some would

argue that mining litigation lends life and activity to a camp, but the saner heads realize that the conditions are artificial and do not make for permanent prosperity. It would seem that the Ballaklava company obtained an entirely fair division of the veins, and should now be able to proceed with mining and development in a profitable way. The settlement of the litigation is apparently accompanied by good feeling all around. The president of the Ballaklava, in a public letter, commends the fairness and just dealing of the Anaconda company in the matter.

PLATTEVILLE, WISCONSIN

CONDITIONS IN THE ZINC-LEAD DISTRICTS.—DETAILS OF MINING WORK.—ORE PRODUCTION AND PRICES FOR NOVEMBER.

The month of November was featured by bad weather, consequent bad roads, and declining zinc-ore markets in the Wisconsin zinc-lead mining districts, but all this failed to deter producers from maintaining a fairly normal production and making further provision for still greater development of the field. From the Missouri districts came reports of reduction in wages of miners, but no such calamity visited the miners of Wisconsin. On the contrary, miners were in strong demand at several points in the field, at wages maintained through the greatest periods of prosperity.

Prices for zinc ore averaged well during the month, 60% ore running through the month from $39 to $42 per ton. The low level for the field is graded at 30% zinc, which brought $14 to $15; 35%, $16 to $18; 40%, $20 to $22; 45%, $24 to $26; 50%, $28 to $30; and 55%, $32 to $34 per ton. A considerable gain was shown in the volume of high-grade ore from the field.

Out of a total shipment of 270 cars of zinc ore, both refined ore and crude concentrate, the Mineral Point Zinc Co. secured over half, or 5740 tons; Grasselli Chemical Co., 1529 tons; National Separating Co., 869 tons; Illinois Zinc Co., 689 tons; M. & H. Zinc Co., 386 tons; Empire Roasters, Platteville, 561 tons; and the Linden Separating Co., 240 tons. The last-named plant was shut down for a time, owing to shortage in the power furnished by the Mineral Point Public Service Co., which supplies the Linden district. The gross production of raw concentrate for November, from mines, aggregated 17,816,740 lb., and net refined ores and raw concentrate to smelters 12,603,630 lb. The Mineral Point Zinc Co. shipped 35 cars or 2,647,500 lb. of roasted ore to the smelter at De Pue, Illinois. Shipment of lead ore was comparatively light, the ore coming in quantity as follows: Saxe-Pollard mine, Linden, 147,640 lb.; Tripoli, at Mineral Point, 59,200 lb.; Fox, at Benton 60,000 lb.; Wilkinson mine, 56,500; Vinegar Hill, Galena, 58,800; Beloit-Elmo, at Big Patch, 50,000 lb.; Kennedy, a Hazel Green, 60,000 lb.; and Winskill, Shullsburg, 66,000 lb.; a total of 558,140 lb. No appreciable gains were shown in the production of iron pyrite, the Wilkinson mine at Benton producing about 400 tons per week. Shipments were made as follows: Linden Separating Co., 347,970 lb.; National Separating Co., Cuba, 629,640 lb.; Wilkinson mine, 3,277,600, all going to the Grasselli Chemical Co., East Chicago, Indiana.

Shipments by districts were made as shown in the following table:

District.	Zinc, pounds.	Lead, pounds.	Sulphur, pounds.
Benton	3,846,000	116,500	3,277,600
Hazel Green	2,580,000	118,800	.....
Livingston	2,500,000	.....	.....
Platteville	1,920,000	50,000	.....
Linden	1,836,000	147,640	347,970
Cuba	1,834,000	.....	629,640
Highland	1,356,000	.....	.....
Harker	618,000	.....	.....
Shullsburg	424,000	66,000	.....
Mineral Point	246,000	59,200	.....
Montfort	242,000	.....	.....
Rewey	84,000	.....	.....
Mineral Point Zinc Co.	2,647,500	.....	.....
Total	20,133,500	558,140	4,255,210

The following mines contributed to the output for the month: New Jersey Zinc Co., Gunn & Co., Highland; Glanville, Ross, Optimo, Hinkle, and Saxe-Pollard, Linden; Grunow, Peacock, Peni, B. M. & B., and Lucky Six, Harker; Barreltown for Mineral Point; O. P. David and Montfort; Coker, Ellsworth, and Rundell for Livingston; Peni for Rewey; Empire, Enterprise, East End for Platteville; Burr, Masbruch, and National Separating Co. for Cuba; Fontier, Fox, Crawhall, Indian Mound, Wilkinson, Temple & Lawyer, and Martin for Benton; Kennedy and Cleveland for Hazel Green; Milwaukee-Shullsburg and Winskill for Shullsburg; Black-Jack, Pittsburgh, Vinegar Hill Northwestern, Federal, and Wilson for Galena.

EMPIRE MILL AND WORKS OF MINERAL POINT ZINC COMPANY.

A number of new properties were opened for the first time to production at several points in the field which are destined to develop into consistent zinc-ore producers. The Highland district, out of the list for the greater part of this year, is now shipping one or two cars per day and will make one of the best showings of any district in the field before the winter is over. The shipments shown for Harker and Livingston cover ores produced in the Mifflin district.

A brief summary of the more important happenings in the field for the month may be stated as follows: The New Jersey Zinc Co. began production at Highland after a considerable outlay of money, and was in the market for men. A pump shaft is being sunk costing $10,000. Engineers for the Company made tentative plans for mining by open-cut on the Carey land, removing the ore with team-shovels. At Linden, the Saxe-Pollard Milwaukee combination bought the Hinkle property, shut it down for the present, and removed the working force of 30 men to the Saxe-Pollard mine, where large ore deposits are being

opened. The Glanville mine, with plenty of ore, is not up to standard conditions owing to mismanagement. The B. M. & B. Co., operating the Squirrel mine at Mifflin, resumed operations after a long period of idleness, and required more help. The Beloit Elmo, after two years, succeeded in getting into producing shape under the management of R. Davis, of the Wisconsin State Mining School. The old Enterprise mine at Platteville was again invaded, and drills are proving adjoining leaseholds recently secured. In two years this mine paid $180,000 in dividends. Good developments in zinc ore were made in a drift in the West Hill Mining Co.'s leasehold, on the Stevens farm, one mile west of Platteville. The Cook mine at Cuba was taken over by local people, after three years' idleness, and a force of men started to work. The Roosevelt mine, another producer, passed into the control of Chicago capitalists and men were set to work. At Benton, the Frontier mine, which in five years has paid $200,000 in dividends, and reported to be looking poor, opened new lodes, insuring an extension of life. Longhenry brothers, after much difficulty, opened ore and began production. The Martin mine, owned by the Vinegar Hill Zinc Co., began operations with a new plant and was producing 20 tons of ore per day at the close of the month. The Bull Moose mine reached ore in new ground and was rushing a new 100-ton plant to completion. The Sans Souci Mining Co., a new venture, was engaged in putting up a new power and milling plant. Good developments in ore were made in four new prospects. The finest discovery of zinc ore made in the field in years, if not in its entire history, fell to the lot of Homer S. Snow, of Platteville. This was at the Champion lease near Benton. The land was purchased outright for $40,000. In scores of borings, made with two Keystone drills, not a blank was drawn. The lode has been proved east and west for 1000 feet. The elevations show ore in some of the borings at 95 and in others strongly mineralized territory extending to a depth of 140 ft. The width has not been fully determined to date, and the work of proving continues. The Cleveland Mining Co., at Hazel Green, is finishing a 100-ton power-plant on the Lawrence property, and another 150-ton plant has been started on the Scrabble Creek near by. The Pittsburgh Lead & Zinc Co., operating at Pilot Knob south of Galena, is constructing a new power and concentrating plant. New shafts are being sunk on extensions of the Winskill property at Shullsburg. The Wilson mine at Postosi was down for a time, due to shortage of coal which caught many mines unprovided. Bad roads prevented most of the outlying mines, many of which are heavy producers, from carting ore to railways most of the month. Leading mine managers interviewed on the condition of the markets expressed the belief that no changes will be shown for sixty or ninety days. Regardless of drawbacks, all thought it the best policy to continue operations, retaining plant equipment at maximum efficiency and holding working forces intact. When the figures showing production for the year are to hand, it will be found that the Wisconsin field has made its best showing in years, and fully 125,000 tons of zinc ore was sent to market.

TORONTO, CANADA

PROVINCIAL MINERAL RETURNS.—POSSIBILITIES OF NORTHERN ONTARIO.—GOLD DISCOVERY IN NOVA SCOTIA.

The Mines Department of Ontario has just published figures covering the mineral output, so far as obtainable, for the first nine months of 1913. These are as follows:

	Quantity.	Value.	Increase.
Gold, ounces	159,962	$3,281,077	$2,163,692
Silver, ounces	23,171,536	12,967,138	259,312
Copper, tons	9,237	1,311,681	169,605
Nickel, tons	18,233	3,825,000	405,196

Nearly all the gold came from the Porcupine district, chiefly from the Hollinger and Dome, also some from the Porcupine Crown and McIntyre mines, the total being worth $3,106,250. The other gold mines making up the nine months' yield of $3,281,077 were in the Long Lake, Swastika, Kirkland Lake, Larder Lake, and Sturgeon Lake districts. There were 31 producing silver mines: 27 in Cobalt, 2 in Gowganda, and 1 in South Lorrain. In output the Nipissing led with 4,387,765 oz., then Coniagas with 2,662,687 oz., and La Rose with 1,903,345 oz. There were a number of other good producing mines. Cobalt is developing splendidly and fulfills the prophecies of the most sanguine; but Porcupine is beating all estimates, and perhaps people will now believe that there is gold in Ontario that only requires men, money, and faith to develop it into good paying gold camps, such as the Larder Lake, Swastika, Long Lake, Kirkland Lake, and Sturgeon Lake districts.

A rich gold discovery has been made quite recently at Isaac's Harbour, Guysborough county, Nova Scotia. The vein was opened by a Mr. Gisburne about forty years ago with good results, when a fault came in, and the search for the vein made at different times since, has been rewarded, a Mr. Keuh having succeeded in finding it. This achievement, after forty years' intermittent labor by various parties, has created considerable interest in Nova Scotia gold mining.

At a special general meeting of the Jupiter Mining Co., the directors were authorized to raise $40,000 by the issue of $50,000 6% one-year bonds, which are to be offered to the shareholders at 80, and any balance that may not be taken up will be offered to the public. The indebtedness of the Company amounts to $36,402, of which $14,000 is due on machinery and power equipment ordered for the mill.

JOHANNESBURG, TRANSVAAL

SHORTAGE OF NATIVE LABOR.—GOLD OUTPUT.

The principal mining topic of interest on the Rand is the increasing scarcity of unskilled native labor, and when the figures are carefully examined, some surprise is expressed that with the growing scarcity the output of gold is not further restricted. At this time of the year the supply generally begins to right itself, but during the latter half of 1913 the loss of labor has been so abnormally large that the year is bound to finish with a smaller available supply than for several years past. Prior to July, the month of strike disturbances, native laborers were deserting the Rand gold mines in extra large numbers. In June, for instance, there was a leakage of 9550 natives, but in July this increased to 17,852, and in August to 12,019. The loss in September came down to 5586, and in October to 3755, and it may disappear by the end of the year; but already there has been a loss of over 50,000 as compared with January, while the previous year showed a gain of approximately 7000. The deep-level mines have been by far the greatest sufferers. One has already been compelled to close down altogether through an inadequate supply of native labor, and several of the largest mines report large losses. Up to May last the Witwatersrand gold mines were showing the usual progressive increase in the output of gold, but it is doubtful whether the setback then suffered will be made up in the coming six months. Under these circumstances, and in the face of the fact that October showed a net loss of 3755 laborers compared with September, it is satisfactory to notice that the Rand gold output for October showed an increase of 11,104 oz. over that of September, although when compared with August a slight decline is noticeable. The Rand output as declared by the Chamber of Mines for October gave a total of 687,515 oz., valued at £2,920,379. As compared with September, there was a decline of no less than 170 in the number of stamps dropping, of which, however, no less than 120 may be attributed to the closing of the Jupiter, the deepest mine on the Rand. Even the Randfontein Central had 25 less stamps dropping, the scarcity of labor being also intensely felt at the Crown Mines. It is quite an unusual monthly occurrence for none of the Rand gold mines to drop additional stamps, but this happened in October and may be regarded as positive proof that native labor is universally scarce throughout the district.

The position of affairs at the East Rand Proprietary mines continues to be interesting, and the announcement that the renewal of Ross Skinner's engagement will not take place, has not caused much surprise. Since June the

estimated monthly profits have declined over £10,000, due, it is explained, to a smaller tonnage being milled owing to the acute shortage of labor caused by the recent industrial disturbances. The quarterly report for the three months ended September 30 states that development covered during that period 11,808 ft., of which 9,326 ft. was sampled, giving an average reef width of 25 in., and over that width an average assay-value of 9.9 dwt. per ton. The closing down of the Angelo Deep and Hercules stopes has naturally thrown the development into the profitable areas in the northern part of the mine, hence the satisfactory results obtained during the quarter; and the further development, about to be undertaken beyond the water dike, will be watched with considerable interest. It is generally known that the Angelo Deep and Hercules, east of the water dike, have proved unprofitable, and it seems likely that the large area owned by the Company on the dip of this vein, and east of the water dike, will also prove of little value. It naturally follows that the future of this great property may have to depend upon the results obtained beyond the water dike, as the underground pumps and dams, to allow the water dike to be pierced, have been installed and completed. Future development operations beyond the water dike are regarded of the highest importance. The future is not, however, by any means discouraging, for beyond this dike, at a depth of 4000 ft., profitable ore was long ago disclosed.

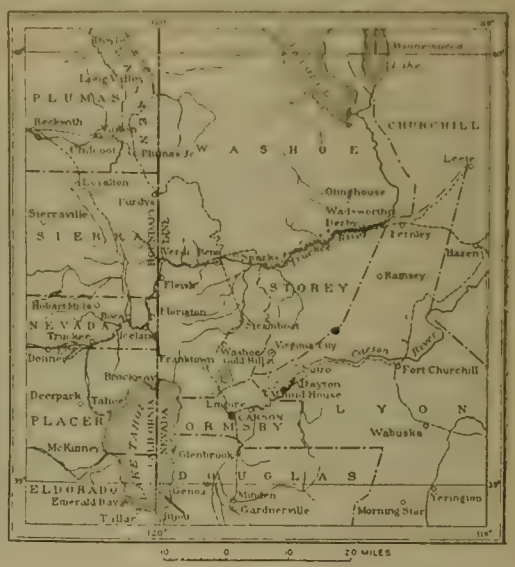
YERINGTON, NEVADA

DEVELOPMENTS AT NEVADA-LUDWIG.—PLANS FOR A LEACHING PLANT.—GOLDEN GATE MINE.—SILVERADO UNDER LEASE AND BOND.—OPERATIONS AT PINEGROVE.

The new orebody discovered about three months ago in the Casting Copper group of the Nevada-Douglas properties, promises to be the most important find ever made in the property. This group is about one-half mile south of the Douglas mine in territory to which little attention was paid in the past. There is an old shaft 300 ft. deep, and on the 100-ft. level some driving was done and an unknown amount of low-grade ore partly developed. About three months ago a little more work was done with the idea of testing some of this ore by leaching, and by accident the new orebody was broken into. At the present time an orebody about 250 ft. long, 50 ft. wide and 170 ft. deep is developed, although the limits have not been found below the 200-ft. level. About two cars per day of 8% ore is being sent to the smelter. This all comes from development work. The ore occurs in a garnetized zone near a contact of lime and shale, and the prospects of opening large quantities are considered very good, as there is much unexplored territory in this group. On the 800-ft. level of the Ludwig mine a body yielding about 6% ore is being explored. It contains large pieces of native copper and these are being sorted out and will be shipped separately. The Company plans to erect a leaching plant at Ludwig. The Greenawalt process will be used, and results of tests, using sulphuric acid as a solvent, have been very encouraging. By agitation 95% extraction has been obtained in a few hours. Precipitation will be by electricity. The ore will be ground to 30-mesh, and the tests at the Company's Denver plant have indicated that the mechanical difficulties can be easily overcome. Sulphuric acid will be made on the ground, using low-grade chalcopyrite ores developed on the 750-ft. level of the Ludwig.

Development work is under way on lower levels of the Golden Gate mine, but the orebodies found in the upper workings have not yet been cut. The mine is in Little Antelope valley, Mono county, California. The ore occurs in a fissure in gneiss. It is opened to a depth of 300 ft. and practically all of the ore above this level has been taken out by lessees. The last lessees built a 10-stamp mill, run by water power, and milled about $35,000 worth of ore which yielded $4.91 on the plates. Concentration was not attempted. It is said that the extraction is low. The property is said to have considerable merit, but needs development at depth. The ore-shoots on the surface are short, but increase in length as depth is obtained. The old Silverado is under lease and bond to local men. It is near Masonic, California. It also is a narrow fissure, and ore is said to average 10 to 24 inches in width, with a value of $25 per ton. There is an old mill on the property, but the present owners expect to ship ore to the smelter at Thompson and will sort out the high-grade ore for this purpose.

The old Wilson mine at Pinegrove is again being operated. It is about 25 miles south of Yerington. Electric power is obtained from the Truckee River General Electric Co., and without this power it would be impossible to operate at a profit. The Wilson mine is one of the old gold mines of the state and is stated to have produced about $4,000,000, mostly by lessees. About five years ago the mill was destroyed by fire, and shortly after that the present owners acquired the property. A long adit was driven in from Scott's cañon side for the pur-


PLUMAS
SIERRA
WASHOE
CHURCHILL
STOREY
LYON
PLACER
ORMSBY
DOUGLAS
ELDORADO
NEVADA
Reno
Sparks
Virginia City
Carson
Fort Churchill
Dayton
Silver Peak
Wabuska
Yerington
Gardnerville
Genoa
Minden
Truckee
Tahoe
Verdi
Fernley
Hazen
Fallon
Lovelock
Winnemucca
Susanville
Quincy
Placerville
Sacramento
Nevada
Carson River
Walker River
Humboldt River
Truckee River
Lake Tahoe
Pyramid Lake
Honey Lake
Mono Lake
Owens Lake
Death Valley
Long Valley
Beckwith
Thomas Jct.
Clanghouse
Wadsworth
Sierraville
Hobart Mills
Boca
Truckee
Donner
Floriston
Brockway
Deerpark
Tahoe
Glentrook
Emerald Bay
Tallac
Morning Star
Ramsey
Alturas
Lassen
Lovelock
Fernley
Hazen
Fallon
Fort Churchill
Wabuska
Yerington
Gardnerville
Genoa
Minden

General Mining News

ARIZONA

Gila County

(Special Correspondence.)—During November the Inspiration Consolidated company made a total advance in its underground workings of 3300 ft., of which 1136 ft. was in large drifts, 782 ft. in smaller drifts, and 1332 ft. in raises. Nearly all of the raises were driven in the Colorado orebody, only two being driven in the Joe Bush portion for the purpose of affording channels of ore extraction from the overlying dumps or stockpiles. One of these two raises holed through into the edge of a stockpile. At the mill the usual activity in construction is shown in all divisions. Three No. 8 Allis-Chalmers gyratory crushers have been unloaded. The coarse-crushing plant will consist of four machines. The shaft of the Arizona Commercial is down 1350 feet.

Miami, December 12.

Messrs. Locke and Bateman have recently made a geological examination of the Inspiration mine, so that they may make a more extensive study and for the purpose of secondary enrichment investigation. This is being conducted under the direction of L. C. Graton, of Cambridge, Massachusetts, who has prevailed upon various other mining companies to bear the expense of a detailed investigation of the copper deposits in the various parts of the country. Last week, the east drift on the 650-ft. level of the Iron Cap was connected with the Eureka shaft of the Arizona Commercial, thus improving ventilation and affording another exit for miners. The new surface equipment at the Old Dominion is being installed as fast as possible. A Hardinge mill was erected in the old concentrating plant, and should soon be at work. An Aldrich quintuplex electric pump has been ordered for the 1800-ft. level of the mine. This will raise water to 1200 ft., and from there other pumps will raise it to the surface. A winze is to be sunk from 1600 to 1800 ft. on the west side. Three furnaces are in blast. The Calumet & Arizona Copper Co. has been criticized at times for not paying more dividends and acquiring too much property.

The Inspiration Consolidated Copper Co. at Miami, will add to its equipment six motors ranging from 50 to 100 hp., and control panels.

Mohave County

On the 100-ft. level of the Gold Reed Mining Co.'s Mayflower claim, 4 ft. of $30 to $80 gold ore has been opened for 15 ft. The Company is also sinking in the Jupiter claim, adjoining the Tom Reed.

Greenlee County

On December 9 eleven kegs of powder exploded prematurely in an open-cut of the Arizona Copper Co.'s mine, killing four Mexicans and injuring three other foreigners. A large Dorr thickener is being built at the Company's plant.

Yavapai County

The Humboldt smelter will probably resume the treatment of custom ores. At present nearly all ores from the county are sent to Douglas. New machinery is being installed at the smelter, which is producing matte from ores of the Bluebell mine. Rich gold-silver ore has been shipped from the Shamrock on the Hassayampa. The United Verde Copper Co. has paid to the county treasurer a check for $148,768, being taxes for the year. At the Little Daisy mine, near Jerome, the Douglas shaft is down 800 ft., with further sinking to be done directly. On the 1230-ft. level of the Haynes, a 24 by 30-ft. station has been cut, and an electric pump and compressor are to be installed.

A large tonnage of ore has been developed by the Nelson Mining Co., at Crown King, and a narrow-gage railway will be constructed to connect with the Bradshaw mountain line, a spur of the Santa Fe system, while a 20-stamp mill will also be built near the mine.

CALIFORNIA

Amador County

The South Eureka Mining Co., Sutter Creek, will place in operation in its mines a 2½-ton electric storage-battery mine locomotive, recently ordered from the General Electric Company.

Calaveras County

Further complaints of damage by smelter fume from the Penn Mining Co.'s smelter near Campo Seco have been made by farmers to the authorities at Sacramento. Nearly 90% of the year the prevailing wind carries the fume away from the farming lands of the county, and almost right at the smelter excellent fruit and crops are grown. As a matter of fact, along the Mokelumne river there are several large orchards, vineyards, and other fields which have every appearance of being in the best of condition. Oaks and pine trees, the latter being the first to suffer from fume, are growing in large numbers just across the river from the smelter, and have not suffered. The Company has spent a large sum of money in testing the 'Thiogen' process for minimizing the fume produced in smelting.

Los Angeles County

The Chamber of Mines and Oil, the Sierra Madre Club, and the southern California sections of the American Chemical Society and of the American Institute of Mining Engineers, had an informal dinner on December 16 in honor of Irving C. Allen, petroleum chemist of the U. S. Bureau of Mines, and Charles E. van Barneveld, director of the Department of Mines and Metallurgy, Panama-Pacific International Exposition. Mr. Allen spoke on government plans regarding the petroleum exhibit at the exposition in 1915. Mr. van Barneveld discussed a state-wide movement for petroleum exploitation at the exposition. Norman Bridge responded on behalf of the oil men of California. S. E. Vermilyea, president of the Chamber of Mines and Oil, presided. The members of the club, the Chamber, and the Institute have been invited to participate with the members of the American Chemical Society in an informal dinner at the Hollenbeck hotel, December 19. The following program will be presented: 'The Technological and Coöperative Petroleum Work of the Bureau of Mines,' by Irving C. Allen; and 'Antimony, Its Ores, Metallurgy, and Uses,' by L. C. Mott.

Modoc County

News of discovery of ore near Willow Ranch has reached Fort Bidwell. The miners have 8 ft. of $15 ore, and men in the High Grade district are interested.

Nevada County

The machine-drill testing apparatus, the invention of W. D. Paynter of Grass Valley, and described in this journal of August 2, 1913, has been placed on the market. One machine has been sent to the Copper Queen mine, Arizona, and another is being made for the Goldfield Consolidated, Nevada.

Placer County

A good asbestos deposit has been discovered by A. W. Hulbert in the Rock Creek district. The Guggenheim company is prospecting placer ground near its main area on the American river, 7 miles from Auburn. Options have been extended on some ground bonded last spring.

Shasta County

(Special Correspondence.)—The steel flue of the Field process plant, at Redding, has been practically completed, and the first test of the process will be made about December 15 unless inclement weather interferes with remaining construction work. The flue is 300 ft. long, with the upper half equipped with jackets for the passage of cold air, and the lower part containing 36 hoppers. It is planned to treat sulphurous fumes by means of cold air, ammonia being the refrigerating agent. A consignment of ore from the Balaklala mine is on the ground for the initial test. The Mammoth Copper Mining Co. is building a new road to the recently purchased Spread Eagle group and will probably commence shipments to the Kennett smelter in the early spring. The Shasta-Belmont Mining

Co. has let a contract for the building of a road from its mines to Heroult, and plans early shipment of ore to the Kennett smelter. The ore carries high copper content, also gold and silver. Carson City, Nevada, people are interested, and W. E. Casson is manager. In the Whiskeytown district, mining is distinctly on the up grade. At the Mad Ox, recently acquired by W. H. McEwen of Oakland, the lower drift is being extended to cut the vein which yielded well in former years. The property was at one time operated with excellent results by Messrs. Hearst and Haggin. The Black Hawk is yielding good ore and the mill is operating steadily. A 12-in. shoot of rich quartz has just been found in the West End, recently reopened by Eaton and Blair. Developments in the Gambrinus, Honey Bee, and other mines are reported as encouraging. L. B. Barnes is arranging for the operation of the Silver King mine on a larger scale. Some gray copper has been discovered in addition to silver-bearing ore. The Russell placer mines, near Igo, were lately inspected by San Francisco investors. A dry-land dredge is employed to excavate the gravel, and results are said to be satisfactory.

Redding, December 8.

Ten carloads of copper ore was shipped from the Balaklala mine, on December 12, to Wabuska, Nevada, where it will be smelted in the plant of the Mason Valley Mines Co. The Noble Electric Steel Co.'s smelter, at Heroult, has resumed work after a shut-down since July 15. The furnaces have been altered to use coke instead of charcoal. The electrodes are of graphite, 12 in. diameter and 48 in. long. Eighty men are employed. At Kennett the Mammoth Copper Co. has just bonded 34 claims in the Spring Creek and Squaw Creek districts, from the Shasta Copper Exploration Co. The bonding agreement was filed for record on December 10.

The Mountain Copper Co. has developed a large tonnage of low-grade ore, and it has been announced that a large concentrating plant is to be built, the first unit to be complete at the end of 1914.

Tuolumne County

Electric motors are being installed throughout the equipment at the Eagle-Shawmut mine. Instead of hoisting ore to the top of the shaft, it is to be hauled to the adit-level and then trammed to the mill by an electric locomotive.

COLORADO

Clear Creek County

The Dividend Mining Co. is developing the Annamosa claim at Empire, and has a shaft down 900 ft. On No. 4 level the ore has been opened for 60 ft., and is rich in gold and silver.

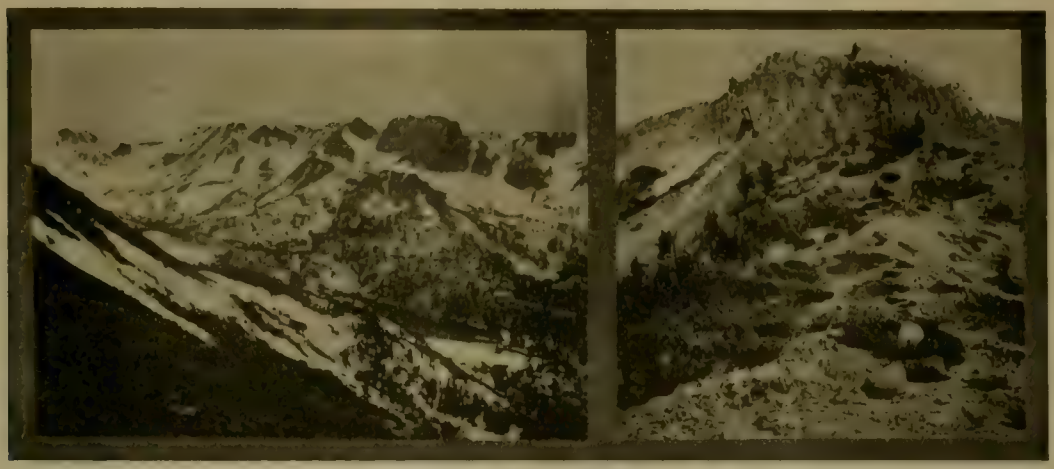
On No. 6 level of the Santiago mine rich copper pyrite has been opened. Regular shipments are made from this property averaging about $40 per ton. Work has been resumed in the west drift on the Magenta-Turner vein through the Prudential adit. The Big Indian Mining Co. has been developing its property on Leavenworth mountain for three years, and in a few days a drift is expected to cut the Big Indian vein.

Eagle County

During the past week the Marion Henry Mining Co., operating the North Dakota group of claims at Brush creek, shipped to the Leadville smelter 40 tons of ore, the first shipment sent out from the property. The vein from which the ore comes is 5 ft. wide, and in this vein is a small streak, 18 in. wide, from which assays of from 600 to 900 oz. silver per ton have been obtained. In the Lady Belle, 60 ft. from its boundary, 2000-oz. ore had been opened. Lessees at the South Dakota cut ore assaying 20 oz. per ton.

Lake County (Leadville)

It is admitted that there would be greater mining activity at Leadville if the underground workings of Fryer hill were unwatered, but plans that were arranged during the past year have fallen through. A large number of companies were interested in the project, but failed to sign an agreement, to contribute to the cost, by October 1, the date set for all to come in. It is stated that the whole area could be drained and permanent pumps could be installed for about $120,000. From the Big Four, Breece hill, there was recently shipped 47 sacks of ore valued at 100 oz. gold per ton. This came from No. 3 level, where it is found in pockets in a stope 40 ft. wide. In the Montezuma district the Cora Belle mine has been developed by six adits, No. 5 being in 1000 ft., and the others from 500 to 800 ft. The ore-shoots vary from 2 to 10 ft. wide, and shipments to the Leadville smelter average 26 oz. silver and 40% lead. Milling ore is sent to the Sutton-Steele company at Denver. On Glacier mountain, the McCulloch main adit is in 1300 ft. and six veins yield silver-lead ore similar to the Cora Belle.



SCENE IN THE HIGH SIERRAS.

Park County

According to the State Commissioner of Mines, T. R. Henahen, there has been a revival in mining at Alma. The following are the properties that are now shipping and have a regular payroll: No End, the heaviest shipper in the district at the present, is yielding a fair grade of ore; Morning Star, which has a new mill and is getting returns; Hock Hocking is shipping and developing; Magnolia, shipping; Galveston, developing; Webber group, developing; Good Samaritan, shipping; and East London, developing.

Teller County (Cripple Creek)

A great deal of damage was done to the district by the recent snowstorm, by covering all railroads and trails

several feet deep, damage to transmission lines and telephones, blowing over smokestacks, and preventing ore shipments. The electric pumps on the 1600-ft. level of the Golden Cycle mine were 'drowned,' and the steam pumps are not used on account of shortage of fuel. The lower levels of this mine and the Vindicator will be flooded. Rescue work in the Golden Cycle has been prosecuted with great energy since the fall of rock, and the bodies of S. Sorensen, P. Kevany, and F. M. Woods have been recovered. Lessees at the Granite Consolidated, on Battle mountain, have opened rich ore. The Portland Gold Mining Co. will pay an extra dividend of 2 cents per share, amounting to $60,000. The total for 1913 is $300,000, and $9,457,080 to date.

THE SAN JUAN

In the Mountain Top, at Ouray, No. 3 vein shows 12 in. of rich ore. The north drift is in 600 ft. A new shoot of ore is developing well, and 39 in. assays $32 in silver and 17% lead. The Brown Mountain smelter is working satisfactorily.

IDAHO

BLAINE COUNTY

Twenty-two inches of galena has been opened in the Queen of the Hills mine. The development is in the adit, 500 ft. below the apex of the vein. Charles Bonner is superintendent of the property, which is being worked under a bond and lease.

IDAHO COUNTY

(Special Correspondence.)—Spokane men have organized the Oro Grande Gold Mining Co., capitalized at $1,500,000, to take over the old Hogan mine, mill, placer, and camp in the Oro Grande district of the central Idaho gold belt. By means of open-cuts, 100,000 tons of ore averaging $3 to $4 per ton in gold was mined years ago. The 20-stamp mill and cyanide plant is to be overhauled, and mining will be started during the winter. Andrew Prader is manager.

Spokane, December 12.

SHOSHONE COUNTY

Control of the Stanley mine, situated between the Hercules and Benton, has passed to outsiders, who secured 600,000 shares in the company from Herman J. Rossi and William Merks at 5 cents per share. The Green Mountain Mining Co. has been organized with a capital of 500,000 shares of 1 cent each, which are held by the Marsh Mining Co., the former being formed to work the Poorman Extension mine, adjoining the Marsh. Option payments on the Amazon-Manhattan group of eight claims, on Beaver creek have been made, leaving $80,000 to be paid out of the total of $160,000.

The preliminary settlement of the controversy between the Caledonia and Bunker Hill & Sullivan companies was ratified at Wallace on December 1, at a largely attended meeting of the stockholders of the Caledonia company. More than 1,064,000 shares of the capital stock voted in favor of the directors' agreement with the Bunker Hill company. The meeting was held to approve or reject the agreement entered into by the boards of directors of the two companies some time ago for dismissal of the Bunker Hill suit against the Caledonia, involving the apex rights to the orebodies existing in the Caledonia property now pending in the federal court. Under the settlement approved by the Caledonia stockholders, the Bunker Hill company receives approximately 1,300,000 shares of the Caledonia stock and representation on the board of directors. In return for this the present suit is to be dismissed and the Caledonia is given the right to connect its workings by an incline raise with the Kellogg tunnel of the Bunker Hill to facilitate handling its ores. It also agrees to tram such ores through the Kellogg tunnel to one unit of the Bunker Hill mill, on which a lease is also given. To provide for the stock which the Bunker Hill is to receive, the stockholders have ratified the increase of the capital stock of the Caledonia from 1,500,000 shares at $1 each to 2,605,000 shares at $1 each. A quantity of lead ore from a mine in Spain, owned by Dan Cordoner, formerly of Burke, has been received at the Hercules mill for testing purposes. The Coeur d'Alene-Crescent Mining Co., capitalized at 1,250,000 shares of $1 each, has been organized to develop the Evolution mine near Osburn, which has been recently worked by lessees.

MICHIGAN

HOUGHTON COUNTY

Three shifts are being worked underground in the Trimountain, and 60 drills are in operation. At La Salle the new electric pump has been installed at No. 2 shaft. An endless-rope haulage has been started on No. 42 level of the Osceola, its length being 2200 ft. No. 2 shaft of the Victoria is being sunk from No. 24 level. Three English miners were murdered in their beds at Painsdale on December 7, following Judge O'Brien suspending sentence in injunction cases. A large number of indignant citizens held a meeting and insisted on the courts and officers doing their duty. All companies declared a half holiday with full pay for December 10, when indignation meetings to rid the country of the agitators were held. The district was considerably excited.

MONTANA

BROADWATER COUNTY

(Special Correspondence.)—The Keating shaft is to be deepened from 800 to 1200 ft. The Congress group of claims, in the Radersburg district, has been equipped with a dry-concentrating mill. Work on the Black Friday mine is expected to be resumed in the near future.

Radersburg, December 12.

GRANT COUNTY

(Special Correspondence.)—A discovery of rich gold ore is reported from the Sunrise mine, 12 miles northwest of Phillipsburg. There is said to be two feet of ore assaying over $2000 per ton.

Phillipsburg, December 12.

LEWIS AND CLARK COUNTY

An amalgamating and cyaniding mill to treat 50 tons of ore per day is to be erected by the Caroline Gold Mining & Milling Co., whose property is five miles south of Helena, near the head of Grizzly gulch. This will be the first unit, additions to be made later on. Underground work is done by two incline shafts, and a good tonnage of ore has been opened.

MADISON COUNTY

(Special Correspondence.)—It is said that the Watseka mine at Rochester is to be reopened. The McUnes of Salt Lake City have already spent a good deal of money on the property, but were driven out by water. It is thought that modern pumping methods may overcome this difficulty. The Pritchett property in Bear gulch is being operated by Bielenberg and Higgins. The ore contains gold, silver, lead, and copper.

Rochester, December 12.

SILVERBOW COUNTY

A safety device or controller, the invention of C. R. Welch, formerly of Butte, was tried on the Mountain View hoist at Butte recently, in the presence of the Anaconda company's officials and the state mine inspector. The gear prevents a hoist 'running away' or overwinding.

NEVADA

ESMERALDA COUNTY

A new pumping plant, with a capacity of 200,000 gal. per day, is being installed on the 500-ft. level of the Sandstorm-Kendall mine, where the flow of water is as high as 150,000 gal. at times. The pump will be fitted with three 6 by 10-in. plungers, and electrically driven.

NYE COUNTY

The Tonopah Extension Mining Co. has ordered a 150-hp. induction motor and starting panel from the General Electric Co. P. Zelavin, who was injured in the Belmont mine some time ago, has been awarded damages of $6500 against the Company. The mines of the Tonopah district produced 11,406 tons of ore worth $271,015 during the week ended December 13. Dealing with the recent developments in the Extension mine, the *Tonopah Miner* discusses the pos-

sibilities of the western ore zone of the district, and there are good prospects for the Victor, Cash Boy, Merger, and Midway mines.

STOREY COUNTY

When the water is lowered below the 2700-ft. level of the north end mines of the Comstock lode, it is thought that good ore will be opened, as reports of mining operations in 1880 to 1898 showed little prospecting had been done below 2500 ft. in the Mexican and Union Consolidated mines. The water is now 38 ft. below the 2500-ft. level, and another Starrett pump has been lowered into the winze.

NEW MEXICO

SOCORRO COUNTY

On December 1 the Ernestine Mining Co. started custom milling, being the third ore buyer now in the field. During November an average of 162 tons of ore was treated per day in the mill. Additional tanks are being added to the cyanide plant.

OREGON

BAKER COUNTY

At a depth of 160 ft. in the Imperial mine, ore assaying $200 gold and 40 oz. silver per ton has been opened for 14 ft. Shipments are being made to a smelter.

COOS COUNTY

At the coal mine being developed by C. A. Smith and associates near Marshfield, the shaft is down 1200 ft. The equipment is to be operated by electric power.

UTAH

JUAB COUNTY

The new vein opened on the 600-ft. level of the Iron Blossom is showing better ore than when first cut. Development is still in progress on the 1900-ft. level, and although nothing of importance has been found there is a good showing there. It is probable that a dividend of $50,000 will be paid for Christmas. At the Gemini, the main shaft is down 1650 ft., and a winze is down about 350 ft. below this. A flow of water comes in at 1700 ft., and from 1500 to 2000 tons of ore per month is mined from the 500-ft. level to water-level. One hundred and twenty men are employed. From 1100 ft. in the Victoria, 30 to 35 tons of ore is mined daily. It contains gold, silver, and copper. The raise between the 1050 and 900-ft. levels will make connections in a few days. The Yankee Consolidated management is still prospecting the 200-ft. level in an effort to find the northern extension of the Beck Tunnel-Colorado ore zone, and in addition to this, extensive development is being done on the 2000-ft. level. This is the only mine sending out zinc ore, the last shipment containing 37% zinc. The first carload of ore from the 1000-ft. level of the Tintic Standard has gone to the smelter.

SALT LAKE COUNTY

Owing to the trouble with the bandit Lopez in the Apex mine, 225 men have been out of employment. On opening the mine, after filling it with poisonous fume, the fugitive was not found.

During October, the Ohio mill treated 66,000 tons of 1% copper ore, yielding 720,300 lb. of copper, with a profit of $14,000. Alfred Frank is in charge of the mine. Readjustments at the mill will be made rapidly, avoiding interruptions in the operations as much as possible, and it is believed that few or no delays will be occasioned. The present capacity of the mill is 1500 tons, and it is said that changes as now planned by George F. Waddell will bring the capacity up to 2000 tons.

Arrangements have been completed whereby the Bingham-Cougar Copper Mining Co. may transport its ores through the Montana-Bingham Consolidated Mining Co.'s adit. This is in about 2400 ft., and will be continued 1000 ft. farther, where several veins may be cut. Eventually the ores from six properties will be hauled in this adit, and the drainage will also be made through it. Electric traction is to be used, and probably the mining companies will erect a joint mill.

SUMMIT COUNTY

The Silver King Coalition Co. will pay a dividend of 15c. per share on December 13, amounting to $187,500. The last shipment made from the American Flag in November was settled for at $53.37 per ton, divided as follows: gold, $13.20; silver, $29.62; lead, $9.35; and copper, $1.20. This ore was taken out in the course of development, being stripped from the high-grade ore streak of the Easter vein, which has been left standing intact for a distance of more than 300 ft. The bins at the mine are being filled for another shipment, which will include some of the first-class ore and which is expected to yield a large profit.

Ore shipments from Park City mines in November were as follows, the total being 6471 tons: Silver King Coalition, 2272 tons; Daly West, 2024; Daly-Judge, 1565; creek jigger, 112; American Exploration Co., 102; American Flag, 77; Grasselli Chemical Co., 81; Summit Leasing Co., 61; Silver King Consolidated, 47; Russell and Kline, 38; E. J. Beggs, 25; Thompson-Quincy Co., 36; and Daly Mining Co., 34 tons. During the 11 months of the year, shipments have totaled 74,686 tons. The Daly-Judge will pay $45,000 in dividends on December 20, making $108,000 for the year. Connection between the 1000 and 1100-ft. levels has been made in the American Flag, resulting in better ventilation.

WASHINGTON

STEVENS COUNTY

On the 600-ft. level of the United Copper mine, near Chewelah, 500 ft. of drifts have been driven, and stopes have been started. The lower adit is in 3800 ft., having been advanced 315 ft. in November. The new 125-ton mill is working well, and from 10 to 12 tons of concentrate is sent away daily. Thirty-five tons of crude ore is shipped daily to the smelters. Work has been resumed at the Ben Venue mine, three miles north of Meyers Falls. The ore contains gold and silver.

WHITMAN COUNTY

A winter school of mines for metal and coal miners and prospectors, mine foremen, mine managers, and business men interested in mining will be conducted at the Washington State College, at Pullman, from January 5 to April 2, 1914. The staff consists of E. A. Bryan, F. A. Thomson, Elton Fulmer, Solon Shedd, C. C. Todd, F. M. Handy, Hallet R. Robbins, J. H. Pierce, and O. D. Welsch.

CANADA

BRITISH COLUMBIA

Spokane people, headed by D. K. McDonald, are prospecting the Lardo river and have engaged P. E. Seelye to superintend the work. If results warrant it, a dredge costing $100,000 will be constructed. Net earnings of the Standard Silver-Lead Mining Co. for November were $91,000. The Granby smelter, at Grand Forks, treated 22,084 tons of ore during the first week of December. Blister copper shipments were 348,000 lb. A quarterly dividend of 3% and an additional dividend of 12% has been declared on the outstanding capital stock of the Hedley Gold Mining Co., payable December 31, 1913.

On November 25 the adit being driven by the Portland Canal Tunnels Co., near Stewart, was in 2500 ft. A shoot of galena has been opened in the Indian mine. Work has been stopped at the Cascade Falls claim for the winter. In addition to the regular monthly dividend of $50,000, the Standard Silver-Lead Mining Co., operating near Silverton, will pay an extra distribution of $50,000. During November the Granby smelter treated 106,173 tons of ore yielding 1,944,145 lb. of copper. It is stated that the Granby company will resume development at the Copper Queen mine, on Texada island, which has been opened to 620 ft. and has produced a large tonnage of good ore.

ONTARIO

Bullion shipments from Cobalt for the year total 8,587,964 oz., valued at $5,040,925. Quick construction has been done at the extensions to the Northern Customs mill, only 105 days being required to erect the 80 stamps, which should be working before the end of the year. Arrangements have been made between the Nipissing, La Rose, and Chambers-Ferland companies relative to draining Cobalt lake. The channel through the Chambers-Ferland will be deep-

ened six feet, so that the water-level may be reduced that depth before pumps are installed in the spring. All proposals connected with this work depend on permission being granted by the mining commissioner, T. E. Goodson. During November the Nipissing low-grade and high-grade mills treated 6334 and 173 tons of ore, respectively, and the refinery produced 576,857 oz. silver. Three small but rich veins were opened at shaft 73, near the Keewatin contact. At shaft 64, No. 3 level, a vein 1½ in. wide, assaying 1500 oz. silver per ton, over 95 ft. in length was opened. The main shaft is 698 ft. deep. The diamond-drill is working in diabase, while hydraulic prospecting is still under way.

YUKON

According to the *Dawson Weekly News*, application for injunction against the Canadian Klondyke company by the Yukon Gold Co., which sought to restrain the former from operating dredge No. 4 on Klondike river at a certain point, was refused November 14. It was claimed that operation of the dredge when the channel was narrow would result in flooding the ground covered by the Yukon shops. The judge decided that evidence of the impending damage was not sufficient to warrant an injunction in view of the relatively greater damage to the Canadian Klondyke company from shutting down. In the course of the hearing, J. W. Boyle stated that No. 4 was yielding 175 oz. gold at a cost of $600 per day.

CHILE

During November the mills at Braden treated 98,095 tons of ore and produced 8200 tons of concentrate. The copper contained in the ore was 3,038,000 lb. There was 1,596,000 lb. of blister copper produced during the month. The discrepancy was due to the converter having been shut down for several days. The saving in the old mill was 79.4%, compared with 76% in October and 71.2% in September. In the new mill the extraction was 68.2%, as against 63% and 56% in the two preceding months. The ore on which these results were obtained averaged 2.24%, compared with 2.7%, the average of the reserves. The lower extractions obtained in the new mill, compared with the old, is due to the fact that the ore plant is not as fully equipped with Hardinge mills. It is expected that when these installations have been completed the saving in this plant will be equally as good as in the old mill. On one day in November both plants treated 4400 tons, against a combined rated capacity for the two mills of 3000 tons. Dorr thickeners are being installed in the Company's flotation plant.

KOREA

During October the Oriental Consolidated treated 27,178 tons of ore, yielding a total of $144,137, as shown by the returns of the following mills: Tabowie, $26,479; Taracol, $24,508; Kuk San Dong, $6824; Maibong, $22,977; Candlestick, $3950; Taracol tube-mill, $45,694; Kuk San Dong cyanide, $7529; Kuk San Dong dump, $5641; and Candlestick cyanide, $715. Okura & Co. have completed their power-plant and commenced supplying electric power on November 2, starting with the Tabowie mill. This mill is now driven by Okura's power, as is also the Maibong mill, and all of the machinery at Charabowie mine with the exception of the surface hoist, with which the Koreans are being trained to do electric hoisting. The Tabowie and Taracol mine pumps and all plants at Taracol are operating by Okura's power. The delay at Taracol camp is occasioned by one of Okura's transformers breaking down during the 50% overload test. A cable to the New York office on December 4 gives the November output at $140,000.

MEXICO

CHIHUAHUA

Bullion valued at $500,000, the property of the Alvarado Mining & Milling Co., and the Inde Mining Co. of Parral, was recently delivered on the border of the United States by J. Y. Baskin and A. H. Burke. They carried the 617 bars of silver on 10 wagons drawn by 14 mules each, the trip from Parral to Santa Rosalia and then on to La Mula pass and Ojinaga taking 10 days. They were not molested by rebels on the road.

Personal

M. L. REQUA was in New York last week.

R. M. RAYMOND is in New York from Mexico.

ALGERNON DEL MAR was in New York last week.

F. LYNWOOD GARRISON was in New York last week.

ARTHUR GIBSON is down from Nome for the winter.

J. F. B. ERDLETS, Jr., of London, is in Austro-Hungary.

H. C. HOOVER is expected in San Francisco before Christmas.

B. C. AUSTIN is manager for Flint Mines, Ltd., at Flint, Idaho.

D. W. SHANKS is at Douglas City, Trinity county, California.

T. J. ANDERSON, of Nome, is spending the winter in New York City.

PHILIP ARGALL was in New York and has returned to Colorado.

S. G. WEINBERG, of St. Petersburg, is in this country on a brief visit.

GUY A. R. LEWINGTON is down from Dawson visiting California friends.

T. M. GIBSON was a passenger on the *Senator* from Nome and is now in California.

JOHN P. COSGRO is now associated with the International Machinery Co., at Santiago, Chile.

HOWARD D. SMITH has left London for New York, and will be in San Francisco by Christmas.

ALEXANDER ADIASSEWICH has returned to New York from his trip through the Western states.

A. E. DRUCKER is visiting Shanghai, and expects to be in London by the middle of January.

C. W. PURINGTON has left London for St. Petersburg and expects to return about December 22.

GEORGE P. A. BLANCHIN, president of the Bill Nye Gold Mining Co., was in San Francisco last week.

WALTER G. PERKINS passed through New York on his way back to London from Korea and Siberia.

J. H. BATCHELLER, of the Goldfield Con. M. & T. Co., Goldfield, Nevada, has gone to Mattapoisett, Massachusetts.

D. A. JONES, president of the St. Joseph Lead Co., suffered from a paralytic stroke at St. Louis early this month.

OTTO F. HEIZER is now general manager for the Argo Reduction & Ore Purchasing Co., at Idaho Springs, Colorado.

W. S. KEITH, formerly superintendent for the Helester Mining Co., of San Francisco, is now permanently in Portland.

M. B. BELDEN, lessee of the Robinson Gulch mine in Siskiyou county, California, is spending the holidays in Portland.

GEORGE T. COFFEY, superintendent of hydraulic operation with the Yukon Gold Co., has returned to spend the winter in California.

W. A. CLARK was tendered a banquet in Butte on November 15, which date was the fiftieth anniversary of his arrival in Montana.

JAMES S. COLBATH, recently with the Mines Company of America, has opened an office at Los Angeles for consulting practice devoting especial attention to cyanide work.

F. G. COTTRELL, of the United States Bureau of Mines, lectured to the students of the Montana State School of Mines on the 'Electrostatic Settling of Smoke Dust' on November 26.

PHILIP H. MOORE, lately mining engineer and manager for the Canadian Allis-Chalmers, Ltd, mining, crushing, and cement machinery department, has accepted the position of general manager for Rock & Power Machinery, Ltd., with headquarters at Toronto, Ontario.

A. E. WHEELER has resigned as superintendent at Great Falls, Montana, to become consulting engineer for the Union Minere du Haut Katanga, the controlling corporation back of Tanganyika Concessions. JOHN H. KLEPINGER succeeds Mr. Wheeler as superintendent at Great Falls, and MILO W. KREJCI takes Mr. Klepinger's place as assistant superintendent. JAMES O'GRADY will become manager at the smelter, a new position.

The Metal Markets

LOCAL METAL PRICES

San Francisco, December 18.

Antimony	10—10½c	Quicksilver (flask)	$40
Electrolytic copper	15¼—15½c	Tin	41—42½c
Pig lead	4.25—4.30c	Spelter	6¼—6½c

Zinc dust, 100 kg. zinc-lined cases, 7½ to 8c. per pound.

EASTERN METAL MARKETS

(By wire from New York.)

NEW YORK, November 17.—The copper market is firmer but quiet. Standard spot to March was offered at 14.35, electrolytic at 14.37½, and Lake at 15 to 15.50. The lead and spelter markets are showing a greater activity than has been exhibited for some time, and an increased business is reported. Prices are quoted at 3.95 to 4.05 for lead and 5.10 to 5.20 for spelter. The London spelter market is reported as somewhat easier, due to the arrival in London of large quantities which have been bought for speculation purposes. These had to be disposed of promptly, and as a result the spot price fell a trifle. A good business is reported with the consumers and an improvement is to be noted in the galvanized iron trade.

SILVER

Below are given the average New York quotations, in cents per ounce, of fine silver.

Date.		Average week ending	
Dec.	11	Nov. 5	59.52
"	12	" 12	59.62
"	13	" 19	59.26
"	14 Sunday	" 25	58.20
"	15	Dec. 3	57.32
"	16	" 10	58.23
"	17	" 17	57.79

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	56.25	63.01	July	60.67	58.70
Feb.	59.06	61.25	Aug.	61.32	59.32
Mch.	58.37	57.87	Sept.	62.95	60.53
Apr.	59.20	59.26	Oct.	63.16	60.88
May	60.88	60.21	Nov.	62.73	58.76
June	61.29	59.03	Dec.	63.38	....

Discussing the silver market on November 27, Samuel Montagu & Co. state that at the present time several factors are at work which render the outlook obscure. Usually, some demand arises at this period of the year for prompt shipment to China, in preparation for the customary settlement of debts at the Chinese New Year. As the stock in Shanghai is still so large, namely £5,920,000, compared with £5,935,000 last week, no urgent need can exist for supplementing supplies on the spot, and if silver be bought for that quarter, forward delivery would be sought probably by preference. This is suggested by the return of silver for forward delivery to a premium yesterday, after an interval of slightly more than two months' duration. For this reason, the dearness of money in the closing quarter of this year may be reflected in prices. Further, doubt exists as to the future of what now remains of the stock accumulated by Indian speculators. On the other hand, large 'bear' sales are known to be in existence, the bulk of which materialize toward the close of next month. In all the circumstances, a great amount of competition is not likely to arise for supplies toward the end of the year.

COPPER

Quotations on copper as published in this column represent average wholesale transactions on the New York market and refer to electrolytic copper. Lake copper commands normally from 1-5 to 1-4c. per lb. more. Prices are in cents per pound.

Date.		Average week ending	
Dec.	11	Nov. 5	16.25
"	12	" 12	15.54
"	13	" 19	15.08
"	14 Sunday	" 25	14.62
"	15	Dec. 3	14.41
"	16	" 10	14.13
"	17	" 17	14.17

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	14.09	16.54	July	17.19	14.21
Feb.	14.08	14.93	Aug.	17.49	15.42
Mch.	14.68	14.72	Sept.	17.56	16.23
Apr.	15.74	15.22	Oct.	17.32	16.31
May	16.03	15.42	Nov.	17.31	15.08
June	17.23	14.71	Dec.	17.37	....

Moderate sales of copper last week served to halt the decline in price. On December 9 Europe was a moderate buyer of electrolytic 30-days at 14½ to 14⅝c. per pound. On December 10 fairly good tonnages of February metal were booked here at 14⅝c., the London dealers quoting £66 15s. (14.474c.) and doing a fair business the same day. On December 12 domestic buyers took some copper and prices were firm at 14½c., sales on European account being fair. Exports for the week ended December 11 were 3245 tons, making a total of 9816 tons, as compared with 11,734 tons for the same period last year. The price at the end of the week was firm at 14⅝c. and the sellers are hopeful of larger sales on domestic account before the end of the year.

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.		Average week ending	
Dec.	11	Nov. 5	4.20
"	12	" 12	4.19
"	13	" 19	4.18
"	14 Sunday	" 25	4.13
"	15	Dec. 3	4.15
"	16	" 10	4.00
"	17	" 17	3.90

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	4.43	4.38	July	4.71	4.35
Feb.	4.03	4.33	Aug.	4.54	4.60
Mch.	4.07	4.32	Sept.	5.00	4.70
Apr.	4.30	4.36	Oct.	5.08	4.37
May	4.20	4.34	Nov.	4.91	4.16
June	4.40	4.33	Dec.	4.20	....

The depressing tactics, which were responsible for last week's decline, were not followed up when it appeared that the lower level created was bringing forward buyers more readily, and the ensuing demand soon found sellers rather stiffer, according to Henry R. Merton & Co., writing on November 22. With the advent of a firmer tendency, a better business developed, and up to £19 3s. 9d. was paid for November shipment, and £19 10s. for earlier delivery. Stocks everywhere are very low, and with the Mexican conditions as bad as ever, not much relief is in sight as yet. Toward the close of the week, the surrounding depression again caused a setback, final prices being £17 17s. 6d. to £18 16s. 3d. for foreign, and £18 5s. to £19 5s. for English.

ZINC

Zinc is quoted as spelter, standard Western brands St. Louis delivery, in cents per pound.

Date.		Average week ending	
Dec.	11	Nov. 5	5.13
"	12	" 12	5.09
"	13	" 19	5.05
"	14 Sunday	" 25	5.08
"	15	Dec. 3	5.00
"	16	" 10	5.00
"	17	" 17	5.00

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	6.42	6.88	July	7.12	5.11
Feb.	6.50	6.13	Aug.	6.96	5.51
Mch.	6.57	5.94	Sept.	7.45	5.55
Apr.	6.63	5.52	Oct.	7.36	5.22
May	6.68	5.23	Nov.	7.32	5.01
June	6.88	5.00	Dec.	7.09	....

This has been practically the only metal to show a firm market, according to Henry R. Merton & Co., on November 22. With a better demand for galvanized iron, consumers showed a little more inclination to buy, though business is as yet very restricted. There was also some speculative inquiry for next year, and rather higher prices were paid. Closing prices were £20 15s. for ordinaries, and £21 10s. to £22 for specials.

QUICKSILVER

The primary market for quicksilver is San Francisco, California, being the largest producer The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending					
Nov.	19	40.00	Dec.	4	40.00
"	25	40.00	"	11	40.00
			"	18	40.00

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	43.75	39.37	July	43.00	41.00
Feb.	46.00	41.00	Aug.	42.50	40.50
Mch.	46.00	40.20	Sept.	42.12	39.70
Apr.	42.25	41.00	Oct.	41.50	39.37
May	41.75	40.25	Nov.	41.50	39.40
June	41.30	41.00	Dec.	39.75	....

TIN

New York prices control in the American market for tin, since the metal is almost entirely imported. San Francisco quotations average about 5c. per lb. higher. Below are given average monthly New York quotations, in cents per pound.

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	42.53	50.45	July	44.25	40.70
Feb.	42.96	49.07	Aug.	45.80	41.75
Mch.	42.58	46.95	Sept.	48.64	42.45
Apr.	43.92	49.00	Oct.	50.01	40.61
May	46.05	49.10	Nov.	49.92	39.77
June	45.76	45.10	Dec.	49.80	....

The Stock Markets

SAN FRANCISCO STOCKS AND BONDS

(San Francisco Stock and Bond Exchange.)

BONDS

December 17.

Listed.	Bid	Ask	Unlisted.	Bid	Ask
Associated Oil 5s	$ 97	99	General Petroleum 6s	62	63
E. I. du Pont pfd	84	—	Natomas Con. 6s	—	50
Unlisted.			Pac. Port. Cement 6s	99½	—
Ass. Oil 6s	$ 75	—	Santa Cruz Cement 6s	81	—

STOCKS

Listed.	Bid	Ask	Unlisted.	Bid	Ask
Amalgamated Oil	75	77	Noble Electric Steel	—	3
Associated Oil	38	38½	Natomas Consol.	1½	4
Giant	80	87	Riverside Cement	50	—
Pac. Cst Borax, pfd	65	—	Santa Cruz Cement	40	43
Pacific Crude Oil	—	35c	Stand. Port. Cement	17½	—
Sterling O. & D.	—	1.60			
Union Oil	—	56½			

NEVADA STOCKS

(By courtesy of San Francisco Stock Exchange.)

San Francisco, December 18.

Atlanta	$ .09	Mizpah Extension	$ .25
Belcher	.48	Montana-Tonopah	.94
Belmont	7.25	Nevada Hills	.45
Big Four	.08	North Star	.39
Cash Boy	.06	Ophir	.20
Florence	.20	Pittsburg Silver Peak	.34
Goldfield Con.	1.42	Round Mountain	.34
Goldfield Oro.	.07	Sierra Nevada	.07
Halifax	1.25	Tonopah Extension	1.47
Jim Butler	.62	Tonopah Merger	.50
Jumbo Extension	.08	Tonopah of Nevada	.33
MacNamara	.08	Victor	30
Mexican	1.25	West End	1.20
Midway	.34	Yellow Jacket	.33

COPPER SHARES—BOSTON

(By courtesy of J. C. Wilson, Mills Building.)

December 17.

	Bid	Ask		Bid	Ask
Allouez	$ 31½	32½	Mohawk	$ 38	39
Ariz. Commercial	3⅞	4	Nevada Con.	14½	—
Butte & Superior	28	28½	North Butte	26¾	27
Calumet & Arizona	60½	60¾	Old Dominion	47½	48
Calumet & Hecla	397	400	Osceola	68	[illegible]
Copper Range	32½	33	Quincy	55	55½
Daly West	2¼	2½	Shannon	5⅞	6¼
East Butte	10½	10¾	Superior & Boston	2⅜	2¾
Franklin	2½	3	Tamarack	28	29
Granby	68	69	U. S. Smelting, com.	37½	38
Greene Cananea	29½	30	Utah Con.	8	8¼
Isle-Royale	17⅞	18	Winona	1¼	1⅜
Mass Copper	2	2½	Wolverine	40½	41¾

NEW YORK CURB QUOTATIONS

(By courtesy of E. F. Hutton & Co., Kohl Building.)

December 18.

	Bid.	Ask.		Bid.	Ask.
Braden Copper	7	7⅛	McKinley-Dar.	1	1⅛
Braden 6s	142	150	Mines Co. Am.	2	2¼
B. C. Copper	2	2¼	Nipissing	7¾	8
Davis-Daly	1⅝	1⅞	Ohio Copper	⅜	½
Dolores	1	2	San Toy	15	[illegible]
El Rayo	2	4	Sioux Con.	1	2
Ely Con.	1	3	So. Utah	⅛	¼
First Nat.	2⅝	2⅞	Stand. Oil of Cal.	228	229
Greene Can.	6	7	Tri Bullion	⅛	¼
Giroux	½	1	Tuolumne	½	⅝
Iron Blossom	1⅛	1¼	United Copper	¼	¾
Kerr Lake	4⅜	4½	Westlaufer	7	9
La Rose	1⅞	2	Yukon Gold	2	2¼
Mason Valley	3	4			

NEW YORK STOCK EXCHANGE

(By courtesy of J. C. Wilson, Mills Building.)

December 18.

	Bid	Ask		Bid	Ask
Amalgamated	69⅛	69⅜	Nat. Lead	$ 43	44½
Anaconda	34	34⅛	Quicksilver, com.	1½	2
A. S. & R.	61	61½	Ray Con.	17⅛	17½
Calif. Pet	16	17	Tenn. Copper	29	29
Chino	38⅜	38⅝	U. S. Steel, pfd.	104½	105
Guggenheim Ex.	43⅛	43⅜	U. S. Steel, com.	66⅛	[illegible]
Mexican Pet	42⅜	44	Utah Copper	46⅛	47
Miami	21⅛	21½			

LONDON QUOTATIONS

(By cable, through the courtesy of Catlin & Powell Co., New York.)

December 18.

	£	s.	d.		£	s.	d.
Alaska Mexican	1	7	6	Kern River Oilfields	0	6	3
Alaska Treadwell	7	16	9	Mexico Mines	5	7	6
Alaska United	3	5	0	Messina	1	[illegible]	0
Arizona	1	17	6	Oroville	0	12	6
California Amalg.	0	1	3	Pacific Oilfields	0	3	9
California Oilfields	6	0	0	Rio Tinto	7	7	6
Camp Bird	0	13	9	Santa Gertrudis	1	16	9
El Oro	0	15	0	Stratton's	0	2	6
Esperanza	0	18	9	Tanganyika	2	0	0
Granville	0	11	3	Tomboy	1	7	6

AUSTRALASIAN

December 18.

	£	s.	d.		£	s.	d.
British Broken Hill	1	16	9	Mount Boppy	0	16	9
Broken Hill Prop.	1	13	9	Mount Elliott	4	8	9
Golden Horse-Shoe	2	15	0	Mount Lyell	1	5	0
Great Boulder Prop.	0	15	0	Mount Morgan	8	3	9
Ivanhoe	2	16	0	Waihi	2	15	0
Kalgurli	1	13	9	Waihi Grand Junc.	1	5	0

San Francisco Mint Receipts

During November, receipts of gold at the San Francisco Mint were as follows:

	Fine ounces.
Alaska:	
Cape Nome	1.397
Douglas Island	9,410.485
Balance	932.776
	10,344.658
Arizona	8,537.801
California	13,153.788
Idaho	35.344
Montana	31.833
Nevada	4,643.918
New Mexico	347.405
Oregon	617.020
Washington	130.747
Philipine Islands	2,598.051
Refineries, Government offices, etc.	126,206.445
Mutilated U. S. coin	15.471
Foreign coin	22.239
Jewelry	785.211
Central America	64.747
Mexico	101.363
South America	1.733
Total	167,637.774

Value of gold, $3,465,380.34.

Mining in Pennsylvania

Since the first record of mining statistics was written into the history of the United States, Pennsylvania has stood at the top of the list. Exclusive of the value of pig iron and of coke and of other derived or secondary products not included in the total made in the state, the value of Pennsylvania's mineral production is nearly one-fourth that of the entire country, and is only about $5,000,000 less than the combined output of Illinois, West Virginia, Ohio, and California, the next four states in the value of their mineral production. The value of the mineral production of Pennsylvania reached the enormous total of $414,426,962 in 1911 and the still greater figure of $445,790,022 in 1912, according to a statement prepared by Edward W. Parker of the U. S. Geological Survey, in coöperation with the state of Pennsylvania. Pennsylvania holds the leadership primarily on account of her supremacy in the production of coal. The combined value of the production of anthracite and bituminous coal in Pennsylvania, $346,993,123, nearly equals the aggregate value of all the mineral products of West Virginia, Illinois, and Ohio, the second, third, and fourth states, respectively, in rank. The production of cement was 27,625,340 bbl.; stone quarried was worth $9,144,214; lime output, 849,159 tons; sand and gravel, 6,509,333 tons; coke, 27,438,693 tons; and pig iron from outside ores, 12,437,685 tons, valued at $181,569,299.

Monthly Copper Production

AHMEEK COPPER MINING CO., Kearsarge, Michigan. $1,250,000 in $25 shares, 24,796 shares owned by Calumet & Hecla; 1800-ton mill at Hubbell; concentrate smelted by Calumet & Hecla smelter

Month.	Pounds.	Month.	Pounds.
April	1,503,535	June	1,281,960
May	1,061,995	July	1,020,500

ALLOUEZ MINING CO., Allouez, Michigan. $2,500,000 in $25 shares; controlled by the Calumet & Hecla, which owns 43,000 shares and $250,000 in notes of the Company; ore is milled by the Lake Milling, Smelting & Refining Co., in which the Allouez owns a half interest.

Month.	Pounds.	Month.	Pounds.
April	603,210	June	556,675
May	475,535	July	398,565

ANACONDA COPPER MINING CO., Butte, Montana. $108,312,500 in $25 shares; controlled through Amalgamated Copper Co. by Thos. F. Cole, J. D. Ryan, and Standard Oil interests; 10,000-ton concentrator and smelter at Anaconda; 5000-ton concentrator and smelter at Great Falls, Mont.; also 70-ton electrolytic refining plant at Great Falls. Production figures include copper from all companies which ship custom ore to Anaconda smelters.

Month.	Pounds.	Month.	Pounds.
April	23,800,000	August	22,500,000
May	25,600,000	September	22,600,000
June	21,500,000	October	18,400,000
July	21,181,000	November	25,250,000

ARIZONA COPPER CO., LTD., Morenci, Arizona. £379,974 in 5s. shares; controlled by Edinburgh investors; mill at Morenci is being enlarged to 3000-ton capacity and a new 1200-ton smelter near Clifton has just been started.

Month.	Pounds.	Month.	Pounds.
April	3,100,000	August	1,800,000
May	3,200,000	September	1,800,000
June	3,000,000	October	3,550,000
July	2,600,000	November	2,800,000

COMPANIE du BOLEO, Santa Rosalia, Baja California, Mexico. Fr. 12,000,000 in Fr. 100 shares; owned by Rothschild, Paris, interests and the Banque Mirabaud; 4000-ton smelter; matte and black copper shipped to Europe.

Month.	Pounds.	Month.	Pounds.
January	2,658,880	April	2,811,200
February	2,535,680	May	2,424,800
March	2,204,720	June	1,984,640

BRADEN COPPER CO., La Junta, Chile. $2,332,030 in $10 shares and $4,000,000 in 6% convertible bonds; entire stock held by Braden Copper Mines Co.; $12,000,000 in $5 shares; $5,000,000 in convertible bonds; controlled by Guggenheim interests; two mills at La Junta; 3000-ton capacity smelter at Raucagua.

Month.	Pounds.	Month.	Pounds.
April	1,148,000	August	1,572,000
May	1,481,000	September	1,322,000
June	1,808,000	October	2,600,000
July	1,046,000	November	1,592,000

BRITISH COLUMBIA COPPER CO., LTD., Greenwood, B. C. $2,958,545 in $5 shares; controlled by Newman Erb; 600-ton sampling plant and 2500-ton smelter.

Month.	Pounds.	Month.	Pounds.
June	634,238	September	626,761
July	618,379	October	688,000
August	700,000	November	682,383

CALUMET & ARIZONA MINING CO., Warren, Arizona. $6,285,710 in $10 shares; has absorbed the Superior & Pittsburg Copper Co. by stock exchange; controlled by Hoatson and other Lake Superior interests; 3000-ton smelter at Douglas.

Month.	Pounds.	Month.	Pounds.
April	4,500,000	July	3,800,000
May	4,300,000	August	4,500,000
June	3,000,000	October	4,500,000

CALUMET & HECLA MINING CO., Calumet, Michigan. $2,500,000 in $25 shares; controls the Ahmeek, Allouez, Centennial, Isle Royale, La Salle, Osceola, Tamarack, and Superior copper mining companies as well as a number that are non-productive; controlled by Agassiz and Shaw interests; 2 mills on Lake Linden, capacity 15,000 tons; smelter Hubbell, Mich.; electrolytic refinery and smelter at Buffalo, N. Y.; figures include output of subsidiaries.

Month.	Pounds.	Month.	Pounds.
April	10,582,870	June	9,743,300
May	10,765,400	July	7,642,163

CANANEA CONSOLIDATED COPPER CO. S. A., Cananea, Sonora, Mexico. Capital ₱20,000 in shares of ₱100; entire stock owned by Greene Consolidated Copper Co.; $10,000,000 in $10 shares; 945,320 shares are held by Greene-Cananea Copper Co.; $50,000,000 in $100 shares, which is controlled by Thos. F. Cole and J. D. Ryan; 2 mills and smelter at Cananea, 3000-ton capacity.

Month.	Pounds.	Month.	Pounds.
April	3,581,000	August	3,186,000
May	3,272,000	September	2,148,000
June	2,908,000	October	3,160,000
July	3,338,000	November	3,150,000

CENTENNIAL COPPER MINING CO., Calumet, Michigan. $2,250,000 in $25 shares, 44,350 shares are held by Calumet & Hecla Mining Co.; ore milled by Lake Milling, Smelting & Refining Company.

Month.	Pounds.	Month.	Pounds.
April	243,295	June	193,295
May	153,010	July	195,455

CERRO de PASCO MINING CO., Cerro de Pasco, Peru. $10,000,000; entire stock held by Cerro de Pasco Copper Co.; $60,000,000 in $1 shares which is owned by Cerro de Pasco Investment Co., which is controlled by J. B. Haggin, and Morgan estate; 3000-ton smelter at La Fundicion; monthly production figures not given out; output in 1912 was 45,000,000 lb. copper.

CHINO COPPER CO., Santa Rita, New Mexico. $3,500,000 in $5 shares; 121,200 shares are held by Guggenheim Exploration Co.; controlled by Sherwood Aldrich and C. M. MacNeill; 5000-ton mill at Hurley, N. M.; concentrate smelted at El Paso.

Month.	Pounds.	Month.	Pounds.
May	4,003,700	August	6,050,867
June	3,904,300	September	4,435,873
July	4,831,200	October	4,914,944

CONSOLIDATED COPPER MINES CO., Ely, Nev. $8,000,000 in $5 shares; $3,000,000 in convertible bonds; is a recent merger of the Giroux, Butte & Ely, Chainman, and Coppermines companies, controlled by Thos. F. Cole, Wm. B. Thompson, Charles F. Rand, and Jas. Phillips, Jr.; reduction plant not yet built; production so far derived solely from Giroux; ore treated at Nevada Con. smelter.

Month.	Pounds.	Month.	Pounds.
May	968,368	August	541,189
June	616,742	September	204,307
July	607,779	October	160,911

COPPER QUEEN CONSOLIDATED MINING CO., Bisbee, Arizona. $2,000,000 in $10 shares; owns 100,000 shares of Greene-Cananea; almost all its stock is held by Phelps, Dodge & Co., Inc.; $44,995,000 in $100 shares; 4000-ton smelting plant at Douglas, Ariz.; output of Copper Queen mine:

Month.	Pounds.	Month.	Pounds.
April	7,079,600	August	7,590,994
May	7,160,021	September	7,775,560
June	6,292,480	October	7,653,153
July	7,439,864	November	6,473,792

COPPER RANGE CONSOLIDATED MINING CO., Painedale, Michigan, $39,369,200, in $100 shares; owns 99,659 shares of Baltic M. Co., 99,699 shares Copper Range M. Co., 99,345 shares of Tri-mountain M. Co., half interest in Champion Copper Co., 16,392 shares of Copper Range R. R. Co., and $870,000 in Copper Range R. R. bonds; controlled by Wm. A. Paine; production is derived from the Baltic, Champion, and Trimountain companies, each of which mills its ore; concentrate is smelted by Michigan Smelting Co., Houghton, which is owned by mining companies.

Month.	Pounds.	Month.	Pounds.
April	3,072,000	June	3,267,600
May	3,400,000	July (est.)	2,500,000

DETROIT COPPER MINING CO., Morenci, Ariz. $1,000,000 in $25 shares; owned by Phelps, Dodge & Co.; 1300-ton mill and 350-ton smelter.

Month.	Pounds.	Month.	Pounds.
April	1,856,517	August	2,187,223
May	2,001,633	September	2,102,818
June	1,750,601	October	1,861,178
July	1,549,224	November	1,922,352

EAST BUTTE COPPER MINING CO., Butte, Mont. $3,000,000 in $10 shares; owns 83% of the stock and all bonds of the Pittsmont Copper Co., which holds 90% of the stock and all bonds of Pittsburgh & Montana Copper Co.; controlled by W. A. Paine; 350-ton mill and 1000-ton custom smelter.

Month.	Pounds.	Month.	Pounds.
May	1,268,595	August	1,162,006
June	1,020,613	September	1,233,018
July	1,060,257	October	1,040,977

FRANKLIN MINING CO., Demmon, Mich. $4,166,650 in $25 shares; controlled by R. M. Edwards and the U. S. S. R. & M. Co.; 1000-ton mill.

Month.	Pounds.	Month.	Pounds.
April	164,640	June	143,000
May	149,960	July	106,000

GRANBY CONSOLIDATED MINING, SMELTING & POWER CO., LTD., Phoenix and Hidden Creek, British Columbia. $14,849,565 in $100 shares; controlled by General Chemical Co. interests; 4400-ton smelter at Grand Forks and 2000-ton smelter at Anyox.

Month.	Pounds.	Month.	Pounds.
June	1,789,000	September	1,824,560
July	1,654,000	October	1,779,552
August	1,827,300	November	1,944,145

ISLE ROYALE COPPER CO., Houghton, Mich. $3,750,000 in $25 shares; owns a $50,000 interest in the Lake Superior Smelting Co., owned by Calumet & Hecla; 2200-ton mill on Portage Lake.

Month.	Pounds	Month.	Pounds.
April	563,983	June	496,134
May	528,809	July	343,750

MASON VALLEY MINES CO., Yerington, Nev. $770,000 in $5 shares; $1,000,000 in 6% convertible bonds; controlled by W. B. Thompson; 1000-ton smelter at Thompson, Nev., also smelts ore of Nevada-Douglas Copper Co. and custom ore; smelter production:

Month.	Pounds.	Month.	Pounds.
April	1,274,000	August	966,000
May	1,226,000	September	918,000
June	1,132,000	October	1,052,000
July	990,000	November	1,174,000

MIAMI COPPER CO., Miami, Ariz. $3,319,690 in $5 shares; $1,433,000 in 6% convertible bonds; controlled by General Development Co. (Lewisohn interests); 3000-ton mill at Miami; concentrate smelted at Cananea.

Month.	Pounds.	Month.	Pounds.
April	2,312,000	August	3,097,500
May	1,948,000	September	2,688,600
June	2,612,650	October	2,862,050
July	2,890,000	November	3,517,800

MOCTEZUMA COPPER CO., Nacozari, Sonora, Mexico. $2,000,000; entire stock owned by Phelps, Dodge & Co.; 2000-ton mill; concentrate smelted by Copper Queen.

Month.	Pounds.	Month.	Pounds.
April	2,753,240	August	3,542,047
May	2,695,881	September	3,024,121
June	3,438,793	October	3,178,136
July	2,693,006	November	3,517,800

MOHAWK MINING CO., Mohawk, Mich. $2,500,000 in $25 shares; controlled by Stanton interests; 3000-ton mill, Traverse Bay; concentrate smelted by Michigan Smelting Co.

Month.	Pounds.	Month.	Pounds.
April	962,994	June	820,522
May	932,979	July	600,000

NEVADA CONSOLIDATED COPPER CO., Ely, Nevada. $10,000,000 in $5 shares; has absorbed the Cumberland-Ely Copper Co.; controlled by American Smelter Securities Co. through the Utah Copper Co., which owns half of the Nevada Con. stock; the Nevada company owns the Steptoe Valley Mining & Smelting Co., $10,000,000; 16,000-ton mill and 1500-ton smelter at McGill, Nevada.

Month.	Pounds.	Month.	Pounds.
May	5,933,275	August	5,989,973
June	6,344,863	September	4,441,671
July	5,403,919	October	5,898,330

NEVADA DOUGLAS COPPER CO., Mason, Nev. $4,054,800 in $5 shares, $276,900 in 6% convertible bonds; also $158,200 6% refunding bonds; controlled by A. J. Orem; ore smelted at Mason Valley smelter.

Month.	Pounds.	Month.	Pounds.
June	392,288	September	426,070
July	399,451	October	583,330
August	354,760	November	678,120

OHIO COPPER CO., Bingham, Utah. $12,292,700 in $10 shares, $1,326,000 in 6% convertible bonds; 3500-ton mill at Lark, Utah; concentrate smelted at Garfield.

Month.	Pounds.	Month.	Pounds.
May	645,400	August	689,400
June	579,400	September	685,900
July	601,700	October	720,000

OLD DOMINION COPPER MINING & SMELTING CO., Globe, Ariz. $4,050,000 in $25 shares; 155,245 shares are owned by the Old Dominion Co., which is owned by Phelps, Dodge & Co.; 800-ton mill, 2400-ton smelter. Production figures include custom ore smelted.

Month.	Pounds.	Month.	Pounds.
April	3,040,000	August	2,524,000
May	2,749,000	September	2,679,000
June	2,511,000	October	2,037,000
July	2,526,000	November	2,150,000

OSCEOLA CONSOLIDATED MINING CO., Osceola, Mich. $2,403,750 in $25 shares; owned by Calumet & Hecla; 2 mills, 4000-ton capacity, at Torch Lake.

Month.	Pounds.	Month.	Pounds.
April	1,667,340	June	1,424,640
May	1,759,815	July	1,217,255

PHELPS, DODGE & CO., Inc. $44,995,000 in $100 shares; controlled by C. H. Dodge, James Douglas, and others; owns the Copper Queen, Moctezuma, Detroit, and Burro Mountain Copper companies, Stag Canon Fuel Co.; indirectly controls Old Dominion, United Globe, and Commercial Copper Mining Co.; members of the firm control the El Paso & Southwestern railway, and have large interests in the Rock Island and Great Northern railways. Production figures include all properties under its control and copper derived from custom ore, the latter ranging from 750,000 to 1,000,000 lb. per month.

Month.	Pounds.	Month.	Pounds.
April	12,819,938	August	13,971,674
May	12,999,119	September	13,561,742
June	12,667,328	October	13,332,943
July	12,611,887	November	12,556,000

QUINCY MINING CO., Hancock, Mich. $2,750,000 in $25 shares; controlled by W. R. Todd; 4500-ton mill at Mason; 340-ton smelter at Ripley.

Month.	Pounds.	Month.	Pounds.
June	1,611,840	October	245,640
July (est.)	1,250,000	November	804,000

RAY CONSOLIDATED COPPER CO., Ray, Ariz. $11,975,740 in $10 shares; controlled by Sherwood Aldrich and C. M. MacNeill; 8000-ton mill at Hayden, Ariz.; concentrate smelted in A. S. & R. smelter adjoining.

Month.	Pounds.	Month.	Pounds.
May	4,520,000	August	4,401,000
June	4,392,612	September	4,470,551
July	4,097,177	October	4,871,516

SHANNON COPPER CO., Metcalf, Ariz. $3,000,000 in $10 shares; controlled by N. L. Amster; 500-ton mill and 1000-ton smelter at Clifton.

Month.	Pounds.	Month.	Pounds.
April	1,238,000	August	1,248,000
May	1,080,000	September	1,232,000
June	924,000	October	1,216,000
July	880,000	November	1,110,000

SHATTUCK ARIZONA COPPER CO., Bisbee, Ariz. $3,500,000 in $10 shares; controlled by Duluth investors; ore smelted at Calumet & Arizona smelter.

Month.	Pounds.	Month.	Pounds.
May	1,026,170	August	1,001,624
June	1,059,625	September	1,163,237
July	1,019,388	October	993,224

SOUTH UTAH MINES & SMELTERS, Newhouse, Utah. $4,300,000 in $5 shares, $1,300,000 in 6% convertible bonds; controlled by Samuel Newhouse; 1000-ton mill; concentrate smelted at Tooele, Utah.

Month.	Pounds.	Month.	Pounds.
April	132,267	July	195,254
May	201,405	August	230,410
June	142,817	September	249,323

SUPERIOR COPPER CO., Calumet, Mich. $2,500,000 in $25 shares; owned by Calumet & Hecla.

Month.	Pounds.	Month.	Pounds.
April	291,525	June	382,080
May	389,975	July	307,260

TAMARACK MINING CO., Calumet, Mich. $1,500,000 in $25 shares; owned by Calumet & Hecla; 2 mills, 3500-ton capacity, at Torch Lake.

Month.	Pounds.	Month.	Pounds.
April	630,190	June	598,770
May	655,885	July	476,725

TENNESSEE COPPER CO., Copperhill, Tenn. $5,000,000 in $25 shares; $1,500,000 in 6% convertible bonds; controlled by Jas. Phillips, Jr., and Lewisohn interests.

Month.	Pounds.	Month.	Pounds.
June	1,379,220	September	1,309,985
July	1,295,804	October	1,392,162
August	1,143,019	November	1,688,000

UNITED STATES SMELTING, REFINING & MINING CO. $44,871,150 in $50 shares; copper production chiefly derived from its subsidiary, The Mammoth Copper Mining Co., Kennett, California.

Month.	Pounds.	Month.	Pounds.
September	1,750,000	November	1,700,000
October	1,658,436		

UNITED VERDE COPPER CO., Jerome, Ariz. $3,000,000 in $10 shares; owned by W. A. Clark; 1000 to 1200-ton smelter at Clarkdale; monthly figures not given out, estimated at about 3,000,000 pounds.

UTAH CONSOLIDATED MINES CO., Bingham, Utah. $1,500,000 in $5 shares; owns the Highland Boy Gold Mining Co. and 5000 shares of International Smelting & Refining Co. stock; ore smelted at Tooele.

UTAH COPPER CO., Bingham, Utah. $15,625,990 in $10 shares; owns half of Nevada Consolidated; controlled by A. S. & R. Co., Sherwood Aldrich, C. M. MacNeill, and W. B. Thompson; 2 mills, 20,000-ton capacity, at Garfield; concentrate smelted at Garfield plant of A. S. & R. Company.

Month.	Pounds.	Month.	Pounds.
May	10,312,605	August	10,900,000
June	11,637,949	September	11,992,780
July	9,849,043	October	10,236,575

WOLVERINE COPPER MINING CO., Kearsarge, Mich. $1,500,000 in $25 shares; owns $80,000 interest in Michigan Smelting Co.; controlled by J. R. Stanton; mill on Traverse bay treated 388,500 tons during last fiscal year.

Month.	Pounds.	Month.	Pounds.
April	641,885	June	627,087
May	663,430	July	426,000

Company Reports

TAQUAH MINING & EXPLORATION COMPANY, LTD.

This Company operates in the Gold Coast Colony, West Africa, and the report covers the period from July 1, 1912, to June 30, 1913. The ore extracted from the Taquah mine was 63,591 tons, worth 63.5s. per ton for an average stoping width of 76 in. The treatment plant crushed 61,607 tons averaging 61.79s. per ton. The total recovery for the year realized £179,591, equivalent to 94.35% of the mill-head value. Operating expenses totaled £98,254, the loan account has been reduced to £50,000, and the balance to the credit of profit and loss is £39,698. Ore reserves are estimated at 198,502 tons worth 60s. per ton.

SCOTTISH GYMPIE GOLD MINES, LTD.

The Scottish Gympie company reports the following results of the year ended May 31, 1913:

Ore treated, tons	85,700
Gold recovered, ounces	22,303
Profit	$38,000
Total costs per ton	4.16

A new treatment plant has been erected in connection with the stamp-mill. Development on the 2100-ft. level cross-cut, at No. 2 shaft, did not turn out as well as expected, and ore from upper levels declined in value considerably.

ANCHOR TIN MINING COMPANY

The report of the Anchor Tin Mining Company of Tasmania, for the year ended March 31, shows that the output was less than usual, owing to an accident to the rock-crusher. The amount of ore from the two mines treated was 86,240 tons, as compared with 104,732 tons the year before. The yield of black tin was 140.6 tons, as compared with 188.3 tons, and the recovery per ton was 3.63, as compared with 4.02 lb. The cost of mining and milling was 98c., as compared with 84c. per ton. About two-thirds of the ore treated came from the Anchor, and the remaining one-third from the Australian mine. The accounts show a net profit of $270, which was carried forward

THE ROOIBERG MINERALS DEVELOPMENT COMPANY, LTD.

The capital of the Company is £180,000, divided into 180,000 shares of the nominal value of £1 each, all issued and fully paid. The property is at Rooiberg, *via* Narmbaths, Transvaal. The report for the year ended June 30, 1913, gives the following data:

Ore crushed by 10-stamp mill, tons	21,742
Sand and slime re-treated, tons	14,175
Concentrate produced, tons	1,196
Metallic tin content, per cent	69.54
Recovery from crude ore, per cent	72.85
Revenue	£184,868
Profit	88,194
Dividends	63,000
Ore reserves, tons	22,051
Metallic tin content, per cent	5.32

NORTH BROKEN HILL, LTD.

The North Broken Hill, Ltd., operates a property at Broken Hill, New South Wales. The report for the seven months preceding June 30, 1913, states that during that period 159,583 tons of ore was mined and the mill treated 153,680 tons of ore assaying 15.8% lead, 7.2 oz. silver, and 13.3% zinc, yielding 26,503 tons of concentrate assaying 69.6% lead, 22.2 oz. silver, and 6.6% zinc. The tailing dump has been sold to the Amalgamated Zinc, Ltd., also the production of tailing for ten years from January 1, 1909, and the output of lead concentrate has been sold to the end of 1914. The recovery of metals was: lead, 75.8; silver, 53.5; and zinc, 8.5%. The profit on working account for the seven months was £155,070, compared with £172,334 for the previous term of five months. The output was considerably reduced by a strike of the Silverton Tramway Co's employees, which caused a stoppage of railway communication for three weeks. The surplus of liquid assets over liabilities is £190,195. Two dividends were paid, totaling £120,000. The shortage of labor is not so acute as before. Contract miners are earning very high wages, the average paid for the term being $4.46, and for trammers $3.56 per shift.

CENTRAL RED, WHITE & BLUE COMPANY

This Company operates a valuable property at Bendigo, Australia, and the report covers the half-year ended September 30, 1913. The main source of production has been from the stopes above the 400-ft. level, and underfoot along the 318-ft. level north. In the latter workings on the hanging wall side gold is seen in breaking ore, and there yet remains a large quantity of highly profitable quartz to take out for considerable distance to the west of the present stopes. The shaft was sunk 160 ft., and stations cut at 800 and 880 ft. Generally the mine is looking well. Results were as follows:

Ore milled, loads of about 3000 lb	15,418
Concentrate sold, tons	173
Revenue	$144,000
Dividends	92,000
Costs per ton	2.78

CHILLAGOE COMPANY, LTD.

The Chillagoe company in Queensland, Australia, has had plenty of trouble during its existence. It owns mines, a railway, and reduction works, and during the year ended March 31, 1913, results were as follows:

Ore supplies:	
Chillagoe, tons	26,161
Heberton, tons	2,230
Etheridge, tons	30,511
Cloncurry, tons	87
Metal output:	
Lead, tons	2,841
Copper, tons	2,200
Gold, ounces	9,826
Silver, ounces	272,669
Railway revenue	$403,000
Railway profit	249,000
Net amount to credit of profit and loss	78,000

SUPERIOR & BOSTON COPPER COMPANY

This Company operates at Globe, Gila county, Arizona, and the report covers the year ended September 30, 1913. Development covered a total of 5842 ft. The extension of the Great Eastern vein, east of the McGaw fault, has been proved on all levels above the 1200-ft. point. On the 600-ft. level the vein has been opened for 800 ft., varying from 10 to 30 ft. wide. At the extreme east end another fault was encountered, and this was prospected by diamond-drill. The first hole showed an extension of the vein east, at a point 200 ft. further south along the fault. It is 37 ft. wide and contains copper. Six per cent ore has been mined along the foot-wall of the vein on this level. Work at 800 ft. has proved the shoot to be 400 ft. long. Ore deposition on contacts usually occurs in the form of pockets. At 1000 ft., 600 ft. east of the McGaw fault, the vein was cut, and developed for 250 ft. For 100 ft. sulphide ore from 6 to 24 in. wide, with 15% copper, was mined. After that the vein became badly folded and was barren for a considerable length. Work at 1200 ft. was disappointing until fault conditions were studied. Ore mined during the year has come entirely from new shoots east of the McGaw fault. The superintendent estimates that in future he can maintain present shipments of 4000 tons per month. Results were as follows:

Ore mined, tons	15,458
Revenue from ore	$153,436
Revenue from assessments and interest	268,502
Mining and equipment	328,052
Note paid	100,000
Balance at October 1, 1913	75,268

Decisions Relating to Mining

OIL AND GAS LEASE—FORFEITURE

An oil and gas lease providing that it should continue so long as oil or gas is produced on the land, cannot be forfeited for abandonment where the lessees continue to pump oil, though it is pumped in such small quantities as to render the venture unprofitable.

Gillespie *v.* Ohio Oil Co. (Illionis), 102 Northeastern, 1043, October 28, 1913.

MARL AND FOSSIL DEPOSITS—CONVEYANCE

An indenture under seal granting all the marl and fossil deposits under the grantor's land to the grantee, his heirs and assigns, together with the right to enter and remove the same, is a conveyance in fee and not a mere license revocable at the will of the grantor. Hence it passes to the heirs and devisees of the grantee.

Outlaw *v.* Gray (North Carolina), 79 Southeastern, 676. October 22, 1913.

DECLARATORY STATEMENT—REQUIREMENT CONSTRUED

The Montana statute requiring that a declaratory statement be filed within 60 days after the preliminary notice of location on a mining claim, which statement shall set forth the number of feet claimed in length along the course of the vein each way from the point of discovery, with the width on each side of the centre of the vein, has been construed as to require, not a description by metes and bounds, but such a description as will enable a person of reasonable intelligence, starting from the discovery point, to readily trace the boundaries as shown by the markings and run the lines. That degree of accuracy is not met if the description given is so erroneous as to be delusive and misleading.

Leveridge *v.* Hennessy (Montana), 135 Pacific, 906. October 6, 1913.

MINING CO-TENANTS—DEFAULT IN ASSESSMENT WORK

Where one of three mining co-tenants died and neither the adminstrator nor the heirs of the deceased contributed thereafter to the performance of the annual assessment work, they may be excluded after the usual statutory notice. That notice, however, must be served upon the heirs and service upon the administrator alone is insufficient as the heirs take their ancestor's title subject only to administration. If the heirs have actual notice of their default, however, and neglect to act over a long period of years, it may tend to show an abandoment on their part of all interest in the claim. A suit to quiet title could not in any event be brought by them if they were out of possession. Their remedy if any lies in ejectment.

O'Hanlon *v.* Ruby Gulch Mining Co. (Montana), 135 Pacific, 913. October 11, 1913.

COAL LEASE—ABANDONMENT

A coal lease, providing that the work of development should commence within ninety days and that if the lessees should elect to mine the coal they should do so within twenty-five years, did not specify the time for developing the mine or the diligence with which mining should be carried on. The lessees put machinery on the land and commenced work, but on account of the quantities of water and sand encountered, ceased it later and removed their machinery, making oral declarations that they were not abandoning the lease, as they had discovered coal. After two years the lessor brought suit to quiet title. Held that the acts of the lessees constituted an abandonment despite their declarations, and that the lease did not give them 25 years in which to commence mining the coal. Procedure with reasonable diligence is an implied covenant. The coal might in fact exist and have been discovered by lessees, but if conditions were such that they could not mine it and they abandoned their work, the lessor was entitled to have the lease declared forfeited.

McColl *v.* Bear Creek Coal Mining Co. (Iowa), 143 Northwestern, 532. October 23, 1913.

Recent Publications

SUMMARY REPORT OF THE MINES BRANCH, DEPARTMENT OF MINES (Canada), 1912. P. 174. Ill., maps.

PROSPECTIVE OIL FIELDS. By L. W. Trumbull, State Geologist. P. 15. Maps. Cheyenne, Wyoming.

MINERAL PRODUCTION OF CALIFORNIA FOR 1912. By E. S. Boalich. California State Mining Bureau Bulletin No. 65. P. 64.

THE STABILITY RELATIONS OF THE SILICA MINERALS. By Clarence N. Fenner. Reprinted from the *American Journal of Science*, October 1913. P. 53.

GLACIATION OF THE PUGET SOUND REGION. By J. Harlen Bretz. Washington Geological Survey Bulletin No. 8. P. 244. Ill., maps, index. Olympia, Washington, 1913.

COAL RESOURCES OF ALASKA. By W. R. Crane. P. 12. An address delivered to the 16th Annual Convention of the American Mining Congress, Philadelphia, October 1913.

DATA ON THE INTRUSION TEMPERATURE OF THE PALISADE DIABASE. By R. B. Sosman and H. E. Merwin. P. 7. Reprinted from the *Journal* of the Washington Academy of Sciences, August 1913.

BUREAU OF MINES, 22ND ANNUAL REPORT, 1913, TORONTO. P. 284. Ill., maps. The report is a general review of the mining industry of the province of Ontario during the year 1912. In addition to tables of statistics, it contains brief descriptions of the principal mines of Ontario, a report of the Hudson Bay exploring expedition of 1912, and reports on the geology of the Lake of the Woods, West Shining Tree, and other areas.

GEOLOGY OF THE NORTH AMERICAN CORDILLERA AT THE 49TH PARALLEL. Part I. By Reginald A. Daly. Memoir No. 38. P. 546. Ill. The memoir contains a full report on the geology of the mountains crossed by the international boundary at the 49th parallel, covering a belt 400 miles long, extending from the Strait of Georgia to the Great Plains. The report is based on field work carried on during the seasons of 1901 to 1906, inclusive. The author gives a full account of the general geology of the region traversed, with detailed descriptions of the stratigraphy, petrography, and paleontology of the individual mountain ranges.

Publications of the Department of Mines, Canada, 1913:

GENERAL SUMMARY OF THE MINERAL PRODUCTION OF CANADA, 1912. By John McLeish. P. 46.

PRODUCTION OF COPPER, GOLD, LEAD, NICKEL, SILVER, ZINC, AND OTHER METALS, 1912. By Cosmo T. Cartwright. P. 86.

RAPPORT SUR LES MINERAIS DE TUNGSTENE DU CANADA. By T. L. Walker. P. 56.

MINERAUX INDUSTRIELS ET INDUSTRIES MINIERES DU CANADA. P. 85. Ill., map.

RAPPORT SUR LES DEPOTS DE FER CHROME DES CANTONS DE L'EST DE LA PROVINCE DE QUEBEC. By Fritz Cirkel. P. 145. Ill., map.

ENQUETE SUR LES TOURBIERES ET L'INDUSTRIE DE LA TOURBE EN CANADA, 1909-10. By Aleph Anrep, Jr. P. 48. Ill., maps.

BUREAU OF MINES, Washington, 1913.

POSSIBLE CAUSES OF THE DECLINE OF OIL WELLS. By L. G. Huntley. P. 32. Ill.

SAFETY IN TUNNELING. By D. W. Brunton and J. A Davis. P. 19. The first of an interesting series of studies.

MINING AND TREATMENT OF LEAD AND ZINC ORES IN THE JOPLIN DISTRICT, MISSOURI. Preliminary Report. By Clarence A. Wright. P. 43.

FIRST-AID INSTRUCTIONS FOR MINERS. By M. W. Glasgow, W. A. Randenbush, and C. A. Roberts. P. 66. Ill.

COAL MINE FATALITIES IN THE UNITED STATES. August, 1913. Compiled by Albert H. Fay. P. 20.

COAL MINE ACCIDENTS IN THE UNITED STATES AND FOREIGN COUNTRIES. Compiled by Frederick W. Horton. P. 102. Index.

MINE-ACCIDENT PREVENTION AT LAKE SUPERIOR MINES. By Dwight E. Woodbridge. P. 38. Ill.

Recent Patents

1,073,076.—Method of Treating Metals. James A. McLarty, Toronto, Ontario, Canada. Treating metals by exposing metal articles to vapors produced from materials comprising water, an oily carbon compound, and a carbohydrate material, the temperature of such articles being maintained at a point below red heat.

1,073,069.—Dry Ore Separator. William W. Bonson, Dubuque, Iowa, assignor to Bonson Dry Concentrator Co., Dubuque, Iowa, a corporation of Arizona. A table, a mesh on the table, means for forcing a current of air through the mesh, means for imparting motion to the table, riffles upon the table, and set substantially in a line with the throw of the table, and deflectors upon the riffles at an angle at the riffles.

1,073,107.—Ore Concentration. George Albert Chapman and Stanley Tucker, London, England, assignors to Minerals Separation, Ltd., London, England. A process of concentrating ores which consists in subjecting to agitation and to the action of a selective agent a pulp of an ore containing a carbonate, in the presence of a bisulphate of an alkali metal, and separating the selected portion of the ore.

1,072,840.—Production of Ammonium Sulphate. Thomas Hill, Easterfield, Wellington, New Zealand. Obtaining ammonia from gases which comprise reacting upon ammoniacal liquor containing ammonium carbonate with calcium sulphate; separating the precipitated calcium carbonate from the solution of ammonium sulphate formed, and thereafter washing gases containing ammonia and carbon dioxide with said solution of ammonium sulphate.

1,072,920.—Roasting Furnace. Francis Albert Curnow, Pittsburg, Kansas. In a roasting furnace or the like, the combination, with the furnace, a raking apparatus arranged to stir and rake ore from the furnace, and means for driving the same, of means arranged to be actuated by the raking apparatus for automatically stopping the latter, and means set into operation upon the stopping of the raking apparatus, for automatically starting the raking apparatus after a predetermined interval.

1,072,686.—Process of Obtaining Potash Salts from Feldspar. Harry P. Bassett, Baltimore, Maryland, assignor to the Spar Chemical Co., Baltimore, Maryland, a corporation of Maryland. Adding sodium chloride to feldspar or similar potassium containing rock, heating the mixture in the presence of air without the addition thereto of lime or other calcium containing compound to a reacting temperature to render the potassium salts present soluble in water and dissolving out the potassium salts with water.

1,072,732.—Ore and Like Separating Means. Pierre Jurien, San Francisco, Cal., assignor of one-half to P. A. Brangler, Agnew, California. Adjoining independently agitatable screens for feeding sized material, a rotatable subdivided receptacle directly beneath the annular series of screens, but placed a substantial distance below the same, means for agitating each of said screens in succession, means for rotating the receptacle to bring its compartments successively beneath each screen, and means of synchronizing the period of successive agitation of each screen with the rotation of said receptacle.

1,075,011.—Method of Treating Ores and the Like. Niels C. Christensen, Jr., Salt Lake City, Utah. In the method of treating metalliferous ore, the steps which consist in moistening the crushed ore with a solution containing at least one reagent adapted to react with the ore, roasting the ore, condensing the volatilized products and the acid fumes generated in the roast in another portion of the above referred to solution, and leaching the metal from the ore with said last mentioned portion of said solution.

1,073,463.—Feeding Tuyere for Ore Treating Furnaces. Ernest Edmund Banes, Strathfield near Sydney, New South Wales, Australia. A metallurgical furnace fitting, consisting of concentric nozzles with air and gas connections respectively, a hollow fitting concentric with said nozzles, a hollow liner within said fitting and forming with the interior of said fitting a plurality of spiral passageways, an auger screw conveyor within said liner and connections for feeding air and powdered mineral respectively to said spiral passageways and said auger screw.

13,611.—Rock Drilling Engine. John George Leyner, Denver, Colorado, assignor to the J. Geo. Leyner Engineering Works Co., Littleton, Colorado, a corporation of Colorado. Rock-drilling engine, the combination with the cylinder and the piston, of a front-cylinder head comprising an integral cylindrical member adapted to be threaded to the end of said cylinder, an axial bore through said head, a counter-bore at its inner end, a chuck-bearing ring rotatably seated in said bore, and a drill-holding chuck rotatably mounted in said chuck-ring, substantially as described.

1,072,904.—Rust-Proofing Iron, Steel, or the Like. Augusto Bontempi, New York, New York, assignor to Bontempi Rust Proofing Co., a corporation of New York. Protecting iron or steel which comprises the step of subjecting the same to the action of the fumes of a fused, non-corrodible, metalliferous substance in a closed chamber, the temperature of the article during the treatment thereof with said fumes being maintained above the fusing, and below the fuming temperature of said substance whereby a non-corrodible deposit is formed in a liquid state upon said article during treatment, substantially as described.

1,073,184.—Mucking Apparatus. Walter E. Trent, Reno, Nevada. Combination with a supporting structure of drive mechanism for imparting longitudinal travel thereto, a rotatable tube mounted within bearings on the supporting structure, an elevating scoop secured to the forward end portion of said tube for raising material and discharging the same therein, devices actuated by the drive mechanism for imparting rotation to the rotatable tube and the scoop carried thereby, and independently operated means for imparting longitudinal movement to the said tube during the rotary motion thereof.

1,073,367.—Ore-Classifier. James W. Shields and Albert C. Thielmann, Hubbell, Michigan. Classified section divided by partitions into a number of pockets, a box removably fitted within the section and consisting of separable sections having lap-joint connection, the said box being divided by partitions, each lying within the plane of one of the first mentioned partitions, the section being provided in one wall with outlet openings and the corresponding wall of the box being provided with openings registering with the first mentioned openings, a screen disposed between the upper edges of the first mentioned partitions and the lower edges of the partitions within the box and dividing the said pockets, an overflow plate adjustable within the box, and means for creating a rise and fall of the material within the pockets of the section.

1,073,218.—Drilling Machine. Eugene Cook, Kalamazoo, Michigan, assignor to National Standard Co., Niles, Michigan, a corporation of Michigan. Combination with the frame comprising a horizontal portion and on upright portion, the horizontal portion being provided with a base at its rear end and with downwardly facing rail engaging hooks at its forward end adapted to co-act with the base in supporting the frame, the upright being provided with a handhold at its upper end; a drill spindle provided with a left-hand feed screw; a driving wheel having a gear thereon splined to said spindle; a feed nut having a gear thereon, a shaft arranged parallel with said spindle, a gear fixed on said shaft and meshing with said gear on said nut; a gear splined to said shaft adapted to be shifted into and out of mesh with said gear on said driving wheel; means for holding said feed nut against rotation, when said gear is shifted out of mesh; a shifting lever for said gear and for said means; a shifting rod provided with a hand piece adapted to be grasped in connection with the handhold of the frame upright; a crank shaft provided with a crank at its rear end; and driving connections from said crank shaft to said driving wheel on said spindle.

The Largest Mine Locomotive

The Carnegie Coal Co. has recently installed at the Charleroi, Pennsylvania, mines two of the largest mine locomotives ever built. These locomotives weigh 30 tons each and are of the Baldwin-Westinghouse bar steel type. It is estimated that each locomotive can haul 100 cars, each loaded with 3 tons of coal, over the local grades. The reasons for using such large locomotives are that a large production is desired and the haul being about two miles long with the grade largely against the load, a large locomotive is required.

The locomotives are described by the makers as follows: Each locomotive consists of two separate units which can be separated and used as 15-ton locomotives if desired. This use of two units in tandem is advantageous in such large machines because the weight is distributed over 8

BALDWIN-WESTINGHOUSE LOCOMOTIVE.

wheels instead of 4, and hence the locomotive has greater tractive power and is also easier on the track than if the weight were more concentrated.

The bar steel construction represents the most modern type of design. As is seen in the illustration, the frames are not built up of plates, but are formed of a grid of steel bars of heavy cross-section. The side frame of each unit is cast separately, forming an extremely strong and rigid construction. The openings in the frame give ready access for inspecting, oiling, replacing brake-shoes, adjusting brake rigging, etc., and also provide thorough ventilation to the electrical apparatus so that its all-day efficiency is higher than would be the case if the frame enclosed it completely. This type of frame has been in use for many years for large freight locomotives, but has been only recently adapted for mine locomotives.

Air-brakes are used, owing to the greater ease of handling so large an engine, but each unit is also equipped with hand-brakes which can be operated from the operating stand of the leading unit. An auxiliary reservoir is provided on the trailing unit, the main reservoir and compressor being on the leading unit. The hand-brakes are operated independently on both units when the two engines are disconnected. The controller for the tandem is of the individual magnetic blow-out type and handles all four motors together. When the tandem is split, the four-motor controller handles the two motors of its unit without change in connections, while the other unit has its own two-motor controller. In addition to the two large haulage units the Carnegie company has installed at Charleroi ten traction-reel gathering locomotives or 'crabs,' also of the Baldwin-Westinghouse bar steel type.

Commercial Paragraphs

H. W. JOHNS-MANVILLE Co. announces that it has increased its office and warehouse facilities at its Cleveland and Baltimore branches.

The SULLIVAN MACHINERY Co. has moved its El Paso, Texas, office to 511 Mills Brg. John Oliphant, for many years president of the Harris Air Pump Co., of Indianapolis, has joined its engineering sta ffand will have charge of its pneumatic pumping department.

MEESE & GOTTFRIED Co., 55 Main St., San Francisco, is distributing an attractive Christmas blotter to which is attached a ten-year calendar.

The EASTON CAR & CONSTRUCTION Co., Easton, Pennsylvania, has purchased the stock, good-will, etc., of the Ernst Wiener Co. and will continue the manufacture of cars, railroad equipment, etc.

The WITTE IRON WORKS Co., Kansas City, Missouri, has adopted the plan of selling its gasoline engines and hoists direct to the user and at factory prices. Catalogues and full information will be sent on request.

The JOSEPH DIXON Co., Jersey City, New Jersey, will send on request its booklets written by W. H. Wakeman, dealing with such subjects as 'Steam Traps,' 'Unions for Steam Pipes,' 'Feeding Graphite for Lubricating Purposes,' etc.

The DENVER ENGINEERING WORKS Co. reports the following recent orders of its machinery. The Furukawa Kune mine of Japan is preparing to install a double-drum electric hoist of 500 lb. capacity; the San Juan mines of Buenos Aires, Argentine, have ordered a 5000 lb. capacity double-drum electric hoist complete with electrical equipment; Takata & Co., New York and Tokio, another 2500 lb. capacity single-drum electric hoist for shipment to one of its customers at Moji, Japan; the Zaaiplaats mine in South Africa, a Richards pulsator classifier. Cia. Minera la Lucha y Anexas, El Oro, Mexico, a 10-stamp mill equipment, 1250-lb. stamps, which includes a 4½ by 18-ft. tire and trunnion type tube-mill.

Catalogues Received

WOOD DRILL WORKS, Paterson, New Jersey. Pamphlet, 'Improved Wood Rock Drills.' 31 pages. Illustrated. 6 by 9 inches.

The LUNKENHEIMER Co., Cincinnati, Ohio. 'Lunkenheimer Regrinding Valves.' 23 pages. Illustrated. 3½ by 6¼ inches.

The COOK RAILWAY SIGNAL Co., Denver, Colorado. Booklet. 'The New Storage Battery.' 21 pages. Illustrated. 6 by 9 inches.

THE MINE & SMELTER SUPPLY Co., Denver, Colorado. Bulletin No. 28, 'The Massco Coal Washing Table.' 12 pages. Illustrated. 7 by 10 inches.

HOSKINS MANUFACTURING Co., Detroit, Michigan. Bulletin No. 8, 'Hoskins Electric Furnaces, Type F.B.' 19 pages. Illustrated. 6 by 9 inches.

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EDITORIAL

A MERRY CHRISTMAS and a happy New Year is the wish of the *Mining and Scientific Press* for subscribers and friends. May your stockings be filled with bonanzas and the new year prove a pay-streak from January through December.

RECRUITING methods in Mexico are not conducive to the developing of patriotic and well organized federal armies. After exhausting the jails, the 'press-gang' has been revived and the ranks are being forcibly filled with those who appear capable of bearing arms and who are found on the streets after sun-down. This gives new impetus to the early closing movement among shopkeepers.

THE final installment of Mr. C. B. Horwood's account of 'The Rand Banket' is printed this week together with a letter in discussion from Mr. F. H. Hatch. We have a number of other letters in hand and will hope to receive many more, since such painstaking work as that of Mr. Horwood, and such elaborate presentation of results, entitles the author to careful criticism from his fellow workers. It is planned to reprint the whole series, including the discussion, in book form.

YEAR ENDS are the natural times for stock-taking, and next week we shall print our usual Review Number. In accordance with the traditions of the *Mining and Scientific Press* which seeks to emphasize in its columns technology rather than news, this number will be devoted to a summary of progress in methods instead of résumés of development by geographical districts. We shall print also the statistics for the year so far as authoritative figures are available; but we have no desire to compete with the Government in collection of figures, or to print wild guesses drawn from esoteric sources. Amateur statisticians take themselves seriously at this season. It is well to remember that production statistics are never complete and that averages only by chance coincide with actual transactions.

COMPLETION of the Northern Longitudinal railway of Chile is announced and a through route is now open from La Serena to the Nitrate railways centring at Iquique, with surveys completed to Arica. From La Serena south to Valparaiso the route is over the Southern Longitudinal and connecting lines. Building of this great through line was one of the projects dear to the late president Montt, and he did much to bring it about. While much of the country traversed is barren, many parts are rich in minerals, and, politically, it is of first importance

that the isolated agricultural districts of the transverse valleys should be bound together by transportation lines. The conditions are similar to those which led to the building of the Union Pacific in the United States, and we hope that the similarity may extend to the extent of bringing our Chilean neighbors equal prosperity.

CHINA is so much in the public eye now that we have taken especial pleasure in the printing of the series of views of Chinese mining and metallurgical industries, of which we present another this week. In the main we have been indebted for these pictures to Mr. F. L. Cole, of Shanghai, whose wide travels in the Far East have permitted his making an unusual collection of notes and photographs.

THERE is an old adage which bears upon results when lawyers fall out. We forbear to quote it, but we are glad to print this week a critique by Mr. Robert M. Searls, of the article on the revision of the mining law by Mr. Russell L. Dunn. It is disconcerting for the plain citizen to be told that his arguments carry no weight because he is not a lawyer, and refreshing, therefore, to learn that one gentleman of the bar considers the logic of the other "legal nonsense." Mr. Searls, no more than Mr. Dunn, believes in abolishing extralateral rights, though he sees no legal objection to the change of basis. This being accepted, the matter becomes one of policy, and we take heart again; for as to policy, a layman may argue as well as a lawyer. Not, however, to peril the holiday spirit by controversy, we defer argument on this most interesting point.

CITIZEN'S ALLIANCE demonstrations at Houghton and Calumet are reported to have shown a unanimous expression of disapproval on the part of the law abiding people of those districts against the lawlessness and disorder which has prevailed in the copper region of Michigan. With the machinery of law in order and the grand jury in session a decided improvement in the situation has taken place within the past two weeks, and announcement has been made that the strike will be peacefully conducted in the future. It is evident that the Western Federation of Miners has fallen into decided disfavor in Michigan, and with such a record behind them in the conduct of this strike, there seems little hope that their Washington delegation will be able to accomplish much at the Capital for the good of its cause.

Camp Bird and Its Reinvestments

The career of Camp Bird Limited has been the cause of some surprises, much discussion, and not a little criticism. The report of the annual meeting held in London on November 19 affords much interesting information about the affairs of the Company and gives one at least a glimpse of the reasons for the criticism that has been agitating the financial district of London. Two years ago it was thought that the Camp Bird mine at Ouray, Colorado, was about to yield its last dividend and that the Company would needs go out of existence; but the mine has surprised everyone by its longevity and continued productivity. The general manager, on June 30, 1913, estimated the ore reserves at 31,000 tons capable of yielding a profit of £66,800. The production for the fiscal year just ended had already yielded a net profit of £41,000. Development has proved sufficiently satisfactory to lead to the belief that production may be maintained for some time, and that the mine will die hard. To offset this pleasant surprise on the part of the Camp Bird, the Santa Gertrudis has caused the stockholders great disappointment due to the sudden and unexpected decrease in the value of the ore in the lower levels. Two years ago it was confidently expected that the Santa Gertrudis would yield a profit of £350,000 per year, yet the net profit for the current fiscal year (to June 30, 1913) was only £235,000. This serious discrepancy between actual profits obtained and those estimated by the engineer from the ore developed is explained by the fact that the nineteenth level happened to be driven along a streak where the ore was of a higher grade than that in the rest of the vein. It was not until the stopes had been opened on the entire width of the vein and along the whole length of the orebody that the true average width and value of the ore was found to be materially less than had been estimated, resulting in a reduced tonnage and a much smaller profit for the year. The Company has not given out any information with regard to the twentieth level, except the statement that the vein there is narrower than on those immediately above. Although it may be possible that the mine is approaching the lower limit of the richer orebodies, yet in addition to the vein upon which work has been mainly done and on which a million tons of developed and possible ore are now known, there are some ten other veins upon which little development work has been done. It is possible that Santa Gertrudis may prove to be as long-lived as its forerunner in Colorado. It is unfortunate that the original estimates of ore tonnage and value were unduly optimistic and that detailed figures were given out before the vein in the nineteenth level had been fully developed, for the unexpected diminution in the value and width of the ore on that level has now caused the Camp Bird stockholders much uneasiness; it has depressed the price of the stock, and has given rise to a large amount of caustic criticism of the Chairman and the Board. We are of the opinion that the directors have been unusually far-sighted and efficient in their management of the affairs of the Company, as is evidenced by the dividends paid and the acquisition of new properties from surplus funds. By the judicious purchases of mines of undoubted merit to replace those which are being exhausted, the life of the Company has been greatly prolonged at no additional cost to the original investors. This is a practice which may be highly commended. On the other hand, we do not believe that the stockholders can be expected to place complete confidence and trust in a Board, many of the members of which are directors of financial institutions that have underwritten the securities of other companies purchased by Camp Bird Limited, or have been engaged in developing and securing options upon mining properties that

have later been recommended for purchase by the Camp Bird company. By this we do not mean to imply that the present Board is not above suspicion, but the necessarily Janus-like position of the Chairman and some of the directors may, with justice, cause the stockholders to wonder whether the Board is looking mainly toward personal interests or to those of the Company. Mr. A. M. Grenfell, the chairman, has been greatly exercised over anonymous letters which appeared in *Truth* criticizing himself and the Board. On account of the large portion of his report which is given to the denouncement of his critics, while evidently dodging the question, we are inclined to feel that these anonymous criticisms may not be entirely without foundation. Interlocking directorates, and organization of companies within companies always places the board members in a position where they are subject to criticism. It is difficult to forestall this even by the most complete publicity. In spite of the fact that the stockholders have received excellent dividends and now have a flourishing property, they have not been taken wholly into the confidence of the Camp Bird board. In January 1910, the Camp Bird bought an 81 per cent interest in the Santa Gertrudis for £922,131. It was an excellent purchase, but the stockholdehs might well wonder at the sum of £244,178 which was paid as commissions to the Consulting Engineer, the Directors, and their friends. In October 1910 it became necessary to raise funds for the further development of the mine and additions to the mill, and therefore 100,000 shares, with calls on a further 135,000 shares, were sold to "third parties"—presumably Mr. Grenfell and his associates—and these shares were never offered to stockholders. When the capital stock was increased in January 1911, the Camp Bird secured an option at par from the Santa Gertrudis on 132,000 of its reserve shares. This option was never exercised, being passed to "third parties," though at a profit, it is true, of £16,800 to the Camp Bird. Since June 30 of this year, Camp Bird has, however, purchased an additional 7475 shares, so that it now owns 74.7 per cent of the stock of Santa Gertrudis company. Why the Camp Bird did not exercise its option on Santa Gertrudis shares and yet purchased later more of the stock, has not been made clear. So what wonder if there are suspicions that commissions and profits in sales of stock may have largely inured to the personal benefit of some members of the Board.

In following out its excellent policy of purchasing new properties from surplus funds, the Company last year took an option for three years on 125,000 shares of stock of the Messina (Transvaal) Development Company, Limited, at the same time guaranteeing the interest on an issue of £250,000 in 6% debentures. The Messina is a copper property which was taken up by Mr. Grenfell and one of his brothers about 12 years ago, and which they have been prospecting, developing, and equipping during that time. From the annual report of the Messina company the mine appears to be doing well and should prove to be a very profitable producer. According to the engineer's estimates, the total probable and possible ore amounts to 480,000 tons. The ore blocked out averages 10 per cent copper. The Bonanza mine, one of the group, has been developed to a depth of 900 ft. and at that level a cross-cut exposes an orebody 44 feet wide which contains an average of 8 per cent copper across the full width. During the past year 22,600 tons was mined and £94,000 was realized from ore sales, leaving a net profit of £14,000 after paying all expenses, including debenture interest. With the completion of the new 300-ton concentrator and the extension of the railway to the property the Company expects to treat 10,000 tons per month, which should yield a profit of over £200,000 per annum. From the reports we have heard of the Messina it would seem as if the Camp Bird directors had done well in securing an option on some of the stock.

With regard to the advisability of another investment which is now proposed, we do not feel so sanguine. Camp Bird Limited is offered a 40 per cent interest in a syndicate organized by the Canadian Agency—in which Mr. Grenfell is largely interested—to acquire a group of gold mines in Nicaragua, at a cost of about a million and a quarter of dollars. The mines have been examined by Mr. Orvil R. Whitaker, who has strongly recommended their purchase and further development. Mr. Whitaker reports that the aggregate length of the known pay-shoots is nearly four miles and the average width of the veins about 15 feet. He estimates 2,400,000 tons of ore above water-level, averaging $6.66 per ton, which can be mined by open-cuts and adits, although this is only a very small portion of the tonnage which can be developed. Just because we are not familiar with Mr. Whitaker's name and do not happen to find it among those of the members of the leading mining societies, there is no reason to suppose that Mr. Whitaker may not be an excellent engineer, and one of sound conservative judgment. However, his report sounds almost too optimistic. It is a mistake to include 'possible ore' in a report intended for laymen, for the term is misleading and the estimates of tonnage and value are necessarily approximate only; for instance, Mr. Grenfell gives the tonnage of 'positive and probable' ore, but fails to state that of the positive ore alone, with the result that the impression one receives is that there are two or three million tons of profitable ore in the mine—which may or may not prove to be the case. Inasmuch as we understand that the orebodies occur as lenses from 200 to 500 feet in length, having a maximum width varying from 3 to 30 feet, and are mostly in different veins, it is misleading to give the aggregate length of known pay-shoots, for that implies a continuity which does not actually exist. The mines of the group have been known for a great many years and have been examined a good many times, but the reports on them have not usually been as optimistic as this one. However, we trust that this enterprise will meet with the unqualified success which the Syndicate and its engineers seem to think is assured. Camp Bird Limited, after all, is an unusually well managed Company; the directors have prolonged its life and dividends by judicious re-investments; and the stockholders have had an excellent run for their money. In many ways it is a model which other mining companies would do well to copy.

Successful Salting of Alluvials

By C. S. Haley

In attempting a disquisition upon this subject, one is minded to take pattern after the famous essay upon snakes in Ireland, which, as will be remembered, began with the pertinent statement, "There are no snakes in Ireland." By the same token, then, there is no such thing as successful alluvial salting, provided: that the examining engineer is honest; that he takes the care, either through his own personal knowledge, or through some absolutely dependable recommendation, that all persons coming in direct contact with the handling of his samples are either honest or directly under the eye of someone who is; and that he use ordinary care, vigilance, and common sense in checking up the results of his sampling.

Preliminary Examination of Alluvials

For an instance, I will take the easiest conditions for alluvial sampling; preliminary examination of an ancient river bed with a view to hydraulic installation. If the deposit is salted, it may lead to the expense of a more careful and, in inaccessible localities, more costly final examination, the result of which might mean a great loss of prestige. In a case of this sort, the examining engineer is apt to make the trip alone, or with one assistant at most; as in all probability his natural inclination, made pessimistic by force of circumstances and experience, is to believe that he is going on a wild goose chase, and should be accomplished with as little loss of time and money as possible.

Arriving at the neighborhood of the property, it is worse than useless for him to attempt to conceal the nature of his business. In these our United States, so neighborly is the interest felt in all the operations of our brother, the chances are that the proprietor of the hotel in which he rests his stage-worn bones on the first night of his journey, has been telephoned in advance of the nature of his errand, and in the course of his evening's wait he will have all sorts of information gratuitously offered him. If, however, our engineer be not too young he will not shun this information thus thrust upon him, but may derive a great deal of keen amusement therefrom. For in even the most isolated mountain communities the knockers thrive as well as the boosters, and he is very like to hear a composite description of the property which he proposes to examine which will be very like to a cubist picture; viewed from one angle, a radiant vision of a glorious dawn; from another, a dark-brown taste on a foggy morning. From such an extreme double characterization, by noting the points overemphasized, he can often determine a course of action, subject to modification on the ground, which will perhaps aid him to the saving of much time. On the other hand, he may decide it best to let it all pass with a 'warming of the head,' as our Latin-American friends very aptly put it, and forget all about it.

Arrived at his destination, and well aware that the object of his trip is a matter of discussion to the entire country-side, it may be well that he does not look upon the men whom he hires to attend to the rougher portion of the work as being like unto Caesar's wife. It may be necessary to run an open cut into the bank, and down along the rim of the channel; or, in the case of a working face, to strip a cut from top to bedrock. In all of this work, there is the easiest chance in the world to salt samples, provided that the engineer is careless and easy going. On the other hand, if he appears to be very insouciant, the chances are that by keeping a watchful eye beneath such an appearance, he can detect much more than if he preserves the air of extreme vigilance. Most salting in such places is very clumsily done. For instance, if you give a man a sample to pan down for you (intending, of course, to pay no attention to the result), you may observe him smoking with his pipe tipped sideways over the pan, or spitting tobacco juice nonchalantly into the pool in which he is panning. But this kind of thing should never be noticed openly. Simply give the man enough rope, and he will hang himself, and you will avoid a great deal of unpleasantness, and possibly the necessity of doing, or receiving, physical harm. One should always remember that the last laugh comes with the report. And, no matter who is handling the manual work of the sampling, always take check samples yourself, from a face exposed by yourself, and pan them yourself, with nobody else within five feet of you.

An Unsuccessful Attempt

So much for this type of sampling, which is very simple, and does not necessitate, in the case of an experienced engineer, any weighing of samples. In connection with this work, I am minded of a tale they still tell in Yreka of two gentlemen of fortune who attempted to dispose of a worthless placer claim to a Chinaman! After very carefully disposing of about five hundred dollars worth of wash gold about the exposed face of the workings with a shotgun, they offered the property to Wun Lung, who had recently disposed of his laundry and pi-gow house, for five thousand dollars cash. Wun Lung very cheerfully consented to enter into negotiations, but requested a day to work the property, to determine its worth. This was, of course, readily accorded him. At the end of the day, the prospective purchaser expressed himself as very well satisfied, but wished to wait two more days before paying over the five thousand. With the lure of easy money in their eyes, our gentlemen of fortune readily assented. On the time appointed, however, the Celestial failed to materialize; in fact, he could not be found in the town. The owners of the property, stricken with a sudden panic, went down to their diggings, and found their worst fears realized. The carefully scraped banks showed them whither had departed their $500 worth of dust, and they returned to town to walk in the virtue of the chastened.

This kind of thing is, of course, clumsy, so clumsy that it often defeats itself, as in a case mentioned in *The Mining Magazine* some years ago, where a young man went out to sample a gravel property, and, in spite of the fact that the promoters managed to slip at least ten cents worth of gold into every pan that he took, he reported the property as valueless simply for the reason that he panned all the gold out and even had no black sand left at the end of his panning!

Keystone and Empire Drilling

In the case, however, of Keystone and Empire drilling, much more artistic work can be done. For this reason, the panner on the drill, or at least one of them, should always be a man absolutely trustworthy and personally known to the examining engineer. In case of any irregularity on the other shift of the drill, it may always be checked by the work of the absolutely trustworthy shift. One very ingenious method of salting a Keystone that has come under my notice has been the plastering of the drill rope with mud containing plenty of No. 3 colors. In this manner the *de trop* gold was carefully and evenly distributed throughout the hole. A watchful drill-runner, who felt the fine flakes of mud dropping round him as they dried, spoiled this little plan very effectually, however.

A drill fireman with the tobacco habit spoiled his game once by spitting too consistently into the box as he lowered or raised the sand-pump. The clumsiest attempt that I know of in this connection was the deliberate spilling of gold on top of the ground after the machine had been set up and the careful salting of panning tubs and boxes. The simpleton did not even take the trouble to use the same type of gold that was ordinarily found in the bar!

Drill Sampling

In drill sampling, however, there is this big advantage over open-cut sampling: that you have a continual check on the weight of your gold by the panners' log. In open-cut sampling, where possibly samples are only weighed once in two or three days, unless the samples are very carefully guarded, it might be very easy to augment the sample; and, as the colors have only been scanned once, and then as a lump sum, a careful job might raise the value of the property several cents on the yard. But in either case, until all samples are weighed up and checked, the utmost care should be taken in guarding them. Usually, in the case of a property extensive enough to justify a Keystone examination, the amount of money involved is big enough to induce men of a certain type to take extraordinary chances.

Of course, in the long run, the most effective way of salting alluvial, as well as other property, is to buy the examining engineer; but this, too, presents its difficulties. If the report is to be worth anything in the eyes of practical mining men, it must be made by an engineer of standing. And, in most cases, that standing is the result of long years of honest work and toil-won experience. Therefore, the man who would barter it, even if he would barter that incomparably more priceless thing, his self-respect, would probably demand so high a price that the promoter's profit would be more than wiped out. For of necessity, to a man who has lived an honest existence as far as the maturity of his life, the prospect of not being able to hold his head high for the balance of his career, is hard to assess to him in financial terms.

In conclusion, one of the most effectual methods of salting a gold mine that ever came under my experience, was not done with gold, but with frogs! The promoter of the property, which was once a famous producer in 'the days of old,' etc., was making a strenuous effort to sell a worked-out mine. His prospective buyers were Frenchmen, and the whole incident came under my personal observation. The price was moderate, the gold was fairly evenly distributed, and there was a fair chance to sell. However, instead of making the mistake of trying to prove the impossible, my friend left the subject of available and workable ground strictly alone, and expatiated on the value and beauty of the place as a summer camp. Then he led his buyers down to a deep and spacious pool of stagnant water in the bottom of an abandoned, worked out diggings. It was a sort of a frog concentrate, and the rest of the mine, from a frog standpoint, was not to be judged by it. At the opportune moment, nets were produced, and before his clients left that summer afternoon, they were begging him to accept a check to bind the bargain.

After an existence extending over 16 years the Hartley & Riley Beach Dredging Co., of Cromwell, Otago, New Zealand, has been voluntarily wound up. This course was adopted in consequence of the poor prospects, and in consideration of the fact that, so far as the river conditions were concerned, it was thought to be impossible to continue work for several months at least. The Company held an area of 32 acres, the material worked upon being at an average depth of 35 ft., and the quantity raised per hour averaged 100 cu. yd. In 1905 two acres yielded 674 oz., and the total gold produced was 29,618 fine ounces, the value of which was $600,000; while dividends amounting to $400,000, equal to $63 per share, have been paid, on a paid-up capital of $30,240, which was also the cost of the dredge employed. For the week ended March 23, 1900, the dredge yielded 1187 oz. 14 dwt. of gold, and for the week ended October 16, 1903, 1158 oz. 19 dwt. was secured. The dredge holds three records in New Zealand: for the gold return for a fortnight, for one month, and for the total dividends paid in one month. The 1234 oz. won by the Electric Gold Dredging Co. still remains the record for a week's dredging in the country. In the days of the dredging boom, the Hartley & Riley company held place of pride for the price of its shares, on one occasion $4.80 shares rising close up to $115.

Block tin and tin ore weighing 32,747 tons was exported from the Malay States during the first eight months of 1913.

For producing cobalt oxide, three Ontario companies received a total of $10,000 in bounties last year.

Dredging at Snelling, California

STAFF CORRESPONDENCE

While Merced county is essentially an agricultural and fruit-growing district, yet an interesting dredge is working on the south bank of the Merced river, not far from the county line. Shortage of water has caused the stoppage of several dredges in other counties, but the one owned by the Yosemite Dredging & Mining Co. has operated continuously, handling up to 100,000 cu. yd. of gravel per month. Feeders to the Merced river are said to have a sharp fall, consequently any little precipitation of rain, or melting of snow in the mountains, keeps the river flowing at a fair rate, although at present it is certainly low.

Operating Conditions

The conditions under which the Snelling dredge is working may be said to be difficult to equal. The river flats consist of two to five feet of sandy loam above the gravel, the average depth of the bank being 15 ft., of which 11 ft. is below water, resting on a bedrock of 'lava ash' which underlies this part of the district. Scrub, fair-sized oaks, and cottonwood trees grow in the area, the roots being badly matted together and giving the dredge some hard work at times. There is always about four acres of land cleared of growth ahead of the dredge. The gravel is ordinary river wash, with stones from six to eight inches diameter, with a few up to ten and twelve inches. As working in the actual river bed is not permitted, the dredge is floating in a pond, separated from the river by a levee a few feet wide. Water is let into the pond by a small ditch fed from the river where it is dammed. Power is supplied by the San Joaquin Light & Power Co. at 1¼c. per kilowatt-hour.

The dredge is of the Bucyrus make, with 3¾-cu. ft. close-connected buckets, the lower tumbler of the ladder weighing 5000 and the upper 6000 lb. Manganese steel lips are fitted on the buckets and last 18 months, the bucket bottoms being in their third year, while the wearing plates on the tumblers last from 10 to 12 months. Instead of having the usual revolving screen, a shaker screen is used, while the ordinary gold-saving apparatus and stacker belt are installed. The following electric motors are in operation: 50 hp. on the bucket line, 20 hp. on the stacker, 20 hp. on the shaker screen, 40-hp. on the 8-in. centrifugal pump for washing, etc., 15 hp. on a small winch, and 5 hp. for priming and small pump work, a total of 150 hp. This dredge has an exceptionally high load factor and average working time, these being 78 and 90%, respectively. This is not mere calculation or time given by the dredge crew, but actually shown on a General Electric recording ammeter in the office away from the dredge. The yardage handled, 1,020,000 cu. yd. in 1912, is surveyed every month, so here again approximate statements are not relied upon. The boat works three shifts per day with a crew of two men on each, except day shift, when a few extra men are necessary for repairs, etc. The men are well looked after, receive high wages, are paid for time off during sickness or holidays, and, consequently, efficient work results.

YOSEMITE DREDGING & MINING CO.'S DREDGE ON THE MERCED RIVER AT SNELLING.

An interesting feature in operating this dredge is that there are no spuds used at all, the ground being unsuitable, so a head-line is maintained to keep the digging ladder against the bank of gravel. At each of three points on the cleared ground is anchored a 1¼-in. diam. steel wire rope about 400 ft. ahead of the dredge. Attached to a winch is a cable of the same size and this and any one of the other lines is joined by a shackle and pin, so that, when digging at either side or middle of the pond, the head-line is almost straight ahead and it is not necessary to move the whole length each time a new position is made, but just change from one anchored line to another. The usual side-lines are used for lateral movement.

The average recovery of gold is 10 cents per cubic yard, and over 350 acres of land has been turned over to date. J. H. White is manager of this economical and interesting dredge, and is experimenting with the recovery of fine gold and platinum from the dredge pulp after it leaves the tables. James W. Neill, of Pasadena, controls the property.

The Rand Banket—Part VII

By C. B. Horwood

Genesis of the Pyrite and Gold in the Bankets

In the year 1903 De Launay[331] summarized the various theories with regard to the genesis of the gold and pyrite in the auriferous banket of the Rand and grouped them under the three following heads, according to whether it was assumed that the gold was formed (*a*) before the banket; (*b*) during the deposition of the banket; (*c*) after the banket had been deposited.

The theory that it was formed during sedimentation is now generally discredited, and has been discarded. The placer theory, which assumes that it was formed before the banket, seems at first highly attractive; it was last presented, in 1907, by Gregory in an interesting, suggestive, and valuable paper,[332] in which the work done and the writings on the subject to date were ably summarized. As he admits, this paper was the result of his observations during a short visit to the Rand in 1905, and of information and ideas obtained second-hand on that occasion. As might, therefore, have been expected, his arguments were far from convincing and were ably opposed in the subsequent discussions with the result that the theory of a placer origin for the gold, far from being proved, was shown to be improbable.[333] At the time those, perhaps, best able to judge, who had for many years studied the question on the Rand itself, were almost unanimous in agreeing that the gold was introduced subsequently, that is, after the conglomerates were already formed. The work done since then amply supports and confirms this opinion, which may now be said to be held by all those qualified to judge who have, on the Rand, given the matter prolonged and serious study; and especially by those who have studied the subject by continual observations taken at first-hand underground, supplemented by microscopical investigations and chemico-physical research work in the laboratory.

De Launay's Theory

It may here be well to recall that in the year 1903 De Launay[334] in discussing the theory under the third heading, that is, of the introduction of the gold into the bankets after their formation, pointed out that if this be accepted one has to deal with a special type of lode formation. The solutions instead of circulating, as usual, along rock-fractures, insinuated themselves into the interstices between the pebbles of the auriferous bankets and there deposited their mineral contents; and although the process must have taken place on a much larger scale, yet it is somewhat analogous to the case of the cinnabar deposits of Almaden, in Spain, where sulphide of mercury, accompanied by silica and hydrocarbons and a little iron sulphide, impregnated what were previously porous layers of sandstone along the entire extent of certain strata. In other words, the gold-bearing pyrite is a product of metamorphism similar to that which formed the chlorite or muscovite of the bankets. The Rand ore deposits are thus a simple, but particular, case of the type of deposit represented by the various formations of South Africa that carry gold-bearing pyrite: they are the result of a subterranean impregnation, produced under pressure and in depth by mineralizing waters from an eruptive magma. He admits that this theory affords a good explanation for variations in the grade of the ore, in following the line of the outcrop from one claim to another; and likewise for the relative uniformity of zones, rich or poor, in sinking on the dip; while as already stated, the placer hypothesis would require a uniformity along a line parallel to a primitive coast and a progressive decrease in richness as distance is gained transversely to the shore. His most serious difficulties, as regards this theory, were that it gave no clue to the presence of the 'rolled' pyrite; and "is scarcely in accord with the general appearance of the pyrite grains, as they are seen under the microscope." These difficulties have already, in the first three parts of this paper, been shown to be really non-existent. The author has visited and studied the occurrence at Almaden and there is no doubt that the cinnabar impregnation of what were formerly sandstones, but are now quartzites, was due to the agencies of the neighboring intrusive rocks; and he agrees with the appropriateness of the analogy as described by De Launay.

Placer Theory of Formation

When the writer first went to the Rand he was attracted by the seeming simplicity of the placer theory, which he at first accepted. He was soon, however, forced to abandon it as incompatible with observed facts; and only after more than ten years of close, constant, and prolonged study does he feel justified in presenting to his readers the results of his researches here recorded. Constant study underground of the actual occurrence of the gold in the banket soon revealed numerous features that cannot be explained by any supposition of a placer origin. The figure (21) printed in part IV shows an example of one of these. It illustrates how when a pebble leader entirely dies out the hanging and foot-wall quartzites are sometimes separated by a thin layer of gold, just as frequently happens when ore pinches in a normal gold-quartz vein and a thin streak of gold persists between the two walls.

Posepny[335] pointed out that the average density of the earth is 5.6, while that of the rocks of the earth's crust is only 2.5, and that consequently it must be admitted that in the central mass substances much denser than 5.6 have been accumulated, that is to say,

[331] L. De Launay, *loc. cit.*, p. 519.

[332] J. W. Gregory, *loc. cit.*, pp. 2-41.

[333] J. S. Curtis also dealt with Gregory's paper and refuted most of his arguments in a paper entitled, 'The Origin of the Gold in Banket,' see *Jour.* of the Chem. Met. and Min. Soc. So. Af., January (1908).

[334] L. De Launay, *loc. cit.*, p. 521.

[335] Posepny, *loc. cit.*, pp. 56, 57, 61, 62, 76, 83 to 85, and 239 to 242 and 249.

"the deep region is the peculiar home of the heavy metals." He then continued, and, here it will be well to recall his words: "If we imagine ourselves standing in the deep region in front of the profile of an ore-lode, like the Adalbert at Przibram, for instance, 1110 m. (3600 feet) below the surface and 564 m. (1850 feet) below sea-level, we perceive a fissure space of discission, filled with symmetric mineral crusts, chiefly argentiferous lead sulphide. Remembering that this filling has been stoped continuously to the surface, we can find no other satisfactory explanation than the hypothesis that it was brought up from still greater depths, and, in view of the comparative insolubility and the large quantity of the metallic sulphide here accumulated, it must have been deposited from perpetually renewed, and, therefore, from *ascending*, mineral solutions. Whoever has had opportunity to study an ore-lode in the deep regions can conceive no other explanation. The miners themselves have always held this opinion; in other words, they have all been ascensionists." He added that in considering the genesis of an ore deposit formed in a pre-existing space where crustification is absent, and therefore the manner of filling is not immediately apparent, recourse must be had to the analogy of the substances and their paragenesis; if these correspond with the contents of spaces filled with crusted deposits, a similar origin must be inferred, as for example in the case of certain metasomatic deposits. He maintained that "from these considerations it follows that all the deposits of the deep region are referable to one general ruling process, clearly shown to be the action of ascending mineral solutions; that is, they were all formed by ascension." Discussing the Przibram veins he stated that in that district sedimentary rocks are traversed by heavy eruptive masses, which are 30 metres thick by the main vein, and 100 metres for the whole group of veins; and even Sandberger[336] admitted that "an essential part of the lead and silver contents of the ore-veins is due to the eruptive rocks." Posepny asserted that the veins might be ascribed to the contraction of the eruptive dikes in which they occur, although they depart, here and there, into the stratified rocks; and that "we cannot dream of deriving their metallic filling from the dikes. The Commission, already mentioned, established to test the applicability of the lateral-secretion theory to Przibram conditions, found the material of the dikes to be the same in depth as in the upper zones. The largest amount of metallic contents attributed to the diorite dikes would account for a portion only of the thickness of ore in the veins. The greater part must certainly be regarded as of deep origin; and it is more convenient to treat the entire metallic contents of the veins as derived from greater depths." Further, that at Przibram, in central Bohemia, above the granite foundation lies a formation of pre-Cambrian slates, unconformably overlying these is the Cambrian system, consisting below of conglomerates and sandstones, and above of fossiliferous slates. The ore occurs in the Cambrian sandstones. Diorite dikes are numerous; their strike making an angle of 45° with the prevailing strike of the sedimentary beds. The veins are mostly in these dikes, only occasionally entering the stratified rocks and returning soon to the dikes they have left, or to others of the group. Also, he stated that in dip they mainly follow the dikes, and the latter determined the formation of the "ore-bearing vein-fissures;" and, that if the vein material (as is very likely) was derived from eruptive rocks, these were much deeper than the eruptive rock disclosed down to the then bottom of the mine (or 3640 ft. below the surface). The rich ore-ground is in that more highly metamorphosed portion of the Cambrian standstones near the main structural fault, which had then been disclosed by mining to a depth of 3600 ft. The rich ground, therefore, starts from the intersection of this fault with the zone of eruptive rocks, in other words, from the point relatively nearest to the barysphere. Both the veins and the dikes are fissure-faults. The dikes present different kinds of eruptive rock, and are generally decomposed in the neighborhood of the ore-veins, which, as Posepny is careful to point out, is "a result naturally to be attributed to the action of the mineral springs." He states that the general rule (which the present writer believes is now almost universally accepted) is that ore deposits carrying metallic sulphides have been formed by ascending solutions. He also stated that "the Przibram district lies, in round numbers, about 500 metres above sea-level, and the mine workings extend, as is well known, to more than that distance below sea-level. The ground-water level is but a few metres under the surface. The deepest adit drains the mines to about 100 metres; and everything below that level is strictly deep workings, from which the water is lifted to the adit-horizon. A comparison of the water raised from different levels shows that the largest quantities come from the upper ones, and that the amounts diminish with increasing depth, so that at about 300 metres below sea-level no water remains to be raised, the ruling rock and air-temperature of about 23°C. (74°F.) at that depth sufficing to evaporate the small existing quantity of water. This is certainly a striking proof that the water encountered in mining is of atmospheric origin." The present writer has visited Przibram and studied the deposit underground, and has quoted Posepny's discussion on it in some detail because he (the writer) considers that in many ways this occurrence is, in essentials, analogous to the gold deposit of the Rand. In each case the extension in depth is great, the lower portion of the mines is dry, the lodes occur in ancient quartzites overlying granite and pre-Cambrian schists,[337] and are genetically connected with main structural faults, and with basic dike intrusions that represent fissure-faults. In both instances the dike-rock is generally decomposed in the neighborhod of the orebodies, and contains the chief minerals of the ore. In the Przibram case the associated minerals are iron pyrite, chalcopyrite,

[336] Posepny (*loc. cit.*, p. 60) pithily remarks that Sandberger's theory of lateral secretion "found many disciples, especially among mineralogists, because it permitted the most extensive genetic generalizations, without requiring the observer to leave his mineral collection and laboratory, to descend into the mine, and to study the ore in the place of its origin."

[337] What are termed sandstones in Posepny's description are really quartzites; and the pre-Cambrian rocks largely consist of schists.

arsenical pyrite, calcite, zinc blende, sphalerite, and siderite, and in the lower levels the galena contains less silver and is largely mixed with quartz. Thus the associated minerals are sulphides in both deposits; and the latter doubtless owe their mineralization to the magma from which the dikes are derived. If the reader will now try to imagine that he is standing in the bottom of the Jupiter mine, in front of the profile of the banket lode, about 5040 ft. or nearly one mile, vertically below the surface, and about 430 ft. above sea-level,[338] he will not, as in the case of the Adalbert at Przibram, see a fissure-space of discission filled with symmetric mineral crusts; because here we have a channel that afforded a freer circulation to the mineralizers than fissures; and as its walls were kept apart by intervening pebbles their presence naturally prevented the structure assuming a crustified form. Remembering that this orebody has been stoped continuously to the surface the reader will more readily admit that, as in the Przibram example, there can be no other satisfactory explanation of its origin than that the gold and its associated iron sulphide were deposited from constantly renewed up-rising deep-seated solutions.

Not a Placer Deposit

Thus among other features which militate against the theory of a placer origin of the Rand gold deposit and which may, on the other hand, be regarded as evidence that it is merely an abnormal type of lode deposit may be mentioned the great depth to which the profitable ore extends; and, the dryness of the mines in depth.

Other convincing facts are, the abundant evidence of former water-ways whence mineralizers could have ascended; the crystalline character of the gold;[339] the close association and relationship of the gold and pyrite; the occasional association of the gold with vein-quartz; the occasional presence in the auriferous banket of small quantities of calcite, tourmaline, or such vein-minerals as galena, blende, copper pyrite, and pyrrhotite.[340] Also, the occurrence of pyrite 'pebbles,' which in the first three parts of this paper were described and shown to be associated with dike intrusions and to be products of metasomatism. Other characteristics indicating the lode origin of the auriferous banket (which were dealt with in part IV) are the shape of the pebbles due to their mode of growth, their association with rich ore, the influence of slates and shales on the mineral deposition, and the association of the gold with traces of iridosmine and other metals of the platinum group. Still others, discussed in parts V and VI, are the manner of distribution of the gold and the various local indications of good ore.

The theory of a later infiltration of the gold being accepted, it merely becomes a question as to what agencies are due the introduction of the mineralizers into the auriferous banket. Also whether there were one or more periods of mineralization; that is, whether the gold in the bedded quartz veins of the Dolomite formation of the Lydenburg and Pilgrim's Rest districts in the Northern Transvaal, and of the bedded quartz veins, and also the banket of the Black Reef formation (which underlies the Dolomite), and of the bankets of the much older Witwatersrand system, belongs to different periods or was introduced during one great period of mineralization.

Genesis of Pyrite

In considering the genesis of the pyrite and gold in the auriferous bankets of the Rand, it cannot be too strongly borne in mind that the latter really differ in no important essentials from ordinary gold-bearing quartz veins. The solutions have merely found these beds sufficiently pervious, to select them rather than fissures for circulation and precipitation of their mineral contents. These channels have finally been closed to further mineralization by the deposition of secondary silica, which is analogous to the vein-quartz of an ordinary lode. In a similar manner ordinary quartz veins have been sealed by the deposition of vein-quartz and other gangue material. As long ago as 1890, six years after the discovery of the Rand, J. S. Curtis, formerly of the United States Geological Survey, evidently considered that the basic dikes of the Rand were connected with the mass of basic eruptive rock composing the Heidelberg range some 30 miles southeast of Johannesburg; and he expressed the opinion that the gold and pyrite of the bankets were due to the intrusion of these rocks. He wrote "These dikes are intrusive, usually, following the dip and strike of the formation, but occasionally they fill cross-fissures and fault the reefs. They outcrop in many places in the basin as well as in the Heidelberg range. This greenstone is most probably diorite,[341] and to its eruption the uplifting of the Rand is not only attributable, but I also believe that the solfataric action incident to its outburst has caused the formation of the gold deposits." He stated that he first visited the Rand in March 1887 with Gardner F. Williams, who had been in the district before and who maintained that the gold was not alluvial but was quartz gold deposited after the bankets had been tilted into their present position. Since then Curtis has resided near Johannesburg and has often had occasion to examine the most important seams of banket, and as a consequence he has

[338] G. H. Thurston, of the Consolidated Gold Fields of South Africa informed the writer that the height of the collar of the Catlin shaft above sea-level was 5470 ft.; and that at June 30 (1913) the vertical depth of the bottom of the lower, inclined portion of the shaft below the collar was 5040 ft. He also told him that in sinking the shafts for this mine the Main Reef was struck in the Howard shaft at a vertical depth of 3528 ft.; and at a vertical depth of 4092 ft. in the Catlin shaft; and that the average dip of the banket is here about 38°.

[339] The grains of gold are often of very irregular shape, with hackly surfaces and jagged outlines.

[340] Even R. B. Young, who seems loath to admit that the basic dikes have any bearing on the origin of the gold in the bankets, writes: "banket and quartzite at their contact with dikes are sometimes crowded with well formed crystals of pyrite" and, "I am told, on reliable authority, that sometimes the proximity of a dike may manifest itself in the appearance of a noticeable quantity of chalcopyrite, galena, and pyrrhotite in the pannings of the banket," R. B. Young (1909), *loc. cit.*, p. 89.

[341] We now know that the Heidelberg range is composed of diabase and belongs to the Ventersdorp system. The strike dikes of the Rand also consist of diabase; and there can be little doubt that they are genetically related to this same rock system.

stated that he has come to the conclusion that in many of their characteristics they closely resemble lodes.[342] Much later he wrote "The earliest evidence of solfataric action is that which was subsequent to the great eruption of basic igneous rock which tilted up the Witwatersrand beds; and the eruption was a very long period after the deposition of these beds," and also "If the theory of infiltration is accepted, as accounting for the presence of gold in quartz veins, there seems to be no valid reason why the presence of gold in the banket should not be accounted for in a similar manner."[343]

Influence of Dikes

Had the analogy not been masked by the fact that the lodes are composed of ordinary sedimentary conglomerate, which has suffered considerable metamorphism, the similarity would long ago have been generally recognized and the mineralization would have been ascribed to the direct or indirect influence of the older, or longitudinal, series of dikes and to the magma with which in depth they are connected. These dikes[344] contain pyrite and gold and are much in evidence throughout the mines of the Rand, as those whose work has necessitated their frequent presence underground in these mines fully appreciate. As the writer has pointed out, they furnish abundant and *sufficient* evidence of former deep-seated communications whereby the mineralizers could have ascended.[345]

It has already been shown that the pyrite was deposited late in the history of the banket, probably in part simultaneously with, and also continuing after, the intrusion of the big longitudinal diabase dikes that occur throughout the Rand. Active mineralizing solutions, as one would expect, still continued to circulate for awhile after the dikes had solidified. In the case of the Crown Reef, the connection between the presence of pyrite replacements and dike intrusion was apparent; and there are many instances where the influence of dikes on the richness of the neighboring banket is generally admitted; the Ferreira-Crown Deep dike is a good example. The close relationship between gold and pyrite and gold and carbon in the lodes of the Rand is admitted; the way in which the gold is frequently interlocked and enveloped in pyrite or carbon indicates that there has been simultaneous precipitation of these substances; the striking association of pyrite replacements; of carbon; of black, black-edged, and pink pebbles; and of blackened quartzite and rich ore has been clearly emphasized. The author elsewhere[346] has shown that the longitudinal basic dikes contain the characteristic minerals and elements of the auriferous banket, namely gold, silver,[347] pyrite, and carbon.[348] He has repeatedly called attention to the evidence indicating that the origin of the gold in the banket is due to the dike intrusions having opened deep-seated communications whence the mineralizers have ascended.[349] He also showed that the carbon, which, like the pyrite, is so intimately associated with the presence of gold, is derived from magmatic vapors, or solutions, emanating from these dikes as a consequence of their intrusion.[350] Also[351] that in examining under the microscope thin sections of ore in which carbon is present, from the Buckshot Reef and Carbon Leader in the Rietfontein mines, from the Randfontein Leader in the Randfontein mines, and of ore from the Buffelsdoorn mine near Klerksdorp, all of them mines in which the occurrence of visible carbon in the ore is characteristic, the most noticeable features are the intimate association and intergrowth of the carbon with gold, the latter not only occurring round the carbon grains, but also sometimes as particles entirely surrounded by carbon, while the carbon grains often contain minute specks of gold scattered through them; the frequent and close association of the carbon and pyrite, which is particularly noticeable in the Buckshot Reef; the frequent association of sericite with free gold and carbon; and the actual replacement of quartz by carbon both in the matrix and in the pebbles. This, together with what has already been written in this paper with regard to the metasomatic origin of the pyrite 'pebbles', or replacements; and with reference to the occurrence and distribution of the gold in the bankets; of local indications of good ore; and of the intimate association, frequent inter-growth, and often more or less simultaneous precipitation of the gold, pyrite, and carbon, all clearly show that one has, here, to deal with a deposit formed by processes in all essentials analogous to those that have operated in the case of ordinary gold-quartz veins.

Stages of Mineralization

The following considerations will help the reader to understand the obvious stages by which this min-

[342]'The Banket Deposits of the Witwatersrand,' by J. S. Curtis, *Eng. Min. Jour.*, Feb. 15, 1890.

[343]'The Origin of Gold in Banket,' by J. S. Curtis (1908), *loc. cit.*

[344]These dikes vary in thickness from about 4 or 5 ft. up to 400 ft., and sometimes even more.

[345]C. B. Horwood (1905), *loc. cit.*, pp. 35 and 62; (1910), *loc. cit.*, pp. 42 and 43; (1910), *loc. cit.*, p. 76; and (1912), *loc. cit.*, p 58.

The unprofitable banket beds are analogous to the barren quartz-veins, which so frequently occur in the neighborhood of gold-bearing quartz lodes. Since the writer has, in the above papers, emphasized the similarity of the bankets to ordinary gold-quartz veins and has laid stress on the importance of the dikes as the agencies to which the mineralization of the bankets is due, others have gradually adopted the same view; for example, Hatch wrote, in 1911, as follows: "The origin of the go'd in the Witwatersrand banket has been referred to as one of the greatest riddles of modern times, but evidence is slowly accumulating to prove that the Rand banket is not a fossil 'placer,' but rather that its gold content has an origin similar to that of quartz-veins." (See 'The Auriferous Conglomerates of the Witwatersrand,' *Mining and Scientific Press* (1911).

[346]C. B. Horwood (1910), *loc. cit.*, pp. 65-92.

[347]C. B. Horwood (1912), *loc. cit.*, pp. 52-63.

Rand bullion as it occurs in the ore contains approximately 875 parts of gold and 125 parts of silver per thousand. In dealing with the occurrence of gold and carbon in the dikes (*loc. cit.*) the presence also of silver was not discussed; but, in assaying the dike samples for fine gold the differences between the bullion weights and the weights of the fine gold consisted almost entirely of silver.

[348]Also traces of cobalt.

[349]C. B. Horwood (1905), *loc. cit.*, p. 62; (1910), *loc. cit.*, pp. 42 and 43; (1910), *loc. cit.*, p. 76; and (1912), *loc. cit.*, pp. 58-63.

[350](1910), *loc. cit.*

[351]C. B. Horwood (1910), *ibid.*, p. 75.

eralization was brought about. Kemp[352] has both constantly and lucidly demonstrated that the igneous rocks are usually responsible both for the contents of veins and also the solutions that conveyed them. Arrhenius[353] has shown that in the fused mass below the earth's solid crust, silicic acid, on account of its smaller density, will be concentrated in the upper portions; while the basic portions of the magma, owing to their greater density, will collect in the lower strata.[354] Further, that the fused magma on penetrating into the upper layers would probably be divided into two portions, the first will be the lighter and gaseous, and will contain water and substances soluble in it; the second, or heavier portion, will consist essentially of silicates with a smaller proportion of water. The more fluid portion, richer in water, will be secreted in the upper layers of the crust, and will penetrate into the surrounding sedimentary strata, especially into their fissures,[355] and will there deposit their mineral contents. The uprising, more viscid and sluggish, mass of silicates will congeal. Vogt[356] has long recognized that magmas consist of an upper layer of aqueous gas and a lower one composed of a silicate magma; and he strongly emphasizes this relation. He is perhaps the greatest exponent of the part played by magmatic agencies, or rather by what he aptly terms 'eruptive after-action.' In association with the auriferous conglomerates of the Rand there is abundant intrusive basic igneous rock of diabase type that contains gold, silver, pyrite, and carbon.[357] These were deposited in the bankets during one and the same period, as is evident from their close association and intergrowth, to which attention has already been called. It has been shown that the traces of iridosmine, and other metals of the platinum group, with which the gold is associated, were probably extracted from neighboring dikes under pneumatolytic conditions;[358] that the pyrite of the 'pebbles' was almost certainly deposited under high temperature and pressure; and it has, also, been demonstrated that the carbon was either in a gaseous condition or a mobile liquid at the time of its introduction, and so doubtless existed under similar conditions.[359]

Order of Ascending Magmas

It is necessary to bear in mind the order in which the various up-rising portions of the magma doubtless ascended. Firstly, there would be the more fluid portion, liquid or gaseous, probably the latter, in a mobile active state, which penetrated the bankets and there deposited the main portion of its mineral contents.[360] Then followed the viscid silicious

[352]'The Rôle of the Igneous Rocks in the Formation of Veins,' by J. F. Kemp, in 'The Genesis of Ore Deposits,' 2nd Ed. (1902), pp. 681-709. See also 'A Consideration of Igneous Rocks and their Segregation or Differentiation as Related to the Occurrence of Ores,' by J. E. Spurr, *Trans.* Amer. Inst. Min Eng., Vol. XXXIII (1903), p. 288 to 340.

[353]'Worlds in the Making,' by S. Arrhenius, Harper Bros. (1908), pp. 16 and 20.

[354]The present writer arrived at a similar conclusion with regard to the division of the magma as a result of his studies of the plutonic complex of the Transvaal Bushveld. Molengraaf had pointed out that the Red Granite occupied the central portion of this area, while other types are confined to the peripheral regions, the basicity of the rocks increasing from the centre to the periphery. In 1905 the present writer called attention to this and suggested that the reason might be due to segregation, according to specific gravities, in the magma before eruption in such a manner that its acidity would increase from below upward. Thus, representatives of the central and earlier stages would be the most acid, while later products would be more basic. The latter would naturally select the marginal portions of the already erupted mass for channels of ascension as offering lines of least resistance; and, thus the final marginal portions would be represented by the most basic varieties of rocks. Further, he suggested that the diamondiferous pipes (which are of an extremely basic character) on the edge of this plutonic complex, to the north-east of Pretoria, represented the final expiring stages of that period of eruptive activity to which this complex is due; and, if this be so, then other pipes of blue ground may occur anywhere around the marginal portions of this plutonic complex. C. B. Horwood (1905), *loc. cit.*, pp. 77 and 78.

[355]In the case of the Witwatersrand system, some of the conglomerates were selected by these solutions as offering easier channels than fissures.

[356]'Problems in the Geology of Ore-Deposits,' by J. H. L. Vogt, in 'The Genesis of Ore Deposits,' 2nd ed. (1902), pp. 636-680.

[357]The results of the systematic sampling for gold and carbon of a typical, decomposed, diabase, longitudinal, or strike dike from the surface down to a vertical depth of over 2000 ft.; together with complete analyses of dikes in the North Randfontein and Rietfontein mines; and gold assays of the latter will be found in Appendices I, II, and III (see also C. B. Horwood (1910), *op. cit.*, p. 77 *et seq.*)

A. R. Sawyer refers to the influence of dikes on the gold contents of the auriferous bankets of the Rand in a paper entitled, 'The New Rand Gold-field,' (*Trans.* Inst. Min. Eng., Vol. 44 (1912), part I), in which he ascribes the gold to the influence of the basic dikes. He is prospecting a large area for the main Reef series near the junction of the Vaal and Wilge rivers, in the Orange Free State some 50 miles south of the Rand, by means of deep bore-holes. These have intersected 15 basic dikes or igneous sheets; and he has had assays made of them for gold; and found that they all contained gold, the amounts varying up to 1¼ dwt. per ton.

[358]C. B. Horwood (1912), *op. cit.*

[359]C. B. Horwood (1910), *op. cit.*

[360]The writer has laid stress on the part played by magmatic vapors in the mineralization of the bankets, for example, when discussing the genesis of the carbon in the bankets (*loc. cit.*, 1910, p. 86), he stated: "The study of the carbon in those mines of the Rand where it is most typically developed certainly shows that its occurrence is closely associated with that of the pyrite and gold and indicates a close relationship between its presence and that of neighboring igneous rocks, which have, in the foregoing pages been shown to contain carbon. It is difficult to account for the way the carbon occurs in tiny spheroids scattered through the matrix in Rand bankets other than that it was deposited from gaseous or very mobile liquid hydrocarbons, in a similar manner to that of the carbon-mineral at the Mary mine as described by Kemp, before the final cementation and induration of the bankets by the deposition of secondary silica; and, taken in conjunction with the known facts of its occurrence in other parts of the world, it is perfectly reasonable to attribute its origin to magmatic vapors or solutions derived from the neighboring basic igneous intrusions before their final solidification." Again when dealing with the occurrence, analysis and genesis of iridosmine in the bankets (1912, *loc. cit.*, p. 63) he pointed out that R. B. Young had called attention to the appreciable amount of tourmaline, of undoubtedly secondary origin, in the Rand bankets and its close association with the gold; and to the occasional occurrence of tourmaline veins in the bankets and to the fact that tourmaline sometimes replaces portions of the quartzites and bankets. He remarked that Young did not seem to have realized the full significance of these facts as strongly suggestive of pneumatolytic action; and he would now add that they also fur-

portion, which deposited the gangue material of the ore in the form of the secondary silica that closed up the interstices of the conglomerates, in a similar way to that in which, by deposition of vein-quartz, normal quartz fissure-veins have become sealed to further mineralizing solutions. Finally, the segregated basic portion of the magma filled and closed the fissures, which are now marked by the presence of this basic intruded rock in the form of dikes. As the dikes cooled eruptive after-action ensued, the liquid and gaseous solutions previously contained in the molten, or more or less viscid, dikes were given off, entered into the main channels of circulation and there precipitated their mineral contents, thus increasing the mineralization of the bankets. A further result of cooling was that the dikes contracted producing fissures within their mass and reopening minute channels along which solutions under pressure from below continued to ascend and not only deposited mineral matter but doubtless dissolved, re-precipitated, locally concentrated, and rearranged that already resulting from the previous processes.

Evidences of the Deposition Period

The final expiring stages of periods of great eruptive activity such as this can often be detected after the lapse of long geological time.[361] Today there are lingering traces of such a former period in the deep-seated waters still circulating and associated with certain dikes, or issuing along their junctions.[362] In studying these deposits it should always be borne in mind that these various processes were not separated by any sharply defined breaks, but that they overlapped each other, and this serves to explain various phenomena (such for example as indications which, at first sight, suggest two periods of gold and pyrite precipitation) otherwise difficult to understand.

Admitting that the source of the pyrite and gold is due directly or indirectly to igneous intrusions, and the magma with which they are in depth connected, then since the auriferous conglomerates of the Rand represent such a huge mineralized deposit, or rather series of deposits, stretching, as proved, for over 60 miles along their strike,[363] these intrusions must have occurred during a period when igneous activity was sufficiently great for extensive and well defined intrusions to have been injected into these beds. The Ventersdorp period[364] meets

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nish still further evidence in the replacement of banket and quartzites, of those metasomatic processes which are so usual in quartz veins. In summarizing this paper he referred to pneumatolytic action and concluded that these very rare metals had existed in minute proportions, as primary segregations due to magmatic concentration, in the basic eruptives in these mines; and that by later, or pneumatolytic phases of eruptive activity they were extracted from the dikes by active superheated gases. Still later, hydrothermal action probably played an important rôle in concentrating them in the banket reefs.

[361] Because, for one reason, lines of weakness once established in the earth's crust naturally tend to continue and remain as such.

[362] For instance, the West Reef dike at Randfontein and a dike known as the water dike at the Witwatersrand Deep mine are characterized by the large quantities of water with which they are associated. It is a common idea that the water encountered when these dikes are pierced is merely vadose ground-water which has been dammed back on one side of the dikes by the impervious nature of the latter. A little reflection, however, will show that this is not the case, for, in these particular instances, it is well known that in mining, the water follows down as far as the mines have gone, or for well over 2000 ft.; that is to say that when one of these dikes is tapped on a lower level the amount of water issuing from the dike from the level above rapidly becomes appreciably less and soon practically ceases to flow, and this in spite of the fact that in some cases when first encountered it issued under several hundred pounds pressure per square inch and so rapidly that the shaft and levels below were drowned, the pumps being unable to cope with the added volume, and the drives in which the water was encountered had to be dammed up to keep back the water. If one considers, for a moment, a given section of such a dike, either as a section of a retaining wall, or as a pipe full of water in which there are two minute apertures at, say, 1600 and 1800 ft. from its top; the water issuing from both apertures should be about the same, as the difference in head is relatively slight; it would take comparatively a very long time to drain the pipe down to the level of the first aperture, and when it was, the water would issue feebly from the lower aperture owing to the great reduction in head. In practice the water issues from the lower level under great pressure and that from the upper level diminishes rapidly. Further, the dryness of the deep-level mines of the Rand is one of their characteristic features in spite of them being mostly connected with the surface through the old workings of the outcrop mines and being therefore under excellent conditions (especially since these conditions prevail throughout miles of adjacent and communicating deep-level mines) to act as huge drains to an enormous catchment area, or terrain. Consequently, at depths of 2000 ft. and over, this theory of ground-water cannot apply unless the water be supposed to descend along the junction of a dike, or through its fractures, in which case the water on an upper level would not rapidly cease to flow when it was tapped on a lower level. If, however, the water be up-rising and of deep-seated origin then, considering the analogy of the pipe, it would overflow at the first aperture encountered, for example, when tapped on the lower level of the mine it would issue there and the stream issuing from the level above would rapidly cease. At Randfontein the writer sometimes detected a smell of sulphuretted hydrogen when large volumes of water had been struck in connection with the West Reef dike in the lower levels of some of the mines, and Henry Hay, formerly manager of the Witwatersrand Deep mine, informed him that he had also sometimes detected a smell of sulphuretted hydrogen from the water issuing from the water dike at the Witwatersrand Deep mine, which supports the opinion that it is of deep-seated origin.

The following is an analysis of the water cut in the West Reef north drive on the 10th level (about 1350 ft. below the surface) at the northern end of the North Randfontein mine.

	Grains per gallon.
Total solids	5.85
Loss on ignition	1.95
Silica	0.91
Iron oxide and alumina	0.21
Lime	1.05
Magnesia	0.14
Sulphuric acid (SO_3)	0.63
Carbon dioxide (CO_2)	1.82
Chlorine	trace
Hydrogen disulphide	nil

[363] If pulled out tandem fashion from their side by side, or twin, positions they would then represent a continuous lode some 120 miles in length.

[364] The only other period of great eruptive activity comparable to this is that to which one owes the great plutonic series of the Bushveld; still more recently during Karroo times there was a period of eruptive activity during which there was a great outpouring, which was general through-

these conditions. Such intrusions are represented by the longitudinal, or strike, dikes of the Rand[365] which are of diabase type and are highly decomposed and uralitized. The writer has frequently, on previous occasions, pointed out that there is undoubtedly a genetic relationship between these dikes and the Klipriversberg diabase, and that their petrological features, habit, and chemical composition certainly indicate that they have been derived from the same magma.[366] The strong development of the Klipriversberg diabase,[367] in the Klipriversberg hills (some three miles south of the Rand) in the central portion of the Witwatersrand syncline, where it has an aggregate thickness of some 5000 ft., and also the occurrence in the Bezuidenhout valley of fragmental and volcanic material belonging to the Ventersdorp series, indicate that one at least of the vents from which the volcanic series of this system was erupted was situated in the central portion of what is usually termed the Witwatersrand basin, but which would be more correctly described as the synclinal valley of the Witwatersrand.[368] The main structural features of the district, such as are described in the first part of this paper, indicate that the origin of this synclinal valley is due to this, and satisfactorily explain the presence of the numerous longitudinal diabase dikes encountered in the mines of the Rand as well as several other phenomena.

out the greater part of South Africa, of olivine-dolerite, which is in a very fresh condition today, as is at once apparent when thin sections are examined under the microscope; it is, however, generally admitted that the mineralization of the bankets was long prior to either of these periods.

[365]The transverse dikes are younger, as is evident from the fact that they have faulted, and in many cases considerably displaced, the longitudinal dikes.

[366]The writer has pointed out that carbon not only occurs in these dikes; but also, according to Harger, in the Ventersdorp diabase, to which the Klipriversberg amygdaloidal diabase belongs, as he ascribes the origin of another form of carbon, namely the Vaal River diamonds, to this rock. ('The Occurrence of Diamonds in Dwyka Conglomerate and Amygdaloidal Lavas, and the Origin of the Vaal River Diamonds' by H. S. Harger, *Trans.* Geol. Soc. So. Af., Vol. XII. (1909) pp. 139-158.) The writer also showed that the sheet of amydaloidal diabase found at a fairly constant horizon (but often split up into several bands) in the Upper Witwatersrand beds, between the Kimberley and Bird Reef series, on the far East Rand is intrusive and is macroscopically, microscopically, and chemically similar to the Klipriversberg amygdaloid, with which it is certainly connected. Also, that an amygdaloid dike occurs in the Saxon gold mine, on the West Rand (see 'The Main Reef Horizon on the Eastern Edge of the Witpoortje Break,' by J. P. Johnson. *Trans.* Geol. Soc. So. Af., Vol. IX. pp. 17 and 18); and, that Geo. S. Corstorphine had told him of the occurrence of a dike of amygdaloidal diabase, 40 ft. wide, which can be traced for 1200 ft. in the Heidelberg district of the Transvaal. Further, the writer pointed out that there was no scientific reason why a dike should not be amygdaloidal, under given conditions, provided the temperature of the aqueous and other vapors that occasion the vesicular cavities remain above the critical temperature during the solidification of the rock, for then these vapors will exist as such and will not liquefy, although their densities may be greatly increased; hence amygdule-shaped cavities will be formed, which will eventually become wholly or partly filled by the deposition of silica, calcite, chlorite, or other secondary mineral matter. See C. B. Horwood (1905), *loc. cit.*, pp. 35-41; 1910, *loc. cit.*, pp. 39, 42, and 43; and (1910), *loc. cit.*, pp. 76, 77, and 81.

[367]Which belongs to the Ventersdorp series.

[368]As pointed out in part I of this paper.

Mineralization in the Pilgrim's Rest District

The origin both of the gold and of the mineralization generally in the bedded quartz deposits of the Dolomite, in the Pilgrim's Rest district have already been assigned to the neighboring intrusive igneous sheets and diabase dikes;[370] and the writer's own observations in this district amply confirm this view. One basic dike can be traced for 1½ miles. It is considerably mineralized with magnetite, pyrite and a little chalcopyrite, which are apparently primary constituents. Assays of this dike give traces of gold. Concentration of the pyrite and copper pyrite has taken place on the fracture-planes produced by the cooling of the intruded rock; and, where there has been considerable concentration of these minerals, assays will yield up to 1½ dwt. per ton.[371]

[369]C. B. Horwood, 'Notes and Analyses of Typical Transvaal Rocks,' *loc. cit.*, in which paper the writer pointed out that the strike of the Klipriversberg hills is east and west, that is, parallel to the strike of the Rand bankets; to the longitudinal dikes; and to the main structural faults, suggesting that they mark the site of a fissure of eruption, situated in the central portion of the Witwatersrand syncline. He also called attention to the fact that G. A. F. Molengraaff, in his 'Geology of the Transvaal,' has shown that the basin of the plutonic series of the Bushveld was produced by the sedimentary strata sinking under the weight of the intrusive masses withdrawn from below; and that, consequently the surrounding strata is pierced by numerous dikes and igneous intrusions from the same original magma, and all around the basin the strata dip inward toward a common centre. The present writer then showed that there is considerable analogy between the Bushveld basin and the Witwatersrand syncline; and similarity of origin not only explained the presence of the numerous ancient strike (or longitudinal) diabase dikes, but also, the main structural features of the Witwatersrand, such, for example, as the fact that, along the northern rim of the Witwatersrand syncline the main dikes strike east and west and dip south, while along the western edge of the syncline they strike north and south and dip east, and in each case the direction of their strike and dip corresponds with that of the strata, that is, the strike follows the contours of the syncline and the dip is always toward its main axis, which by analogy with the Bushveld plutonic basin, has evidently sunk under the weight of the igneous masses, in this case Ventersdorp diabase, withdrawn from below.

[370]'The Geology of Pilgrim's Rest Gold Mining District,' by A. L. Hall. Transvaal Mines Department Geol. Surv., Mem. No. 5 (1910), pp. 138-144. Hall pointed out that these 'reefs' have an essentially quartzose nature and are associated with metallic sulphides, notably iron pyrite. Also that a higher gold content and abundance of pyrite, decomposed or fresh, frequently go together, and that the more earthy (richer in hydrated iron ore) or spongy the ore the greater its value, pointing to the introduction of the gold being directly dependent on the presence of pyrite; the gold having been introduced by circulating underground waters carrying gold, iron, and silica in solution. He also called attention to the influence of shales on the gold deposition, several 'reefs' being situated in close proximity to horizons where shaley beds are associated with calcareous, or other more permeable, strata.

[371]W. H. Rundall, managing director of the South-East Africa Co., Ltd., gave the writer the particulars of this dike which is known as the Malidike (*mali* is the native word for money). It pierces the Black reef and Dolomite series and outcrops on the farm Graskop, just southeast of Pilgrim's Rest. Near the surface it is reddish-brown and much decomposed; in depth it is hard and is dark-green in color, and much fractured. In the decomposed zone the

The officials of the Cape of Good Hope Geological Survey have shown that the Ventersdorp diabase is intrusive in the Black Reef and Dolomite formations of the Vryburg district.[372] Carbon not only occurs in the dikes and in the auriferous bankets of the Rand, but also in the Black Reef banket; and in at least one of the bedded quartz veins of the Dolomite in the Pilgrim's Rest district. Metasomatic pyrite 'pebbles' are found not only in the Rand banket, but also in the Black Reef banket;[373] and gold is associated with pyrite in the interbedded ore-sheets in the Dolomite of the Pilgrim's Rest and Lydenburg districts.

Genesis of the Gold

Thus it would seem that the genesis of the gold (and of the pyrite, carbon, and other minerals with which the gold is associated) of the Witwatersrand banket, and of the Black Reef conglomerate in the Southern Transvaal, and of the bedded quartz veins in the Dolomite and also in the Black Reef formation of the Northern Transvaal, can be satisfactorily explained on the assumption of one period of mineralization and that the gold was introduced into the Rand conglomerates after, or during, the period when the dolomites were being laid down. Thus as previously foreshadowed[374] the immense wealth of this richest of all goldfields is apparently a product of the period of eruptive activity to which the Ventersdorp series is due: the mineralization representing some of the final expiring stages of volcanic and eruptive activity characteristic of that period; the diabase dikes (genetically related to the amygdaloidal diabase of the Klipriversberg) and their underlying magma being responsible, directly or indirectly, for the gold.

magnetite remains unaltered, while the pyrite is converted into limonite; the decomposition of the chalcopyrite being manifested by an occasional greenish stain.

For about a mile the surface of the dike has been extensively worked by sluicing, some of the workings being of great size and as much as 70 to 80 ft. deep. Between 1870 and 1880 considerable quantities of gold are said to have been won from a small stream known as Digger's creek, running below and parallel with, the dike. Large piles of débris and boulders and numerous channels cut to divert the stream from its original course testify to the activities of the old diggers, who, after working the gold in the creek, turned their attention to the outcrop of the dike itself.

Within recent years quartz veins have been located, both within the dike and on its contacts, below the level to which the outcrop of the dike had been stripped by sluicing. A small 5-stamp mill and cyanide plant has been erected; running intermittently it has produced some £12,000 worth of bullion. An analysis of an average sample of the dike made up from samples taken at regular intervals over a section of 120 ft. gave 15½ dwt. gold and 6½ dwt. silver per ton; besides iron, it revealed the presence of a small quantity of copper, bismuth, and a trace of nickel.

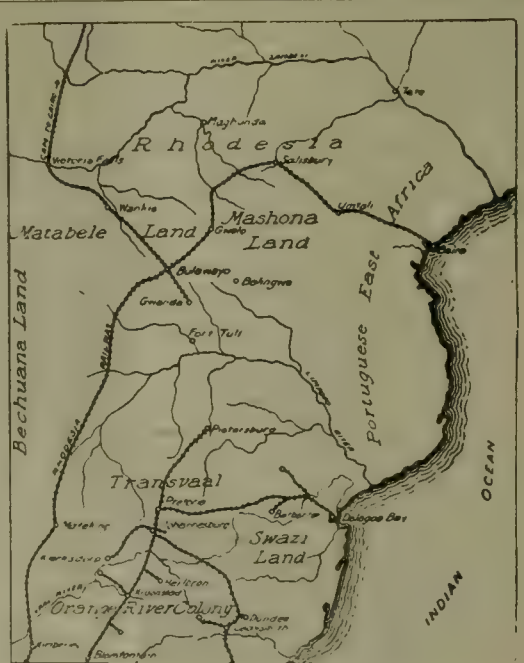
Concentration tests have proved that the gold is present in an extremely fine condition. Well defined lenses of vein-matter are sometimes found, on the contacts of the dike with the sedimentary beds, varying from a few inches up to 3 or 4 ft. thick and some hundreds of feet long. The veins sometimes leave the contacts and continue in the dike with sinuous courses. Profitable ore has been found on both sides of, and also within, the dike. The gold contents vary greatly within short distances, samples taken only 2½ ft. apart often giving very different results. High assays are more often obtained where the ore is colored a bright red with iron oxides; and below the permanent water-level the undecomposed pyrite gives good gold assays. The 'reefs' are not continuous throughout the length of the dike, either within it or along the contacts; on the latter there is often only a few inches of selvage matter. Within the dike there may be a regular stockwork of quartz leaders, but no defined vein; or there may be considerable bodies of white, fractured, barren-looking quartz which gives traces of gold; or sometimes a well defined lode with good gold contents. Rundall ascribes the origin of these 'reefs' to the dike intrusion and subsequent contraction, and to the circulation along the fractures thus produced of deep-seated mineralizing solutions.

[372] A. L. du Toit, 'Report of the Geol. Com. of the Cape of Good Hope' (1905); also A. W. Rogers in the 'Annual Report of the Geol. Com. of the Cape of Good Hope for 1906'; and also 'Geology of a Part of Bechuanaland West of Vryburg,' by George G. Holmes, *Trans.* Geol. Soc. So. Af., Vol. VII (1905), p. 131. The present writer has recently shown that the Ventersdorp diabase is also intrusive into the Black Reef series in the Transvaal. 'Note on the Relationship between the Black Reef Formation and the Ventersdorp Diabase,' by C. B. Horwood, *Trans.* Geol. Soc. So. Af., Vol. XV (1912), pp. 77 to 80.

[373] C. B. Horwood (1910), *loc. cit.*, p. 83, where he stated that Andrew Crosse informed him that the ore, which is of a pyritic nature, from the Theta reef from the Lisbon-Berlyn mine, near Pilgrim's Rest, contains carbon; and gave the result of a complete analysis, made by Crosse of a typical sample of rich ore from this mine which gave 1.28% of carbon; and 16 dwt. of gold and 114 dwt. of silver per ton. At the same time he stated that Crosse had called his attention to the fact that "carbon exists in very appreciable amount in the Black Reef banket in the Machavie mine, between Klerksdorp and Potchefstroom." At this mine the banket is of a very pyritic nature and contains numerous 'pebbles' of pyrite. Crosse further informed him "that an appreciable quantity of carbonaceous or graphitic material is found in the highly pyritic silicious ore from the Mount Morgan mine on Moodies, near Barberton." Iridosmine also occurs in the auriferous banket of the Rand, and in that of the Black Reef formation at Klerksdorp. C. B. Horwood (1912), *op. cit.*, pp. 52 and 53.

N. B.—The Theta reef is near the top of the Dolomite formation, near its contact with the overlying shales of the Pretoria series.

[374] 'Notes and Analyses of Typical Transvaal Rocks,' by C. B. Horwood, *Trans.* Geol. Soc. So. Af., Vol. XIII (1910), p. 43.



APPENDIX No. 1

CARBON IN THE WEST REEF DIKE, NORTH RANDFONTEIN MINE

Average dip of dike, 72°; average width of dike, 5½ feet.

Level.	Distance apart measured along dip of dike (feet)	Vertical distance below collar of shaft (feet)	Fine gold present. Dwt. per ton	Fine gold present. Percentage	Carbon present, percentage	Remarks.
2nd	200 from surface	190	Nil	Nil	0.70	Soft decomposed specimen, light gray in color. The sample for gold was taken over the central 8 in. of the dike.
3rd	126	307	0.55	0.00009	0.12	Fissile, schistose structure, considerably decomposed; light gray slate color. The sample for fine gold was taken over the central 6 in. of the dike.
4th	205	407	0.73	0.00013	Trace	Soft decomposed specimen; light gray in color. The sample for gold was taken over the central 18 in. of the dike.
5th	106	503	1.29	0.00022	0.22	Fairly fresh; somewhat schistose structure. A good deal of mica observable in specimen. The sample for fine gold was taken over the central 12 in. of the dike.
6th	155	660	0.04	0.000007	0.08	Fairly fresh specimen; more so than from fifth level. A good deal of mica observable in specimen. The sample for gold was taken over the central 12 in. of the dike.
7th	203	859	0.80	0.00014	0.08	Fresh specimen; a little copper pyrite is present. The sample for fine gold was taken over the central 12 in. of the dike.
8th	201	1058	Trace	.....	0.22	See analysis in column 1 in Appendix No. 2. The sample for gold was taken over the central 12 in. of the dike.
9th	158	1207	0.85	0.00015	0.02	Good fresh specimen. The sample for fine gold was taken over the central 12 in. of the dike.
10th	158	1357	Trace	.....	0.04	Fresh specimen; but a little weathered on the surface. The sample for gold was taken over the central 12 in. of the dike.
11th	156	1504	1.46	0.00025	0.05	Fresh specimen. The sample for fine gold was taken over the central 12 in. of the dike.
12th	158	1653	2.35	0.00040	Trace	Fresh, very close-grained specimen. The sample for gold was taken over the central 24 in. of the dike.
13th	157	1803	0.25	0.00004	0.06	Fresh specimen; weathered on one surface. The sample for gold was taken over the central 24 in. of the dike.
14th	154	1950	0.30	0.00005	0.03	Fresh specimen, very close-grained. The sample for gold was taken over the central 12 in. of the dike.
15th	149	2090	3.00	0.00051	0.04	See analysis in column II, in Appendix No. 2. The sample for gold was taken over about the central 12 in. of the dike.

In the above, trace = under 0.01% for carbon; and 0.1 dwt. or under in the case of fine gold.

The samples for both gold and carbon were taken in the cross-cuts (with the exception of that from the 3rd level, which was taken in the West Reef south drive) over the central portion of the dike; the samples for the carbon analyses were in each case taken over the central 12 inches.

APPENDIX No. 2

	I.	II.	III.
SiO_2	56.40	53.87	46.30
TiO_2	0.54	1.29	Nil
Al_2O_3	19.64	18.36	12.70
Fe_2O_3	4.33	8.40	3.50
FeO	12.24	10.80	6.43
MnO	Nil	Tr.	0.04
CaO	0.28	1.23	10.16
MgO	1.16	0.42	4.82
K_2O	0.16	0.46	0.85
Na_2O	0.80	1.50	2.75
FeS_2	3.34	0.92	0.10
P_2O_5	0.03	0.15	0.09
CO_2	0.01	0.04	3.20
Carbon	0.22	0.04	0.03
Combined water	0.10	0.60	8.50
Moisture	0.07	Nil	Nil
	99.32	98.08	99.47
Specific gravity	3.10	3.11	2.76

I. West Reef Dike, North Randfontein mine, 8th level cross-cut, about 1050 ft. vertically below the surface. The dike is here 5 ft. thick and the sample analyzed was quite fresh and undecomposed from the centre of the dike.

II. West Reef dike, North Randfontein mine, 15th level cross-cut, about 2090 ft. vertically below the surface. The dike is here 5½ ft. thick and the sample selected for analysis was quite fresh and undecomposed from the centre of the dike.

In the analysis, the results of which are given in column I, arsenic, copper, nickel, and platinum were sought but were not present. Cobalt was found as a trace.[1]

[1]Andrew Crosse informed the writer that traces of cobalt

III. The big southern diabase dike from the eastern section of the Rietfontein mines.[2] There the dike is about 230 ft. thick and the sample analyzed was from the central portion, from 114 ft. inside the dike. The diameter of the core was 15/16 inch. The rock was of a light grayish-green color, close-grained and compact, but rather soft, being scratched with a knife. It looked considerably decomposed, and was covered with thin streaks and blotches of some white substance, which evidently represented some decomposition product, which effervesced strongly with dilute hydrochloric acid and was probably calcite; and it will be noticed that the analysis reveals the presence of 10% lime.

It will also be observed that the analysis shows 0.03% carbon. Another sample[3] of this same dike from the eastern section of the mines was also analyzed for carbon and found to contain 0.2%. A further sample of dike[4] from the central section of the mines showed a trace of carbon. It is worthy of note that the two samples from the eastern section contain more carbon than that from the central section, and it is in the eastern section of the mines that carbon is most abundant and the gold contents of the ore are highest. In this connection it may also be mentioned that the presence of carbon in the North Randfontein mine, where the West Reef dike is well developed, is a far more characteristic feature than it is in the Robinson-Randfontein mine, where this dike is only very poorly developed; and the former mine is richer in gold than the latter.

exist throughout the mines of the Rand; and that all the cyanide solutions which he has analyzed contained cobalt, copper, and nickel, there being generally a little more cobalt than copper; and, of course, less nickel than either. He discovered arsenide of cobalt from the Driefontein and Angelo mines by noticing a heavy substance come off a Wilfley table on the outer edge of the rest of the concentrate, which by analysis he found was cobalt arsenide.

[2]From bore-hole No. 67 (No. III shaft, 9th level, south cross-cut). The assays in Appendix No. 3 are from this same dike.

[3]From bore-hole No. 65, No. III shaft, 9th level; 4 east stope (see details of same bore-hole in appendix No. 3). The bore-hole passed through 190 ft. of dike and the core (15/16 in. diam.) used for the analysis was from a distance of 127 ft. inside the dike.

[4]From bore-hole No. 17, No. V shaft, 5th level, north cross-cut. The drill passed through 355 ft. of dike and the core selected for analysis was from a distance within the dike of 170 feet.

APPENDIX No. 3

NEW RIETFONTEIN ESTATE GOLD MINES, LTD., EASTERN SECTION

ASSAYS OF DIKE SLUDGE FROM UNDERGROUND BORE-HOLES

Position of bore-holes: No. III shaft; 9th level, east drive.
Bore-hole No. 64: Direction, 240°; dip, 39°.

Distance in feet.	Assay-value, dwt. per ton.	Remarks.
0-9	0.5	
25-30	0.8	
30-80	0.5	
80-85	2.0	
85-90	1.2	
90-95	1.0	
95-100	4.0	
100-105	0.5	
105-110	1.0	
110-115	0.8	
115-120	0.8	
120-125	Trace	
125-130	0.5	
130-135	Trace	
135-140	Trace	
140-145	0.8	
145-150	0.5	
150-155	183.6	The core from this section assays 1 dwt.
155-160	2.0	
160-165	2.0	
165-170	1.0	
170-175	4.0	Bottom of hole; still in dike.

The bore-hole was in dike from start to finish.

Position of bore-holes: No. III shaft; 9th level, east drive.
Bore-hole No. 65: Direction, 240°; dip, horizontal.

Distance in feet.	Assay-value, dwt. per ton.	Remarks.
0-5	Trace	
5-10	0.6	
10-15	0.5	
15-20	..	Lost in fire when drying.
20-25	Trace	
25-30	..	Lost in fire when drying.
30-35	Trace	
35-40	Trace	
40-45	Trace	
45-50	Trace	
45-50	Trace	
50-55	Trace	
55-60	8.0	
60-65	1.0	
65-70	..	Lost underground.
70-75	Trace	
75-80	Trace	
80-85	Trace	
85-90	Trace	
90-95	Trace	
95-100	0.6	
100-105	0.5	
105-110	Trace	
110-115	Nil	
115-120	Trace	
120-125	Nil	
125-130	Nil	
130-135	Nil	
135-140	Nil	
140-145	Trace	
145-150	0.56	
150-155	Trace	
155-160	0.55	
160-165	9.0	
165-170	Trace	
170-175	Nil	
175-180	Trace	
180-185	Nil	
185-190	Nil	Bottom of hole; still in dike.

The bore-hole was in dike from start to finish.

Coke-Making in China

The Chinese have always made a good deal of coke, as throughout the whole country the coal is commonly rather friable, and the loss by dusting and spilling in the course of transport over long distances would be prohibitive, while hard coke will endure handling. In some cases the coke is made into heaps which are covered up and burned, much as in charcoal-making in Europe. A more elaborate form of Chinese coke-ovens is shown in the illustrations. These ovens are filled with small coal, which is carried to the oven in baskets, having previously been washed in wicker baskets by hand. The charge consists of about 24 tons of two sizes of coal in layers; dust and about 1-in. pieces. The ovens are 14 ft. in diameter on top, 7 ft. on the bottom, and 6 ft. deep in the centre. The top 3 ft. of the sides is vertical, and the lower 3 ft. slopes toward the centre. There are 18 small draft holes in the sides of the oven and a larger hole on one side near the bottom. The lower half of the oven is beneath the level of the ground. Each layer is tamped by coolies wearing shoes having thick wooden soles. One charge makes about 12 tons of coke. The bottom three feet of the coke is of poor quality, but the rest is fair. After burning, the coke is quenched by water carried in buckets. It takes about four days to fill, two weeks to burn, and two days to cool an oven. According to figures given by Y. T. Woo in the *Transactions* of the American Institute of Mining Engineers for 1906, the coal used for coking at Tongshan is worth $4.50 silver at the oven and the coke sells for $18 to $20 silver per ton, affording a good profit. The Tongshan coke made in this way contained 15.2% ash and 0.97% sulphur. Washing the coal and filling and discharging the ovens is done by contract labor, the laborers earning about 20c. silver each per day. More recently a washing plant and modern coke ovens have been built at Tongshan. The lower illustration shows one of two banks of Otto ovens at the Pingsiang colliery in Kiangsi. Here also the coal, which contains 25 to 30% ash, is washed before coking, and then yields a coke almost free from sulphur and low enough in ash to serve excellently in the iron blast-furnaces operated by the same company at Hankow. Two grades are made, foundry and smelting coke. The first contains: fixed carbon, 87.941%; ash, 10.94; and sulphur, 0.506. The corresponding percentages in the smelting of coke are: 88.06, 11.10, and 0.618 respectively. Considerable quantities of this coke comes to the Pacific coast states, as does also iron made with it. It has recently been proposed to remove this coking plant to the vicinity of the blast-furnaces, so that the coke oven gas can be mixed with the furnace gases for power production.

NATIVE CHINESE COKE OVENS.
(Photographed by F. L. Cole.)

COKE-OVENS, P'ING-HSIANG COLLIERY, KIANGSI.

Revision of the Mining Law—A Critique

By Robert M. Searls

In the *Mining and Scientific Press* of October 18, 1913, there appears an article on 'Revision of the Mining Law—a Protest,'* which calls for comment. Largely because my conclusions upon the subject of mining-law revision coincide with those of the author of that article, I am moved to express my dissent from many of the premises which he assumes as a basis for his conclusions, and to offer what seem to me to be the cogent reasons why the fundamental principles of the federal mining law should not be changed, even if a few minor modifications are admittedly desirable.

Department Regulations

At the outset, the severe condemnation of Department officials indulged in by the writer of that article is surely unwarranted. There have been few abler men in the presidental cabinets of the past few years than those who have headed the departments of the Interior and Agriculture. If in the administration of the public land laws they have woven into the rules of procedure, which were entirely within their jurisdiction to make, somewhat onerous requirements as to what the miner must prove before he is entitled to his grant in fee simple from the government, it must be remembered that these officers are charged with the duty of protecting the government from imposters. There have been so many cases where speculators, 'land-sharks,' and unscrupulous public-service corporations have acquired valuable power-sites, timber lands, and a practical monopoly of water rights, under the guise of mineral patents, where no commercially valuable mineral in fact existed, that the government officers have not unjustifiably come to require a higher degree of proof than was formerly exacted. The honest miner, confident of the justice of his claim for a patent, naturally finds the departmental 'red tape' irksome to unwind; but the black sheep cannot always be segregated from the white, and he must bear his share of the burden of protecting all the people from imposition by an unscrupulous few.

Miners' Customs

The writer of the 'Protest' next suggests that miners' rules and customs afford ample protection against 'land-grabbers.' In the first place, under what theory should the disposition of the public domain—the domain of all the people of the United States—be left to the protection of miners' rules of the locality in which it happens to be situated? The federal statutes, it is true, recognize rules and customs of the mining districts, but surely Congress never intended to look to those districts to protect the public domain from wholesale land-grabs, or to deprive itself of the power to vest in the proper government officials the administrative power over the disposition of that domain under the general laws. In the second place, miners' rules and customs have so far fallen into decadence that in most instances they have become entirely obsolete. They have been supplanted by state legislation, supplemental to the federal law, which in its more important features is practically uniform throughout the mining states. This state legislation serves to cover the local requirements for special rules in 'blanket lode' districts, and in a measure to reënforce the federal law as to assessment work. I shall speak further of the need of reform in this last subject later. If the federal law had nothing more to supplement it than the district regulations, in most places obsolete, the call for reform might have more justification.

Locators' Title

Again, the writer of the 'Protest' states that the mining laws confer a right of exclusive occupancy upon a locator for the purpose of discovering minerals. One infers from his statement that this occupancy is for all time—or at least so long as the claim is held as a mere location and no patent is applied for. Let us see what the law says. Section 2319, Revised Statutes, reads as follows:

"All valuable mineral deposits in lands belonging to the United States, both surveyed and unsurveyed, are hereby declared to be free and open to exploration and purchase, and the lands *in which they are found* to occupation and purchase by citizens of the United States and those who have declared their intention to become such, under regulations prescribed by law, and according to the local customs or rules of miners in the several mining districts, so far as the same are applicable and not inconsistent with the laws of the United States."

Discovery

From the above section it will be seen that only the lands in which valuable minerals *are found* are open to occupation and purchase. In construing this, the courts have indeed given expression to the doctrine of *pedis possessio*, that is, that a miner who has taken the preliminary steps to locate a claim, and is proceeding with due diligence to make a discovery of mineral thereon, will be protected in his possessory right so long as he continues in his discovery work. This rule, made necessary to prevent physical conflicts, has been crystallized into a law in some states and a definite period allowed for discovery work. But nowhere does it appear that mere occupancy confers a locator's title, or that Congress ever intended that it should. The necessity of a discovery is everywhere upheld. In the case of oil placers, the California Supreme Court has well stated the rule in Miller *v.* Chrisman, 140 Cal., 440, 447, where Justice Henshaw said:

"To constitute a discovery, the law requires something more than conjecture, hope, or even indications. The geological formation of the country may be such as scientific research and practical experience have shown to be likely to yield oil in paying quantities. Taken with this, there may be other surface indications, such as seepage of oil. All these things combined may be sufficient to justify the

*Written by Russell L. Dunn for the *Mining and Engineering World*.

expectation and hope that, upon driving a well to sufficient depth, oil may be discovered, but one and all they do not in and of themselves amount to a discovery."

But the Court continues a little later:

"One who thus in good faith makes his location, remains in possession, and with due diligence prosecutes his work toward a discovery, is fully protected against all forms of forcible, fraudulent, surreptitious, or clandestine entries and intrusions upon his possession."

By the above rule, which is very different from that stated by the writer of the 'Protest,' the bona fide miner is protected during his actual possession and continues diligent search for mineral prior to discovery, while the Government is protected against 'paper locators' and persons who seek to acquire tracts of public domain for purely speculative purposes. No location title can be perfected until a discovery is made.

Rental System

Another assertion advanced is that the exaction of rentals for mining ground by the Government would constitute the imposition of an "unconstitutional federal tax" on the miner. This is legal nonsense. For a long period prior to adoption of the present mining laws, the federal government did lease the public mineral lands and no question of constitutionality was ever raised. As sole proprietor of the public domain, the federal government can impose such restrictions as it sees fit upon its disposal. The only question involved is one of policy. Some serious objections to the leasing system from the standpoint of policy may exist. But as a matter of law, there can be no doubt of the constitutional power of Congress to change its public-land policy in the manner suggested if it sees fit.

Extralateral Rights

One more erroneous statement made by the writer of the 'Protest' is as follows: "If the people consider that it is to their best interests that lode claims in their district should not have extralateral rights, they may make rules and regulations of lode-mining claims which limit them to their side boundary lines." Section 2322, Revised Statutes, guarantees to the locator the right to follow his vein on its dip and within the boundaries of parallel end-line planes, although such vein, lode, or ledge may so far depart from a perpendicular in its course downward as to extend outside the vertical side-lines of such surface location. Any district regulation abolishing the extralateral right would be in contravention of the above statute and consequently void. What the writer was probably thinking of was the situation which arose in the 'blanket lode' districts in Colorado, where the dip of the veins was nearly horizontal, and the locator of the apex would acquire a segment of vein running underneath the whole district. Although the courts held that if the locator could prove his apex he would be entitled to his extralateral right, in nearly every case the matter was settled practically by the jury's refusal to find any apex. With this tacit recognition of the situation, these districts were worked for the most part with vertical boundary claims, and no dispute has arisen for many years.

Timber Cutting

Finally, the writer of the 'Protest' asserts that officers of the Department of Agriculture have made it a rule that miners must buy timber of them for mining purposes, and that they may buy only what these officers choose to sell, although the statutes grant free timber for mining purposes. This statement is not borne out by the rules or practice of the Department. Miners are allowed to take free timber from their own claims to use for mining purposes on such claims. They are prohibited from taking timber from public land outside of their claims for use on such claims or from selling or otherwise disposing of for commercial purposes timber cut on their claims. All of which regulations are in entire harmony with the federal law.

With this criticism of various legal fallacies appearing in the above-mentioned article, which, if uncontroverted, might lead one to suppose that the opposition to revision of the mining laws has no sounder foundation, permit me to state briefly the objections to such revision which are being advanced by its leading opponents at the present day.

Confusion of Titles

First—The time for such revision, if it ever existed, has gone by. A fundamental change in the law at this time can only result in unutterable confusion in mining titles throughout the Western states. Rights which have vested under the apex law would be thrown into constant conflict with rights which would be claimed under a vertical-boundary leasing system. Titles which have been finally settled after years of litigation would again be subject to scrutiny, and the always difficult burden of proving his apex would again have to be taken up by the extralateral claimant. Forty years of decisions have served to mold the American mining law to fit the actual physical conditions which have arisen. It is comparatively seldom now that a case involving interpretation of the federal law comes into the appellate courts. An occasional conflict—not many—arises between rival claimants to the underground segment of a vein, but it usually stops with the finding of facts in the trial court. The districts in which the apex law worked a real hardship in earlier days have settled their mining titles to their own satisfaction. The requirement of discovery and improvements sufficient to act as a guarantee of good faith, properly enforced by the land department prior to granting patents, protects the Government against impostors. Where a change to a leasing system might open to prospecting a few lode claims which are illegally held under color of a locator's title, it would cause dismay to thousands of miners who have in good faith located and worked claims for years past, not always profitably, but always with hope of ultimate success. Many of them would be put to the expense of litigation to defend what is now conceded to be theirs. I have been speaking more particularly of lode claims. The same thing is true of placers, and in a greater measure in some respects. The present locator of a placer subdivision, not having his boundaries marked where he is on surveyed land, would be un-

der the necessity of submitting to the leasing system and paying rental to the Government or being constantly put to the necessity of proving his location against a prospector armed with a government lease. Slight modifications in the present law can remedy the existing evils.

Economic Considerations

Second—To substitute the judgment of the average government surveyor, passing hurriedly over large tracts of public land, for the judgment of the prospector who painstakingly examines each subdivision for the mineral he seeks, would not help, but hinder, the mining industry. An arbitrary classification of public lands will be a detriment to its proper economic development. There is an old saying in the mining country that "gold is where you can find it." And it is usually necessary to engage in considerable prospecting work to find even indications of metal. Only the prospector, actuated by economic motives, will devote the necessary time, labor, and money to a proper determination of the character of the land. Such a fundamental change in the law as will eliminate the requirement of a "discovery" as a basis for determination of mineral character, and substitute therefor the judgment of the average government surveyor, however conscientious he may be, is contrary to the best interests of the industry it is sought to develop and not to retard. The needs of posterity have been amply cared for by the extensive withdrawals already made of oil, coal, and timber lands. The "ploughed furrows" and "shotgun patrols" in the oilfields, to which the editor of the *Press* recently alluded, can be obviated by the requirement of permanent boundary monuments in the case of placers as well as lodes, and a proper policing of the oilfields.

Suggested Modifications

In other words, the opponents to the proposed mining legislation believe that the need is not for new and radical changes in our mining laws, involving the substitution of bureaucratic classifications and regulations for economic principles, but rather the enforcement of the spirit of the existing laws, with one or two modifications necessary to make the intent clearer and its enforcement easier.

I have already indicated that the requirement for permanent boundary markings should be one of these modifications. Mexican requirements in this respect could be profitably followed. The other greatest need is for a better assessment-work statute. The suggested payment of annual rentals to the Government in lieu of annual labor might swell the public treasury, but it will not help the development of the land. A man should not be allowed to hold a claim for over a year after location without working it, as the "calendar year" law now permits. The year in which the location is made should be included as a year is which labor must be performed. Some means of supervision should be devised to insure its being performed in fact, and not merely a formal proof of labor recorded.

Conclusion

In conclusion, I believe that the opinion of a majority of the men who know and understand mining conditions and the needs of the mining country is against a fundamental revision of our mining laws. The original policy of the Government was to encourage the maximum development of our mineral resources along economic lines, subject to just sufficient regulation to insure good faith and honest development. The magnificent growth of our mineral-producing states is a tribute to the wisdom of this general policy. The evils which have been attendant upon its administration have been due to a subversion of the spirit of the law, not to errors in the policy on which the law was based. At this late date, after forty years of judicial interpretation have firmly established the principles of this mining code as applied to actual conditions, let us not change its fundamental basis and have two systems of law to administer. Let us rather seek with the aid of minor modifications, if necessary, to enforce the spirit of the present law to the wisdom of which the prosperity of our mining states so strongly bears witness.

Safety in Tunneling

At times even experienced men believe the roof of a tunnel to be sound, when suddenly and without warning a large block crashes down. This is generally regarded as an accidental occurrence; yet even the danger from such a block in many cases might have been discovered in time if there had been a systematic and regular examination of the roof of the tunnel. For this reason a miner should form the habit of examining the roof as he passes through and test all places that appear to be unsound.

It should be said in this connection that sounding a roof is not a proper way of determining its safety; there are numerous cases on record where the roof gave a satisfactory sound and appeared solid even to experienced men, but in which a block or boulder was actually loose. A better method of testing the roof, which is used by many large mining companies and is recommended by the Bureau of Mines, is to strike it with a pick or heavy stick, at the same time touching the doubtful piece with the free hand. If any vibration is felt, the rock is unsafe and should be taken down or supported at once. If the rock is too high to reach with the hand, a stick should be held against the doubtful piece while it is being struck, and if it is loose the vibration can be felt through the stick.—*Miners Circular, Bureau of Mines.*

Pennsylvania, Ohio, Illinois, and West Virginia are credited with over 40% of the total mineral production of the United States. Pennsylvania outranks all other states, producing nearly 25% of the total, West Virginia comes second, Illinois third, and Ohio fourth. California, with no standing as a producer of pig iron, iron ore, or coal, stands fifth in rank among the states, owing to its heavy production of gold and petroleum.

Dividends paid by mining companies in Western Australia, during the first nine months of 1913, amounted to $3,030,000.

Dredging at Natoma, California

By M. W. von Bernewitz

In Sacramento county, the work of the Natomas Consolidated of California is well known, and much of its operations has been dealt with in the technical press from time to time, so the following notes cover certain details not usually considered, though of great importance.

Scattered over a length of about twelve miles, the Company has 10 large dredges at work on the south

NATOMA No. 7 DIGGING INTO THE PAY.

bank of the American river. Some time before the visitor to Natoma reaches there, are seen large piles of tailing consisting of gravel of all sizes, and here and there among them is the gantry of some dredge just visible above the waste. At Fair Oaks is a large rock-crushing plant,* producing several sizes of stone from the tailing, which is shipped to all parts of the state for ballast and road construction. The crushing plant which the Company has maintained at Natoma is temporarily shut down. The ground attacked by the dredges differs considerably from time to time, but during one month's operation the performance of the dredges was as follows:

	Dredges									
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
Bucket capacity, cubic feet.....	13.5	8.5	8.5	13.5	9	9	9	15	15	15
Height of bank being dredged:										
Above water, feet.....	4	3	6	2	12	6	20	10	3	16
Below water, feet.....	16	23	20	18	44	54	42	53	58	21
Daily operating time, hours.....	19	20	19	21	21	21	20	19	20.5	19
Gravel dredged, cubic yards...	232,014	232,644	124,440	205,274	159,294	150,553	170,690	142,529	238,004	253,376
Power consumed, kilowatts.....	221,440	143,520	137,600	192,600	238,800	219,600	272,000	346,800	362,400	282,000

It will be seen that the banks being dredged vary from 20 to 63 ft. in height, but the operating time is fairly even throughout. The gravel handled by No. 1, 2, 3, 6, 7, 8, 9, and 10 boats was for October; by No. 4 during September, and by No. 5 during May, the latter having capsized during that period, but has since been righted, overhauled, and is in full working condition again. A study of the yardage against the power consumed, the latter being in the same months as given, shows at once the physical character of the gravel being attacked. In the case of No. 2 the power used is only 0.62 kw., against 2.4 kw. per cubic yard by No. 8 dredge.

Boat No. 10

A day's study of No. 10 boat, the hull of which is of steel, under full operating conditions, shows what a powerful machine it is. On the ladder is a bucket-line of 82, 15-cu. ft. buckets, each weighing 4200 lb. This is driven by a 400-hp. General Electric motor, belted to a countershaft by a 32-in. leather belt, in turn driving the gear of the top tumbler by a 32-in. rubber belt. The 9-ft. revolving screen is driven by

STACKER OF NATOMA No. 8 DURING RECONSTRUCTION.

a 75-hp. motor of the same make. For keeping the buckets against the gravel bank or stepping ahead are two steel-plate, box-construction spuds, weighing 45 tons each. A 50-hp. motor drives the 42-in. rubber stacker-belt, being placed right at the discharge end; while a 50-hp. variable-speed motor drives the winches for lateral movement of the boat. The following centrifugal pumps are used: a 14-in. high-pressure for the revolving screen; a 14-in. low-pressure for the gold-saving tables; a 12-in. for two giants which wash down the bank, and a 6-in. for general work. The dredge complete weighs 750 tons. At the time of my visit the dredge-men were engaged in building a dam of mud and gravel at the back of the boat, in order to prevent water flowing away through the tailing, and to deepen the pond, as it was found that bedrock was rising rather rapidly. This work takes time and is done by skillful manipulation of the buckets and stacker.

At Natoma, a large and complete machine-shop is maintained, where new buckets are assembled and old ones repaired, tumblers are relined, and all necessary repairs are effected for the 10 dredges. During September, the Company's boats yielded gold worth $198,621, the profit being $94,864.

*Described in *Mining and Scientific Press*, November 6, 1909.

Mining and Milling at the Vulture Property

By W. M. Wood

The property of the Vulture Mines Co. is about 15 miles southwest of Wickenburg, Arizona. The holdings consist of twenty claims, a well equipped mill, and all the necessary paraphernalia for operating a modern mine. About 500 people make their homes at the mines, and approximately 200 men are on the payroll of the Company. The original location was made about 1863 by John Wickenburg, who founded the town of Wickenburg and gave it his name. Mr. Wickenburg and others mined the rich oxidized ore from near the surface and hauled it to mills on the Hassayampa river where the gold was extracted to the satisfaction and enrichment of the owners. This kind of work was continued until 1880.

The Mill

In 1881 an 80-stamp mill was built on the property by George B. Treadwell and associates. The stamps weighed about 750 lb. each. All the machinery for this mill was hauled to the mine from Ehrenburg, on the Colorado river, a distance of about 100 miles. The treatment was by amalgamation. A large tonnage of tailing was produced, about 30,000 tons of which was leached by a succeeding management at a supposedly good profit. The present management acquired the property in September 1908. Twenty stamps in the old mill were put into commission and run for about a year, in order to arrive at definite conclusions as to the proper treatment for the ore and the kind of mill to erect. The new mill was erected in 1910 and placed in operation in September of that year, the use of the old mill being totally discontinued. The new mill consists of twenty stamps of 1650 lb. each, with a capacity of 100 tons per 24 hours when crushing to 40 mesh. Amalgamation is effected inside the mortars, the ore being crushed in a cyanide solution. Both sand and slime are concentrated, 4 Wilfley and 3 Deister tables being used. The tailing from the tables is sent to the cyanide tanks, consisting of 4 large Dorr thickeners. The gold is precipitated by the Merrill zinc-dust process. The concentrate is shipped to the El Paso smelter for final treatment. The regular mill feed will average about $20 per ton in gold, and the saving is effected approximately as follows: amalgamation, 60%; concentration, 20%, and cyanidation, 20%. The greater portion of the fuel used is crude oil and distillate. Six-ton motor-trucks are used to haul the fuel oils, and are loaded with concentrate on the return trip. Haulage expense has been reduced about 50% by the use of the truck in place of teams. The trucks use distillate for power. The main working shaft is 750 ft. deep on a 40° incline. It is a single compartment with two skip tracks. Because of faulting of the orebody, the present workings are about 400 ft. east of the main working shaft. There are about three miles of underground work. The main working shaft is timbered throughout with 8 by 8-in. square sets, being 5½ by 10 ft. in the clear. The ground is good and easily held, no trouble having been experienced in the shaft for several years. The hoisting equipment consists of an Ottumwa double-drum steam hoist, handling skips of one-ton capacity, which dump automatically into bins. The ore is then trammed by hand to the crusher bins, about 150 ft. distant. From there it goes through a No. 5 Gates crusher which reduces it to 2-in. size. It is then elevated on a Robbins belt conveyor to the fine ore bin, from which it is sent by a four-ton rope skip to mill-bins, from which it is fed by gravity to the stamps. Development work is being pushed eastward and vertically below the 1000-ft. level, keeping the ore reserves well in advance of mill requirements. The ore is principally white quartz, carrying galena, and iron pyrites. The method of mining consists of breast stoping and back-filling. The power-plant consists of two 500-ft. Sullivan power compressors, driven by two 150-hp. Nash gas-engines, using distillate as fuel, and two 300-ft. Sullivan steam compressors. The power for operating the stamp-mill is also supplied by two 150-hp. Nash gas-engines. The water-supply for camp purposes and the boilers comes from a 1000-ft. well, while water for the mill is pumped from the mine, which furnishes an adequate supply.

The total value of the mineral production of Alabama, exclusive of the value of the pig iron, but including the value of the iron ores, was $30,641,983 in 1912 and $28,005,785 in 1911, approximately two-thirds of which is represented by the output of the coal mines and one-fifth by the output of iron ore. The iron ores of Alabama, while inferior in quality to those of Lake Superior, have the advantage of being near deposits of good coking coal and of the limestone requisite for fluxing, so that Birmingham, the Pittsburgh of the South, can manufacture pig iron cheaper than any other district of the world.

Gold, silver, lead, and copper output of Charters Towers, Queensland, in October was worth $115,000. The Deep Sinking Commission has finished its work and furnished a report. Briefly the report recommends a reduction in the diameter and depth of the proposed shaft, and an increase in the capital to be provided. It remains to be seen how this recommendation will be dealt with by the Queensland Government and Mr. Mills.

After a lapse of eight months, the British Australian Oil Co.'s shale mines at Murrurundi, New South Wales, Australia, and works at Newcastle, are resuming operations. A new company has been registered in London, with a capital of £300,000, and it is proposed to recommence at once the manufacture of crude and refined oils, sulphate of ammonia, candles, and all products of coal shale oil and petroleum.

During September the Mt. Bischoff Tin Mining Co., Waratah, Tasmania, produced 100 tons of tin oxide, from the treatment of 20,806 tons of crude ore by the concentration plant. All the open-cuts are producing average-grade ore.

Discussion

Readers of the MINING AND SCIENTIFIC PRESS are invited to use this department for the discussion of technical and other matters pertaining to mining and metallurgy. The Editor welcomes the expression of views contrary to his own, believing that careful criticism is more valuable than casual compliment. Insertion of any contribution is determined by its probable interest to the readers of this journal.

The Rand Banket

The Editor:

Sir—You have been good enough to ask me to contribute to a discussion on Mr. C. B. Horwood's articles on the 'Rand Banket' now appearing in the *Press*, and as this is a subject to which I have given much attention, and on which I have written not a little, I have much pleasure in acceding.

On main principles, Mr. Horwood and I appear to be in accord: thus he agrees with me that the gold has been introduced after the deposition and cementation of the pebble beds that now form the conglomerates.[1] In regard to some minor matters, however, there are points of difference between us, as I shall endeavor to show later.

Mr. Horwood gives prominence to the question of the origin of the so-called pyrites pebbles, and rightly, because their existence in the banket has been one of the chief arguments brought forward by the supporters of the alluvial theory. We are agreed that rolled pebbles of pyrites—that is, pebbles of pyrites formed by attrition with the quartz pebbles of the conglomerate—do not exist in the banket; further that certain flattened or ellipsoidal pyrite pebbles which are microcrystalline and entirely devoid of radiate structure, are pseudomorphs after quartz pebbles. But this variety of pyrites pebble is exceedingly scarce in the banket; the bulk of the nodules and pellets of pyrites shows a distinct radiate or concentric structure, and are ordinary concretions of pyrites. Such concretionary pyrites is quite common in the banket, and although it may be in part of metasomatic origin—that is to say, during its introduction it may have replaced a portion of the silica of the groundmass of the banket—I cannot agree with Mr. Horwood in regarding this particular variety of the nodular pyrites as pseudomorphs after quartz pebbles; nor do I understand his explanation of the radiate structure, which, in the cases I have seen and described, is a property of the pyrites itself, similar to that of other well known concretions of that mineral, and not a septarian structure.

Mr. Horwood has done good service in collecting, and in reproducing by photography so much valuable material, which will be of great assistance in making clear the nature of the process by which the pyrites has been introduced into the banket. But he cannot be given all the credit for the discovery of its metasomatic origin. This has been the work of several. Even the possible pseudomorphism of pyrites after quartz pebbles was simultaneously suggested by several observers, although the idea only assumed concrete shape when Mr. C. R. Young brought the microscope to bear on it. Mr. Horwood bases a claim to priority for this discovery on a paper read before the Geological Society of London in March 1907, and states[2] that the "view was a new one, advanced for the first time, and it met with a considerable amount of opposition." Unfortunately the paper was not accepted for publication, consequently all that appears in the *Quarterly Journal* of the Society is its title and a footnote setting forth that it was "withdrawn by permission of the Council."[3]

As the subject is of some importance, perhaps I may be permitted to review briefly the whole discussion. The existence of pyrites 'pebbles' or pellets in the banket has been known for a great number of years, and their origin has been the subject of much discussion. The so-called 'buckshot pyrites' of the Rietfontein series was described by myself[4] in the 'Gold Mines of the Rand,' a joint production of the late J. A. Chalmers and myself. Then came

[1] See Hatch: 'The Geology of the Southern Transvaal,' *Quart. Jour.* Geol. Soc., Vol. 54 (1897), p. 81; and Hatch and Corstorphine: 'The Petrography of the Witwatersrand Conglomerates, with Special Reference to the Origin of the Gold,' *Trans.* Geol. Soc. So. Af., Vol. VII (1904), p. 145.

[2] *Mining and Scientific Press.*

[3] A brief abstract of the papers read before the Geological Society is circulated to the Fellows immediately after the meeting. The one referring to Mr. Horwood's paper is No. 841, March 5, 1907, p. 54. As these 'Abstracts of the Proceedings of the Geological Society' are not everywhere available, it may be useful to reprint the abstract of Mr. Horwood's paper. It is as follows:

"THE OCCURRENCE OF PSEUDOMORPHOUS PEBBLES OF PYRITES AT THE CROWN REEF MINE (WITWATERSRAND), by C. B. Horwood.

"Reference is first made to the existence of calcite 'pebbles' in the Main Reef, which Julius Kuntz believes to be due to the replacement of quartz by calcite. Pellets of iron-bisulphide known as 'buckshot' occur at the Rietfontein 'A' mine in the Buckshot Reef; they exhibit radiate fibrous structure, and are probably of concretionary origin. At the Crown Reef mine a few 'pebbles' of pyrite—some measuring as much as an inch in length—occur in a narrow band of conglomerate at the contact of the reef with a basic dike. It is conjectured that the mineralizing solutions which deposited the pyrites (together with some, if not all, of the associated gold) ascended along the fractures due to the intrusion of the dike, and found an easy course along the small conglomerate bed, where they replaced some of the quartz pebbles with pyrites, being kept up by a band of shale underneath the conglomerate."

The only discussion which took place at the meeting consisted of the following remarks made by myself:

"Dr. F. H. Hatch said that the abstract of the paper read by the secretary did not contain any facts tending to show that any of the pyrites nodules in the Witwatersrand conglomerate were really pseudomorphs after quartz-pebbles; nor was there any suggestion offered as to how such a replacement might be supposed to have taken place. The specimens on the table contained abundant examples of pyrite-nodules with radiate structure, which were evidently of concretionary origin. The speaker had not, however, noticed on the table any specimens that showed clear evidence of pseudomorphous origin. Pyrites occurred in the Witwatersrand conglomerate in three forms, namely: (1) in crystals; (2) in concretionary nodules with radiate structure; and (3) in flat pebble-like bodies of amorphous structure. The last named had been described by Becker and others as 'rolled pebbles of pyrites' and it was no doubt to those that the author referred as 'pseudomorphous pebbles.' Anything approaching a proof of their pseudomorphism would have a bearing on the mode of origin of the gold in the conglomerate."

[4] 'Gold Mines of the Rand,' Hatch and Chalmers 1895, p. 51.

(in 1897) Becker's[5] description of the pyrites pebbles as of detrital origin, which he used to support his argument that the gold was of alluvial origin. In 1904, in conjunction with my friend, Mr. Corstorphine,[6] I again took up the cudgels against the alluvial theory, and in support of the infiltration theory. We recognized the importance of the origin of the pyrites pebbles, and devoted especial attention to the examination and distribution of a number of typical specimens from the Buffelsdorn mine and from the Rietfontein mines, noting the radiate, and, in some cases, the concentric structure. We also examined a great number of slides made from specimens obtained from different mines, in which, while we described the pyrites as of all shapes, we pointed out that the spherical predominated, although some of the particles were sharply angular and showed crystal facets. We expressed our opinion that the bulk of the so-called rolled pyrites was of concretionary growth; and added that if rolled pebbles of pyrites really occur, we had not seen any to which we could assign such an origin. The same views are stated in our joint work on the 'Geology of South Africa.'[7] Later on we came across pyrites 'pebbles' that showed no concentric or radiate structure and possessed a curiously flattened or ellipsoidal shape, and we admitted that these certainly did recall the appearance of true pebbles. The possibility of this being pseudomorphs after quartz pebbles suggested itself,[8] and was freely discussed among those interested in the subject at that time in Johannesburg; but it remained a mere supposition until it was proved by the careful microscope work of C. R. Young,[9] which was embodied in a paper read before the Geological Society of South Africa on March 18, 1907. A few days previously, on March 5, 1907, Mr. Horwood's paper had been read before the Geological Society of London; but it contained no proofs and was, as already stated, withdrawn without publication.

The subject was again dealt with in the discussion on Mr. Gregory's paper on the 'Origin of the Gold in the Rand Banket,' read before the Institution of Mining and Metallurgy in October 1907. His paper contains a photograph of two of the flattened non-concretionary pebbles referred to. Mr. Gregory, being a strong supporter of the alluvial theory, appears to think that they have been worn by attrition to their present shape; but he does not deny the possibility of their pseudomorphous origin, although in that case he prefers that they should be pseudomorphs after ironstone instead of after quartz. That the idea of the pseudomorphous origin of the pyrites was in the air, prior to the reading of Mr. Horwood's paper, is further shown by the fact that Mr. Gregory also suggested it in a lecture at the Society of Arts which was given on February 4, 1907.[10]

Finally the whole subject was reviewed by myself in 1911 in a contribution to 'Types of Ore Deposits,'[11] where I described the pyritization of the banket as a case of metasomatism belonging to a post-cementation period, since (as C. R. Young had already shown) not only are occasional pebbles, but also the cement of the banket, in part replaced by pyrites.

F. H. Hatch.

London, November 21.

[5]G. F. Becker, 'The Witwatersrand Conglomerate,' Washington, 1896, p. 107; G. F. Becker, Eighteenth Annual Report, U. S. Geol. Surv., 1897, Part V, p. 167.

[6]'The Petrography of the Witwatersrand Conglomerates,' *loc. cit.*

[7]London, 1905.

[8]Kuntz had already demonstrated remarkable pseudomorphs of the calcite after quartz pebbles and cement in Meyer & Charlton mine, *Trans.* Geol. Soc. So. Af., Vol. VI, 1903, p. 74.

[9]*Trans.* Geol. Soc. So. Af., Vol. X, 1907, p. 26.

[10]See footnote on p. 37 of Mr. Gregory's paper, *Trans.* Inst. Min. and Met., Vol. XVII, 1908.

[11]Published by the *Mining and Scientific Press*, San Francisco, 1911.

Gold in Surinam

In Surinam, Dutch Guiana, gold-placer deposits have been worked since 1879, but there have been few improvements in the methods of operation from that time up to the present. The concentration of much of the gold in rich pockets has enabled the miner to work the placers by primitive methods and still make a good profit. The smaller and richer spots of the placers are profitably worked by many of the gold-diggers, for there is only a moderate overburden and the bedrock gravel is reported to carry about $5 in gold per square yard of surface.

The more extensive gravel deposits carry much smaller quantities of gold, but they might be profitably worked by improved modern methods, provided they were first carefully examined and prospected. The low grade of the large gravel deposits, together with the lack of water (or an excessive oversupply) make the exploitation of these fields impossible for the man of small means. The small rich spots in many of the placers do not seem to be exhausted, but still afford attractive opportunities for the energetic and optimistic gold-digger.

A recent official report, published in London, gives interesting details of gold-mining in this colony. Encouraging results had been obtained in the Kaituma and Barima rivers, but the outstanding feature of the year was the richness of claims located near Pigeon island, on the left bank of the Cuyuni river, the return of gold surpassing anything hitherto worked in the country. From one creek, in which 70 to 80 'toms'* were in operation, a day's work yielded as high as 60 oz. per 'tom', and on rewashing sand, 30 to 35 oz. per day; worked for a third time, 12 to 15 oz. per day was won, and the fourth time the diggers were rewarded with a return of 4 to 5 oz., for a day's work. Following these rich discoveries on Pigeon island, gold, it was reported, had been found over an extensive area at the head of the Caburi creek on the Mazaruni river. There was also a rich find reported in the upper Mazaruni, and if the statements of the finder could be given credence, a substantial addition to the gold output would result from the discovery. The gold output of the colony for 1912-13 was 62,098 oz., as compared with 49,607 oz. in the preceding year.

*A washing machine.

Concentrates

Most of these are in reply to questions received by mail. Our readers are invited to ask questions and give information dealing with the practice of mining, milling and smelting.

Coal sold by the Chinese Engineering & Mining Co. during its last financial year totaled 1,728,296 tons.

Products of mines, largely coal, account for 55% of the total tonnage handled by railroads in the United States.

Good wagon-roads and trails are badly wanted in Alaska. A prospector near Valdez, during the past season, had to pay from 5 to 12c. per pound to haul three tons of supplies.

Costs of producing 'blister' copper at Mt. Lyell, Tasmania, during the past half-year were: mining, $2.50; smelting, $2.54; and bessemerizing, $0.28; a total of $5.32 per ton of ore treated.

Fuse is frequently injured by falling rock or other causes. Such injury increases the burning rate, and there have been cases where fuse damaged in this manner have burned almost instantaneously.

'Pork-knockers' are placer miners who work on ground that belongs to mining companies in British Guiana, South America. Although they are trespassers, they are steadily producing a fair quantity of gold.

Two 120-hp. Crossley suction gas-engines, driving a 20-stamp mill and 10-drill air compressor, respectively, at the Central Red, White, and Blue mine, Bendigo, worked the last half-year without any stoppages due to the engines themselves.

There is danger in using frozen or chilled explosives. Most dynamite freezes at a temperature of from 45 to 50°F. Priming or the placing of a detonator or electric detonator in dynamite should not be done in a thawing house or magazine.

Quicksilver ores, after being sorted to some extent, are generally treated direct in furnaces. Lately, however, there have been plants erected for crushing and concentration of these ores, especially when low grade. Although cinnabar has a specific gravity of 8.99, the millman must be careful not to crush the ore too fine, otherwise there will be a considerable loss from whatever type of concentrator is installed.

Fire in the North Lyell mine, Tasmania, necessitated its being flooded late in 1912. Early in June 1913 unwatering was completed, having taken 4½ months to bail 41,500,000 gal. of water. The precipitation plant recovered 146 tons of precipitate containing 63 tons of copper. In addition, 109 tons of precipitate, with 16 tons of copper, was cleaned up in the mine workings, representing the copper precipitated by steel and ironwork., etc., out of the water with which the mine was flooded. Although the loss by the disaster was $201,000, there was recovered $27,000 of copper precipitated during the flooding of the mine.

Unit is a word employed in smelting contracts and means 1% of the metal or other constituent of the ore to which the word is applied. Thus, a 'unit' of lead or of iron means 1% of these metals, or 20 lb. of lead or iron per ton of ore. The smelters usually make payments per 'unit' for the desirable constituents of an ore, and charge the shipper for each 'unit' of the substances which they do not want. For example, many smelters exact a 'zinc penalty' of 40 or 50c. per 'unit,' which means that an ore containing 10% zinc would be subject to an extra charge of $4 or $5 per ton.

Gold mining in Hungary is mostly done in Transylvania, in the eastern portion of that European country. At Boicza there are eight separate mines, according to Newton B. Knox. The ore, as a rule,

PLANT AT THE BOICZA GOLD MINES, HUNGARY.

is free milling, containing from $4 to $12 per ton. There is only one mill, with 50 stamps, remaining in the district, and gold recovery is low. The accompanying halftone shows the character of the country and surface buildings at Boicza.

Important minerals of commercial value occurring in the Joplin district are galena, cerussite, sphalerite, calamine, and smithsonite. These are better known locally as 'lead' for galena; 'blende' or 'rosinjack,' 'rubyjack,' 'steeljack,' or 'blackjack' for sphalerite; and calamine and smithsonite are classed together under one term as 'silicate.' Closely associated with these minerals are pyrite, marcasite, chalcopyrite, calcite, dolomite, and, in a few mines, small crystals of quartz. These minerals also have their local terms, such as 'mundic' for the iron sulphides, 'tiff' for calcite, and 'spar' for dolomite. Besides these, in a few of the mines there are small deposits of the hydrocarbons, which are termed by the miners 'coal tar' or 'asphalt.' This substance occurs in small openings or crevices, and is usually viscous at the ordinary temperature of the mines. A yellow to light-brown clay also occurs, especially in the 'soft-ground' deposits, and, although it is not a definite mineral, it in many places contains considerable zinc silicate. Other minerals occur throughout the district, but are less common and important.

Special Correspondence

AUCKLAND, NEW ZEALAND

LABOR TROUBLES AGAIN.—THE YEAR'S RESULTS AT THE THAMES, COROMANDEL, KARANGAHAKE, AND WAIHI DISTRICTS.—GOLD MINING IN THE SOUTH ISLAND.—COAL, OIL, AND KAURI GUM.

It is unfortunate that labor troubles have again interfered with the output of minerals in New Zealand. It is estimated that the loss during the year to shareholders in mining companies through strikes was about $240,000, and to the employees quite three times that amount. The regrettable point is, that such figures appear to have little weight with those who start disputes, as toward the close of the year the men were once more called out from the coal mines, and the trouble spread to other trades. The result was that the ports were closed for a few weeks, until the farmers got anxious regarding the shipment of their produce and resolved to ride into the towns and assist the authorities. In Auckland about 1500 farmers came to town bringing their own horses, and nearly 1000 citizens were also sworn in as special constables. This resulted in peace, and when the strikers found that they were not entirely masters of the city, work in the port was resumed. The total value of the gold and silver exported from New Zealand from 1857, the year in which the first discovery was made, until the end of 1912, was $395,500,000, to which may be added about $6,200,000 for 1913. To November, five mines in Ohinemuri county in the Hauraki peninsula produced $3,370,000, as follows: Waihi, $1,330,000; Waihi Grand Junction, $720,000; Waihi-Paeroa Extraction Co., river dredging, $160,000; Talisman Consolidated, $940,000; and New Zealand Crown, $120,000. These properties have already paid over $27,000,000 as dividends. The year 1913 has been somewhat disappointing, as far as mining was concerned, in the Auckland district. It was naturally thought that when the strike terminated in Waihi, in October 1912, there would be a revival of interest in mining. Such, however, was not the case. It would appear as if investors had their eyes opened by that strike, and are less inclined to spend money in an industry in which labor troubles have to be added to the ordinary risks. That there have not been any important new finds on the Hauraki peninsula during 1913 is hardly to be wondered at, seeing that little prospecting has been done, owing to the fact that there has been plenty of work at good wages for ordinary laborers.

In the Thames goldfield, the most important work has been the continuation of the cross-cut at 1000 ft. for the purpose of testing the deep levels. Over $96,000 has now been spent on this work. In November, operations had to be stopped, owing to a heavy inflow of gas and water, supposed to be the result of the proximity of the Moanatairi fault. There is, however, an equal probability that this may prove to be the Waiotahi vein, but this will not be proved until more work has been done. The Kuranui-Caledonian company, which has its headquarters in London, has reconstructed in order to provide capital to develop that property, as soon as the drift gets near its shaft. The Waiotahi mine, which adjoins, has started sinking its shaft to 1000 ft. The May Queen is driving at that depth to cut the Vanguard vein, and the Saxon has opened No. 7 level to reach the Cardigan vein. The Watchman mine at Thames has been systematically developed for a few years, and 1000 tons of ore treated at the Waiotahi mill proved that it is a paying proposition. A stamp-mill has therefore been acquired, and this is being overhauled for regular work. The New Sylvia mine has been producing fair-grade ore for several months, yielding a profit on each return. A long low-level adit driven at great cost by the Waitangi Consolidated company, failed to find the veins at depth, so that operations were resumed at the upper levels, where recent assays showed the ore to be profitable. In the Kuranui mine, important developments took place toward the end of the year. The directors abandoned the old policy of prospecting in the upper workings and started to continue what was known as the Magazine adit. In the first 100 ft. no less than three veins were cut, all being of a promising character, and five more veins are known to be farther on. In November a stringer showing gold was cut, so that there are hopes that the other veins will prove profitable.

Mining has been dull throughout the year at Coromandel, and at the present time only about three companies are carrying on active operations. One is the Hauraki Reefs, which adjoins the Old Hauraki, and from that mine several unfavorable reports have been rendered at intervals. The Mt. Welcome mine, at the Tokatea range, is driving a lower adit to enable work to be resumed in winzes,

from which some good ore was extracted until the men were driven out by water. The other mine being worked is Bremners Freehold, at Tiki, where it is hoped that gold may be found in the Tiernans vein. At Kuaotunu, the New Waitaia mine is yielding regular shipments, the ore ranging from $43 to $57 per ton.

In the Karangahake district, three companies are carrying on operations, the principal one being the Talisman Consolidated, whose mine is opening well on the lower levels, and is paying regular dividends. The total output from this mine to date, November 1913, reached $9,700,000, out of which $4,080,000 has been paid in dividends. The New Zealand Crown Mines Co. has not done anything of note during the year, the returns ranging from $9700 in January to $14,000 in May, and $12,000 in September. As the ore treated for the latter month was 1323 tons, it will be seen that the ore is not high grade. The total output from the Crown Mines to November is $4,300,000. Adjoining the Talisman mine, a local company is developing the Dominion property, where a large vein on the surface, which gave promising assays, is expected to be cut before long in the low adit now being driven.

Rather important developments have taken place at Waihi during the year, particularly toward the close of 1913. When operations were resumed at Waihi in October 1912, after the strike, it was thought that a barren zone existed at No. 10 level. This theory has since been entirely disproved. A vein was cut on that level, which has been named the 'Dreadnought,' and has shown by average assays that the ore is profitable. This discovery

at a depth of 1300 ft. gives hope that gold contents will be found deeper. The vein has since been found in the level above, but was smaller and poorer. This may be taken as an indication that it is an orebody which extends downward and improves in value as depth is attained. The Hora Hora electrical scheme, which has been carried out by the Waihi company at a cost of $720,000, will shortly be ready for work, enabling the ore to be handled more economically. Up to November 1913 the Waihi mine has produced $49,000,000, out of which $2,100,000 has been paid in dividends. The lastest report from the mine is to the effect that the Edward vein is opening splendidly at a depth of 1150 ft., both in respect to width and gold content, and the other veins were also looking well. It would therefore seem as if the dark days for the Waihi company were passed, and that there is still a good future for the greatest mine in New Zealand. Even more important were the developments in the Waihi Grand Junction mine, in the lower levels. When driving on the Empire vein, a fault was found, and on the other side, what was thought at first to be the same orebody was cut. Subsequent work showed this to be an entirely new vein, and the Empire was found again after a cross-cut had been driven 100 ft. The ore was opened for some distance and proved to be 10 ft. wide, averaging $20.60 per ton. The Royal vein at this level was opened in November to 34 ft. of profitable ore, so that the future of this mine seems bright. The total return to date from the Waihi Grand Junction is $3,700,000, out of which $280,000 has been distributed in dividends. The Komata Reefs mine, which has produced $2,110,000, reduced the number of employees toward the close of the year, as the total return for the 10 months had only been $38,000. The Silverstream mine, at Maratoto, is producing telluride ore, and shipments varying from $177 to $240 per ton have been sent to a smelter for treatment. There is also a large vein on this property, known as Cumola, which is 40 ft. wide. This is free-milling ore and has been opened for 450 ft. and is profitable for the whole distance. A raise was driven 50 ft., and a winze sunk, in both of which the vein assayed $14 per ton. At Waiorongomai, near Te Aroha, the Waitawheta Gold Prospecting Co. had the misfortune to have its stamp-mill destroyed by fire early in the year, just as crushing had been started. A new plant is being erected and fitted with vanners and a complete cyanide plant, so that treatment should be resumed early in 1914. This Company holds a combined area of 343 acres, as well as machine sites and ditches. It is considered that enough ore has been opened during the last few years to keep the mill in full operation.

In the South Island the story of the Ross Goldfields company is one of persistence on the part of shareholders in the face of many difficulties. This mine is situated at Westland, and in the early days of that field, when the Cassius, Morning Star, and Excelsior companies were working, 11,543 oz. of gold was recovery in 35 days. Exclusive of the returns from the ordinary small claims, the output for about 32 weeks was valued at $430,000. Subsequently, the Mont d'Or Sluicing Co. recovered 40,700 oz. from Ross Flat, and one man named Cassius got 22,000 oz. in two years, while at the top end of the field, known as 'Jones Flat', over five tons of gold was extracted. Later on, for a period of over ten years, all mining was suspended, as the properties were inundated with water. In 1882, the first Ross Gold Mining Co. was formed, but was only able to work in the gravel for 35 days, and during that period 614 oz. was won. Then the water in the Cassius workings was tapped, with the result that the Ross mine was flooded out, as the plant proved unequal to cope with it. In 1905 the Company went into liquidation, and it was not until 1907 that the Ross Goldfields, Ltd., was formed with a capital of $384,000. An electrical plant and other machinery was installed, but once more shareholders were disappointed, and it was not until a Diesel engine had been installed, with additional pumping plant, that the mine was again unwatered. In the past, no less than $960,000 has been spent by four companies in trying to unwater this ground. In sinking the Ross shaft, eight strata of gold-bearing gravel were passed through in 392 feet.

KARANGAHAKE, NEW ZEALAND.

The Crown and Talisman properties are in the cañon below the mountain, which is 1700 ft. high. Ohinemuri river in foreground drains the Waihi, Waitekauri, and Karangahake districts.

Gold-dredging seems to have passed its zenith in the South Island, yet the 80 dredges in commission returned $1,290,000 in 1912, of which only $72,000 was received by shareholders as dividends. Toward the close of 1913 the Big River company paid several good dividends. By the systematic testing of gravel areas with Keystone drills, placer mining has been rendered less speculative. The Consolidated group of mines at Reefton has produced steady returns during the year and paid several dividends.

The output of coal from the various mines in New Zealand shows steady increase. A new state coal mine has been opened at Seven Mile creek, near Greymouth, which is estimated to be capable of yielding 2000 tons per day. The Westport collieries still supply large quantities of excellent bituminous coal, and the Westport Stockton is stated to have 9,000,000 tons in its area. In the North Island, the Taupiri Coal Co. is the main source of supply of brown coal for household purposes, but a new company, called the Waipa Collieries, is developing property farther up in the Waikato district. A railway is being constructed seven miles, and there is a good seam of coal which can be worked by adits. Another company, named the Pukerimu, is also opening a mine, so that the supply of household coal should be ample for years to come for the Auckland province. North of Auckland, a good deal of bituminous coal is mined by the Hikurangi and Northern companies. During November all coal mines were shut down on account of the strike.

An area of 1850 square miles has been set apart by the New Zealand government for the purpose of boring for oil. About fourteen companies are now drilling for petroleum in the North Island, and a refining plant has been erected at Motura, Taranaki, at a cost of $120,000, which will have a capacity of 10,000 gal. per day. During 1913 the New Zealand Oil Wells Co. was formed in London with a capital of $1,920,000. This Company has already secured the government bonus of $12,000 for the production of 250,000 gal. of oil. Several of the companies are interested in the refinery that has been erected, and six are now drilling with modern rotary machines. Indications of oil have also been found at Marlborough, Buller, and Ross, in the South Island, and at Ohinemuri in the Hauraki peninsula. North of Auckland, at a place callel Pungare, there is a large deposit of oil shale, which is also receiving attention from a company.

The kauri-gum industry continues to be an important one for the Auckland province. At the extreme north of

the North Island a company is to systematically work an area recently acquired. The kauri-gum market has been good throughout the year, the total exports from Auckland, the only port in New Zealand near where gum is found, was $2,160,000 up to November 1913, an increase in value on the similar period of 1912 of about $816,000. The value of the kauri gum industry to Auckland may be gathered from the fact that the total export to date amounts to $180,160,000.

MELBOURNE, AUSTRALIA

BIG DIVIDEND PAYERS.—OIL IN SOUTH AUSTRALIA.—VICTORIAN COMPANIES LEGISLATION.—OIL FROM COAL.—A RICH MINE REVIVED.—'PICKING THE EYES OUT.'

In contradicting a misstatement made by a Tasmanian publication, to the effect that the Mt. Bischoff tin mine has paid more to its shareholders in dividends than any other mine in the world, the *Australian Mining Standard* recently gave some interesting figures as to the dividend payments made by Australian mines. Among the companies that are still carrying on operations, the following have made the largest disbursements:

Company.	Metals produced.	Dividends.
Broken Hill Proprietary	Silver and lead	$47,762,800
Mount Morgan	Copper and gold	39,426,460
Great Boulder	Gold	21,939,823
Ivanhoe	Gold	15,035,000
Mount Lyell	Copper	13,417,884
Mount Bischoff	Tin	11,717,600

Next to these, not mentioned by the *Australian Mining Standard*, because its editor only wished to name those having paid more than Mt. Bischoff, is the Oroya Links company, of Western Australia, which, with the old Brown Hill and Oroya Brown Hill companies, all the property now being controlled by the first named, has paid out $10,409,269.

Considerable interest nas been aroused in South Australia by a difference of opinion that has unhappily found further ventilation in the columns of the press, between the government geologist, L. K. Ward, and Mr. Basedow, who was at one time assistant government geologist and has since been assistant government geologist in the Northern Territory. Mr. Ward, in the early part of the year, issued a bulletin in which he doubted the alleged discoveries of oil-bearing material on the northern coast line of the state. This naturally checked the flow of capital for the proving of those supposedly petroliferous areas; but the hopes of those who were concerned were revived by support of their theories from Mr. Basedow, who contradicted some of Mr. Ward's conclusions and said it would be a scientific mystery if so extensive a system of fossiliferous Tertiaries as obtained throughout the areas in question should not contain subterranean reservoirs of petroleum. Unfortunately a good deal of personal animus has been imparted into the discussion, and it seems to the impartial outsider as if personal animosities have had no small weight in the establishment of the differences of opinion that have been ventilated. It is now announced that an independent authority is to be appointed to inquire into and report upon the probabilities of South Australia having unknown oil reserves.

A bill has at length been introduced into the Victorian Legislative Council for the amending of the present state law relative to mining companies (no liability). The bill is mainly based upon suppositions and recommendations made over three years ago by a conference of the committee of the Stock Exchange of Melbourne, the Chamber of Mines of Victoria, and the mining attorneys. Its object is the better protection of shareholders and the public generally, and it provides penalties for the issuing of a false prospectus. It contains a clause providing that, before a company is registered and incorporated as a 'no liability' company, two-thirds of the proposed capital shall be subscribed and 5% of the capital subscribed must be paid in cash. It will be the duty of the manager to pay money and checks into the bank within seven days. Verified copies of the half-yearly balance-sheets and statements will have to be lodged with the registrar-general. Books of accounts, balance-sheets, and half-yearly statements are to be open to the inspection of shareholders in and creditors of companies. The manager will have to give all resaonable information to shareholders as to the working of the company. Another innovation is a clause providing that no director or manager of a company shall be personally interested in a contract for profit made on behalf of the company. This is one of the most important of the clauses, for the extent to which directors have pocketed secret commissions and sold machinery of their own to companies, the interests of whose shareholders they are paid to protect, has become a scandal. It is to be hoped that the measure will become law.

Newcastle, New South Wales, is not greatly alarmed at the threat that oil will invade the domain that has hitherto belonged to coal. In fact, it is even hoping to derive some benefit from the output of oil for motive purposes. Some weeks ago, a shipment of ten tons of three different local coals was sent to England to be tested under the Del Monte process for the production of motor oils. One of the coals, frm the Rothbury colliery, about 35 miles from Newcastle, was said to be rich in oil, and good results are expected from the trial. If the tests prove satisfactory, steps will be taken to erect a plant to treat the coal locally for the production of oil and by-products. The Rothbury colliery contains a large seam of coal, and estimates of the quantity under the area which is being worked vary from 50,000,000 to 100,000,000 tons. The seam gets thicker with depth. In any case, there is an enormous quantity of coal of the same nature as that sent to England to be tested, and if it is oil bearing, then there is enough of the mineral at Rothbury and under the adjoining country to supply Australia with oil for many years to come.

J. B. Jaquet, chief inspector of mines of New South Wales, has been reporting upon a new tinfield 60 miles west of Wyabong, and about the same distance northwest of the Ardlethan field. Though little work has been done, too small indeed for the forming of any very definite opinion, Mr. Jaquet does not hesitate to pronounce a belief in the future of the field, on the ground that it is traversed by genuine fissure lodes. The tin occurs in quartz along the junction of granite and slate, and in one shaft, which is down 50 ft., the lode is 5 ft. wide, with well defined walls. That being so, the prospects of permanence are certainly better than they ever were at Ardlethan. The new field is called the Conapaira.

It is not often that an old mine, when unwatered, proves up to expectations, but that seems to be the case with the Golden Springs mines, near Blayney, New South Wales. A good deal of ore was apparently left standing at the 250-ft. level, and a mining engineer of repute, who has reported upon the property, states that considerable work has been done off the lode, so that there is a probability of further work revealing an extension of ore that may prove very profitable, to say nothing of developments at depth. All the samples of ore taken have given good assays, varying from $6 to $17 gold per ton. The amount of ore immediately available cannot yet be determined, but there can be no doubt that the prospects of the Company are unusually good.

The inspector of mines of the Northern Territory has been examining mines east and southeast of Pine Creek, and is of the opinion that the usual custom of 'picking the eyes out' is being pursued, and that soon nothing will be left but low-grade ore and collapsed workings. It is due to the administration of the territory not insisting on timbering the underground workings, so that the danger of collapse may be avoided. As regards the other evil, it is difficult to see how it can be legislated against.

DULUTH, MINNESOTA

A NEW DRILL.—FIRST-AID WORK.—THE MINNEWAS MINE.

Apparatus recently introduced on the Mesaba Range, that promises to be of great value to underground mining methods, is the jack-augur drill. This drill is of the jack-hammer type, but has both a rotary and percussive action, using an augur bit. It will operate in ground that is too hard for hand augurs, what is called 'poke-bar ground.'

A bit about six feet long is used, and a two-pronged augur. The operator holds the drill against the face, the augur screwing the cuttings out. The rate of advance in this ground averages about a foot per minute, and one man operating the drill and going to different faces in the mine will drill about 50 ft. of holes in a four-hour shift. Where hard spots are encountered, the ordinary cross-bit is used. Trouble is frequently met by small pieces which break in the hole, and, turning with the bit, prevent its further advance. If the spoon will not go in, a flat-ended steel is inserted in the hole and the hard piece is broken with a blow or two from a sledge. In favorable ground it is possible to break enough ground for a set of timber, so that if the holes are properly placed room will be squared out with one round for a set of timber. This means from 10 to 12 ft. of advance per shift if the timber can be placed to render the place safe. The introduction of the drill will probably result in the organization at the mines turning from miners, as they are now, into drillers, shovelers, and trammers, with special timber gangs. At present the miners drill, shovel, and tram their ore, and put up their timber with the assistance of timber-

STEAM-SHOVEL AT ONE OF THE OLIVER MINES.

men. The gangs are mostly made up of two men per shift, and the rate of advance in hand-augur ground has been at the rate of from 3 to 5 ft. per day. With the contract system, as established on the range, it is not expected that this will make any difference with the labor, especially in view of the present decrease in production.

Bureau of Mines Rescue Car No. 8 has just completed its first round of the mines in its territory and gone back to headquarters at Ironwood, Michigan. The territory included in its district embraces the states of Minnesota, Wisconsin, and Michigan. Its trip on the Mesaba range was to Aurora, Biwabik, Gilbert, and Eveleth. This is the first government car to be situated in a metal-mining district, and is probably the forerunner of others to be placed as soon as funds for their equipment and maintenance are provided. The work done by the cars is to give instruction in first aid to the injured, and train men in the use and care of mine-rescue breathing apparatus. This instruction is given without cost to the companies or the employees. The car spends a week at each large property or group of mines, and instructs the men in the vicinity who wish to avail themselves of the opportunity. For the men who complete the course a government certificate of competency is issued. During this trip to the Mesaba range about 50 men were trained in the use of the oxygen-breathing apparatus, and about 150 in first aid. Since the car was brought to the Lake Superior district in December 1912, five or six hundred men have been trained in the use of the breathing apparatus, and about 1500 in the first aid to the injured work. In addition to this, the mining companies have been training their employees in the work, so that at the present time in the entire district it would not be wrong to assert that there are at least 1500 men trained in the use of the breathing apparatus and 3000 or 4000 competent first-aid men. The work of the car has met with approval, and a great interest has been taken in the work. The results of the work have been apparent on several occasions. The company physicians say that since the 'first aiders' began their work, the cases of infection have notably diminished. The use of the oxygen-breathing apparatus in metal mines has already prevented a great loss of property. In addition to the work of training, the district engineer has also visited probably 100 mines and made observations, chiefly with regard to equipment, methods, and conditions as to safety. The results of this work will be published in pamphlet form for free distribution. Nearly all the companies operating in the Lake Superior region now have safety organizations of some sort. Some have regular inspectors who look after the work and see that the rules are enforced. Some very comprehensive sets of rules have been published covering all classes of surface and underground work, and a great deal of money has been spent in protective devices. While in some cases the matter has rather been carried to extremes, the general result is beneficial, and with the campaign of education now being carried on it is thought that the percentage of accidents will be materially decreased.

The Oliver Iron Mining Co. is preparing to open the Minnewas mine, between Eveleth and Virginia. The Duluth, Missabe & Northern Railroad Co. has a steam-shovel at work grading for tracks, and foundations have been built for an engine and boiler house. This is a large property and will probably be operated as an underground proposition. The mine was worked a number of years ago, but only in a small way.

DEADWOOD, SOUTH DAKOTA

HOMESTAKE DIVIDENDS AND OPERATIONS.—DRILLING FOR OIL AT ARDMORE.

It is stated that the dividend rate of the Homestake Mining Co. next year will be 75c. per share per month, an increase of 10c. over the present year. The stock has recently sold in New York for $120 per share, the highest on record. Economies in operation, due partly to the successful operation of the Spearfish hydro-electric plant, and also to the new caving system of mining the surface ores, have made large profits available for dividends. Preliminary work on the new boiler plant, which will operate the steam-driven electric plant and the new hoisting engines at the Old Abe shaft, is well under way. Buildings are being removed and grading will shortly commence. With the new equipment at the Old Abe shaft, skips will be used for ore hoisting in place of the cages now used. It is apparent that this will effect a decided economy in delivering the ore to the rock-crushers.

At Ardmore, in Fall River county, near the southern boundary of the state, the Ardmore Oil Co. is sinking a well in the hope of finding an extension of the Wyoming fields, which lie in the same formation, directly westward. The rig is one of the best in the district, has a 72-ft. steel derrick, and as the hole was started with a 12-in. casing, it is stated that it will be possible to go 4000 ft., if necessary. A well sunk some years ago by a railroad company at this point, in a search for artesian water, is 1500 ft. deep and in the Benton shales for the entire distance, except that there was 30 ft. of sandstone, which produced a poor quality of water. This well was abandoned when the tools were lost. The Ardmore company has five-year leases on 30,000 acres of land. The leases carry a clause allowing privilege of renewal for 25 years. It is expected that a depth of 1500 ft. will be attained shortly after the first of the year, at which time some interesting results may be expected.

CALGARY, ALBERTA

PROSPECTS OF OIL IN THE PROVINCE

Further details of the oil rush in the neighborhood of Athabasca landing, Alberta, show that the excitement was caused by the operations of O. T. Ross, an oilman from California, who had been making investigations for some months. These convinced him that a deposit probably existed on the Athabasca river, about 50 miles northwest of the landing. He interested W. T. Shillington, a financier who has been connected with Cobalt mining enterprises, in the project, and staked several claims. A stand-

ard oil-drilling outfit will be taken in this winter, and work will begin in the spring. Mr. Ross states that they will be prepared to go down 4000 ft., though he does not anticipate having to drill anything like this distance. As soon as the public heard of the enterprise, a rush to take up claims in the vicinity set in, until over 300,000 acres were taken up on the chance that the operations of Mr. Ross and his associates may be successful. In the meantime, the efforts of promoters to organize companies on the basis of the find near Calgary appear to have fallen flat. The public is by no means speculatively inclined at present.

NEW YORK

BUSINESS STAGNATION.—LABOR AT LAKE SUPERIOR COPPER MINES.—GRANBY CONSOLIDATED DOME MINE.—DREDGING IN COLORADO.—SOCIETY MEETINGS.

Conditions in various industries in the country are bad, and reports from the Middle West are discouraging. The National Lead Co. has laid off three-fourths of its men, the American Car & Foundry Co. has followed a previous reduction of 250 by laying off 300 more men, and the National Enameling & Stamping Co. has reduced its working force one-half. Both the American Steel Foundry, at Granite City, Illinois, and the Corn Products Refining Co. have entirely shut down, throwing 2700 men out of employment. The Illinois coal mines have only been working three or four days a week for some time, reflecting the depressed condition of the iron and steel business. Altogether, everything points to a hard winter, and the mining men can console themselves with the thought that they are at least much better off than anyone else. Newspaper reports state that the mining companies are planning to import large numbers of miners into the Lake Superior district after the first of the year unless the strike is settled by that time. The strikers demand recognition of the Western Federation of Miners, the eight-hour day, and the abolition of the one-man drill. The operators are ready to agree to the eight-hour day, but the absurdity of the demand to give up the use of the one-man drill is shown by the fact that its use has cut the cost of stoping from nearly 50c. down to 15c. per ton. As a result, mines which would otherwise have had to shut down long ago are able to continue work at a small profit. Thus instead of the one-man drill robbing men of jobs, it is actually the means of giving employment to a large number of men, for, except for the Calumet & Hecla, practically all the Lake Superior mines work very low-grade material at an extremely small margin of profit. Everyone who has impartially considered the matter agrees that the Western Federation is unworthy of recognition, but it seems unreasonable to maintain that no union will be recognized. The miners are obviously entitled to organize themselves if they want to, and if a union were formed and officered by men of character and intelligence it is probable that both the operators and the miners would benefit by it.

As a contrast to the state of general business, it is pleasant to speak of a company which is more prosperous now than it has been. The Granby Consolidated reports that its operating profits for the four months ended November 1 amounted to $254,000. The work of building the new smelter is well advanced, and the date of beginning work is set at January 15. As an adjunct to the smelting work, a copper property, the ore of which carries excess lime, has been secured, and also limestone quarries for flux. The properties of the Snowshoe Gold & Copper Mines, Ltd., have also been taken over, the total investment in all these properties amounting to $275,000. The development in the Hidden Creek mines has proved a reserve of 8,000,000 tons of 2.2% copper ore.

Much interest has been excited by the report of the Dome Mines Co., Ltd., which shows that in November the 13,820 tons of ore milled yielded $121,100, or at the rate of $8.76 per ton, while the October yield was at the rate of $9.60 per ton, but from a less tonnage. As these yields compare with $6.50 per ton in September and $6.31 in August, speculation is keen as to whether the orebody of the 'big Dome' is showing a marked improvement which is likely to be persistent or whether the stopes are temporarily in ore of higher grade. It is no secret that the Dome has been decidedly disappointing, on the whole, and it is to be hoped that the better returns will persist. The officials of the Company maintain a sphinx-like silence, but as that has always been characteristic of the International Nickel Co., it is not particularly significant. International Nickel is at last beginning to feel the depression in the steel industry and reports a recession in business during the past two months. The Company is in a good position to stand this, though, for earnings this year are above what they were for the same period last year, and expenditures for new construction have been less.

A development of great interest which has attracted little attention is the news that the Tonopah Placers Co., a subsidiary of the Tonopah Mining Co., has taken over five new placer claims, aggregating about 3000 acres, in the Breckenridge district of Colorado. The Tonopah company has been looking for good properties for some time, and its venture into the placer-mining field is interesting both for that reason and because Colorado placers have not been much in the public eye of late. There are four dredges in the Breckenridge district, but only three were working last year, the Colorado Gold Dredging Co., a subsidiary of the General Development Co., having partly dismantled one of its 9½-ft. boats. This Company handled 1,270,400 cu. yd. in 1912, with an average recovery of 16.4c., at an average working cost of 5.6c. per cubic yard. The other two dredges are the *Reliance*, a 9-ft. boat working in French Gulch, and the Bucyrus boat of the French Gulch Dredging Co. As the total gold yield of the county in 1912 was only $426,000, these two boats cannot have contributed much to the total.

Cordiality of the relations existing between the Mining and Metallurgical Society and the American Institute of Mining Engineers, was well shown last week when the New York section of the Society and the recently organized coal and coke committee of the Institute met in adjoining rooms in the Engineers Club. The president of the Society, H. M. Chance, was chairman of the committee. After the committee had concluded its business it adjourned, in response to an invitation, to the next room and took part in the general discussion of the one-man drill, which was the topic of the evening.

JOPLIN, MISSOURI

PRODUCTION AND PRICES FOR 1913 COMPARED WITH 1912.—OVERCOMING HEAVY WATER IN SHEET-ORE DISTRICTS.—WORKING ABANDONED MINES.

The year 1913 will give an aggregate valuation for zinc and lead ores from the Missouri-Kansas-Oklahoma district close to $15,000,000, which makes it one of the big years of the district's history, despite the fact that unusually low prices have prevailed. Compared with past years, this figure, $15,000,000, is a good one. Only 1912 exceeded this output, the total valuation being slightly over $18,000,000. The year closes with zinc-sulphide concentrate selling for $35 to $40 per ton, basis of 60% metallic zinc; while premium grades, high in metallic zinc, sell as high as $42. Spelter at East St. Louis is weak at $4.90 to $5 per 100 lb. For the corresponding period of 1912 zinc sulphides brought from $53 to $56, basis of 60% metallic zinc, with the choicer grades selling as high as $59. Spelter was then quoted firm at $7.15. Calamine ore is in weak demand at $18 to $20 per ton, basis of 40% metallic zinc, with choicer lots selling up to $24. For the corresponding period of 1912, calamine brought $27 to $30, with the choicer lots bringing as high as $36.50. Lead ore is unsteady at $48 per ton, basis of 80% metallic lead; while pig lead, East St. Louis quotations, is unusually weak at $3.85 to $3.90. For the corresponding period of 1912 lead ore brought $53, and metal was quoted at $4.15. Several important development undertakings were launched this year. New mineralized areas have been opened in several parts of the district. The importance of soft-ground mining has been a great factor in maintaining a fair average for the district, as sheet-ground operations have lagged to a great extent, due chiefly to the low prices which have prevented this work at a profit.

The North Webb City sheet-ground field continues to be a good producer of zinc ores, although production has been curtailed to a great extent by low prices. In the average sheet-ground mine it is possible to extract the richer orebodies, leaving the thinner ground to be mined out when prices are at a figure permitting profitable development. Heavy water has forced the North Webb City operators to coöperate in the cost of maintaining a central pumping plant, which is being operated at the Providence mine. The shutting down of the Yellow Dog mine, early in 1913, caused water to rise in the abandoned drifts until the overflow is finding its way into the adjoining properties on the south, where operations are conducted at a depth of 200 feet.

After large companies have given up a lease, it is often profitable for individuals to go into the old ground and continue production. Often the restrictions of mine liability are such that a large company cannot afford to continue work in treacherous ground, fearing heavy losses from injuries to workmen; yet these same workmen, if employed on their own responsibility, will not hesitate to go into the same ground and mine out the rich deposits that have been left. They will face the risk of personal injury where big profits are assured. An instance of an old mine being a good money-maker for individuals is that of the Kramer company at Cave Springs, Missouri, where a large mill was operated for some time. Not that the ground was dangerous did the Company suspend work, but because ore prices became so low that a great bulk of the thin 'dirt' could not be handled at a profit. The individual operators, however, to whom the property has now been leased, are enabled to go into the old drifts and work only the richest pockets of ore that remain, and thus they are making the old mine a paying one again. The reduced cost of management is one of the chief reasons why individual workmen can operate profitably where a large company, with a big expense, could not succeed.

The mill of the Pocatella Mining Co., on the Snapp land at Thoms Station, has begun operations and is producing steadily. The ore contains a high percentage of metallic zinc and regular turn-ins are being made.

RHODESIA

Results of Mining Operations in 1913

The year now drawing to a close has been quite similar to 1912, in so far as mining operations in Rhodesia are concerned. There has been a further material, though not great, advance in mineral production; and also a continuation of the efforts initiated about three years ago, which are to bring six important gold mines to the productive stage in the near future. The situation in regard to native labor has shown no marked changes, but on the whole the position in this regard may be said to have improved somewhat. During the first nine months of the current year there has been £2,162,477 of gold produced. Other minerals were £180,172, making a total of £2,342,649, against £2,964,597 for the whole of 1912. The 1913 output may be figured at about £3,125,000, a record production for the country.

Trial runs of the new plant at Antelope mine, capacity 3000 tons per month, have been made, and both this property and the Bell mine will enter the producing list by the end of the year. There has not been such a serious scarcity of water as there was in 1912, and this has undoubtedly contributed toward the larger output.

There have been no sensational discoveries made during the past twelve months. Prospecting has continued with great vigor, but while numerous lodes, hitherto not located, have been opened, nothing that promises to develop into a large and profitable orebody has been found. In this respect the past year was an exceptional one, as in most of the past years there have been one or more reports of a sensational discovery, and which have in one or two instances been confirmed by subsequent development, but which in the majority of cases have proved to be quite uncalled for. In addition to the knowledge of the various mineral belts of Matabeleland and Mashonaland that is continually being added to by individual prospectors and small syndicates, the Geological Survey of Rhodesia has extended its sphere of investigation and has collected considerable valuable data.

H. B. Maufe, the director of the Survey, has closely examined the association of gold deposits with igneous rocks, and the results of his work are embodied in an important bulletin issued about the middle of the year.

In regard to the older and more or less established producing mines of the country, it must be admitted that 1913 has given many disappointments, the bitterness of which is reflected in stock exchange prices. The Eldorado Banket company, operating at Lomagundi, has had to reduce its yield and profit, as result of less favorable developments in the lower levels. The Giant company proposes to acquire the Cam block of claims hitherto belonging to the Cam & Motor company, and distinct from the Motor lode. This enterprise on the part of the Giant company's directors has been construed into an admission that all efforts to re-locate the faulted orebody in the Company's mine at Gadzema, have failed.

At to the leading producer of the country, the Globe & Phoenix at Que Que, while revenue, profits, and ore reserves have been fairly well maintained, there has prevailed a spirit of uneasiness among shareholders. For the reputation of the Company, it is good to learn that the directors have now agreed to accept a smaller percentage of the profits. It must be admitted that in the past their fees were very high. The Company has recently ordered extensive equipment for the new shaft and evidently further development will be undertaken. As to other gold mines, the Lonely Reef has had another satisfactory year. At the end of June the ore reserves aggregated 184,000 tons averaging over one ounce per ton. The Rezende mine, which now includes the Penhalonga, also had a good year, recent profits having been at the rate of £2600 per month. As to the new and large gold mines which are expected to enter the producing stage within the next month or two, there appear to have been some delays in the delivery of machinery; but at both the Shamva and Cam & Motor construction work has reached an advanced stage. The essential features of these plants have already been described. Each proposition is in a strong position as regards development. At the end of June last, the Shamva's ore reserves amounted to 2,300,000 long tons worth $5 per ton; while in the Cam & Motor there are nearly 1,000,000 tons of over $10 ore blocked out. The Falcon, a large gold-copper property in the Gwelo district, is also being equipped and should help to swell the mineral output of Matabeleland next year. This mine has recently come into one unfortunate notoriety on account of discrepancies in assays between sampling made by the owners of the mine, and Messrs. Ackermann and Pickering of the British South Africa Co.'s mining department. Ore reserves at the end of June last year were stated officially to be 817,000 tons, valued at $11.76 per ton. In regard to the smaller gold mines of the country, those operated by syndicates, working owners, and limited liability concerns, with small capital, reference must be made to the continued good returns by the Pickstone gold mines in the Hartley district, and the high yields of the Criterion, Bulawayo.

The production of minerals other than gold has been principally made up of coal and chrome iron ore. The Wankie company's mines, in northern Matabeleland, have again been the only producing collieries in the country, and in addition to supplying the larger number of important mines in southern Rhodesia with coal, these collieries have also during the past year sent considerable quantities of coal and coke to the Tanganyika Concession's copper mines at Katanga, Belgian Congo. The Selukwe mines continue to export chrome ore. Production is regulated by shipping facilities at the port of Beira. In August chrome ore worth £26,143 was exported. During the first eight months of the year, diamonds worth £1759 have been found on the Somabula 'diggings.' There have also been satisfactory outputs of lead, silver, and asbestos, as in former years.

As to labor, it is worthy of remark that the Rhodesian Native Labor Bureau has first decided to remove from Bulawayo to Salisbury, and thus reduce expenses.

General Mining News

ALASKA

Cordova

The *Cordova Daily Alaskan* gives the following distances to the new placer districts. McCarthy to Shushana is the winter route. From Cordova to McCarthy, on the Copper River & Northwestern railway, the distance is 191 miles. The distance from Chitina to Chisana or Shushana is 225 miles.

	Miles.		Miles.
Chitina	0	McCarthy	0
Bull's roadhouse	9	Nizina roadhouse	14
Nafsted's roadhouse	15	David & Vogt roadhouse	18
Woodland	26	Foot of Nizina glacier	30
Willow creek	39	Homestead roadhouse	30
Copper Center	50	Mrs. Hill's roadhouse	33
Tazline	58	McLeod's roadhouse	33
Dry creek	66	Jas. Clark's roadhouse	42
Gulkana	76	'Shorty' Gwin's roadhouse	46
Gulcona	80	Summit of Nizina glacier	50
Tolsona	98	Relief station	52
Chistochina	116	Boggs & Young roadhouse	57
Indian creek	128	East Fork glacier	59
Mouth of Salana	146	End Chisana glacier	68
Batzuneta	155	Boggs & Young roadhouse	69
Jack creek	175	Mouth of Johnson creek	73
Nabesna	195	Mouth of Wilson creek	78
Shushana	225		

Juneau

A bonus dividend, No. 104, of $1 per share will be paid by the Alaska Treadwell Gold Mining Co., on December 29.

ARIZONA

Mining men of Arizona are pleased with a recent ruling of the General Land Office which requires that when an application for patent on a mining claim has been made, the proof submitted therewith shall be considered on its merits, and a certificate issued if it is found regular, regardless of any protests that may have been filed. Heretofore when an application has been presented, regular assessment work has been required till all protests were passed upon and patent issued. This assessment work, in addition to the work necessary to secure a patent, has in many cases worked a hardship. After this an applicant shall receive a certificate upon making his application, though the patent is withheld till protests are passed upon. No additional assessment work is required.

Graham County

(Special Correspondence.)—The Stanley and Aravaipa mining districts cover an area of over 6 by 30 miles, and as the surface showing on the various copper claims is promising, the claim-holders continue to work in the hope that there will be better communication for the districts. Freight by wagon, 18 miles from San Carlos, costs 1 cent per pound. Several miners are extracting ore which averages 12% copper and 5 oz. silver, and hope to make this pay by shipping to El Paso. A good road can be easily constructed a distance of 25 miles, making direct connection with Globe to Bisbee.

Stanley, December 13.

Mohave County

The Copperville mill is in full operation. The distance between Yucca and the mines is 25 miles, covered in four hours by auto-trucks. Crushing in the 150-ton plant is done by a Symons disc machine and Hardinge ball-mill, while concentration is by 14 Overstrom tables. Power is generated by a 150-hp. generator driven by a Metz and Weiss oil-engine.

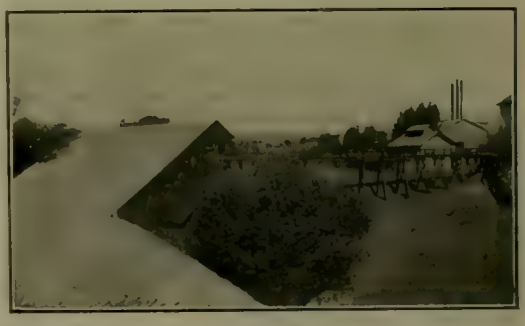
Yuma County

A carload of ore from the Bouse & McMahon mine, six miles southwest of Bouse, returned gold worth $11,500 at the Selby smelter, near San Francisco. There is considerable activity about this place, which has been named Goldzone.

CALIFORNIA

Amador County

A circular has been issued by the Keystone Mines Co., of Amador City, containing the position of affairs as given by the manager, C. R. Downs. An ore-shoot was opened on the 900-ft. level north drift, 700 ft. from the main cross-cut. A raise is up 40 ft., and the vein is well defined with profitable ore. It was decided to reopen the 1200-ft. level on this vein, and ventilating pipes were placed in position. The north drift was badly caved, and after 180 ft. of repairing, it was too difficult for further work, so a new drift was driven in the foot-wall of the old workings. On December 17 this was in 265 ft. The 2600-ft. level was sampled and assayed, and it was decided to drive an inclined raise on the vein, as it was figured that it had faulted. At 40 ft., this theory was proved to be correct, and there is 10 to 12 ft. of good ore, with promising conditions. A total of 871 ft. was driven and cross-cut, in addition to the raise, since the last report.



ZEILA MINE AND MILL, NEAR JACKSON.

The secretary, C. L. Culbert, states that receipts from June 10 to December 10, 1913, were $36,372, and cash on hand at the latter date was $3829.

With the exception of installing motors, the tailing-disposal plant at the Kennedy mine is complete. It is reported that Oakland people have secured an old mine in the county, and intend developing and equipping it at once.

Butte County

The South Banner Mining Co., owning quartz and gravel mines six miles from Oroville, in the Morris Ravine district, has secured further capital from London to develop its property.

Eldorado County

It is reported that 1200 acres of land, between a point several miles below Plymouth and the Cosumnes river, and extending toward Latrobe, have been bonded by the Guggenheim interests, who will build a large dredge in the near future.

Inyo County

A California company is about to drill for potash at Ryan, in the centre of Death valley. E. V. Gamble, head driller for the Railroad Valley Company of Nevada, is in charge of operations.

A fine-grinding and cyanide plant is to be erected at the Bishop Creek mine, equipment being supplied by the Colorado Iron Works. The remodeled mill will be as follows: 10 stamps, 45-in. Akins classifier, 5 by 16-ft. tube-mill in closed circuit, thickeners, agitators, and a 12-ft. Portland filter. E. Walter is superintendent.

Modoc County

There will only be about 40 men in the High Grade district during the winter. In the Modoc Mines Co.'s 50-ft. level a vein has been opened for 150 ft., and at 100 ft. depth the drift is in 75 ft. in fair ore. The main shaft is 200 ft. deep. Twelve men are employed. The Consolidated Mines Co. has four men working. The Dandy, Bergen, White Star and Mineral Springs, Evening Star and

Alturas, Tamarack, and others, will be developed by their respective owners during the season.

NEVADA COUNTY

A mass of gold and quartz, valued at $700, has been extracted from the Red Ledge mine near Washington. The specimen was exhibited at Grass Valley. At the Oustomah, sinking is still in progress. At the Golden Center, Grass Valley, 17 men are employed. The shaft is down to 500 ft., and rapid progress is made in using Leyner drills. A new stamp-mill is being built by Robert Hathaway, of Nevada City, and early in January it should be ready.

PLUMAS COUNTY

The owners of the Plumas-Eureka claims at Johnsville are preparing to increase the yield next spring. Six miles from Portola, rich copper ore has been discovered. Work is to be resumed in the Poker Flat shaft, which is down 800 ft. in lava. The Claybank gravel claims are being developed again. The Black Diamond quartz mine, on the ridge between Hopkins and Slate creeks, has been bonded to M. Duvall.

SHASTA COUNTY

Various reports have been current regarding the new mill for the Mountain Copper Co., which is to have a capacity of 250 tons per day, and will include concentration and probably the flotation process.

TRINITY COUNTY

The Weaverville *Weekly Trinity Journal* of December 6 has a special supplement illustrating the mineral and other

GLOBE MILL AT DEDRICK, TRINITY COUNTY.

resources of this county. In 1912 the gold yield was valued at $723,503. There were 85 producing mines and 59 placer properties, the former yielding 57,307 tons of ore and gold worth $257,357, and the latter $466,146. The Headlight mine, at Carrville, is the principal deep mine and is equipped with a 250-ton mill and cyanide plant. Other mines are the Blue Jay, Golden Eagle, Deer Lick, Rams Horn, and Golconda. At Coffee are the Battle Peak, Gold Ridge, and Mule.

At Deadwood are the Brown Bear and Readjuster, the former being opened by long adits. The Globe is at Dedrick, while at Denny, Douglas City, Lewiston, Minersville, Quinby, and Trinity Center are numbers of small mines. The Alta Bert Dredging Co. has the most productive placer property. This at at Trinity Center. At Weaverville is the well known Lagrange hydraulic mine. Other placers of importance are the Big East Fork hydraulic, at Dedrick; Browns Ranch hydraulic, Trinity Consolidated hydraulic, at Douglas City; Chapman hydraulic, at Junction City; Trinity Dredging Co., at Lewiston; Sykes hydraulic, at Trinity Center; and Five Cent mine of the Trinity Consolidated Hydraulic Mining Co., at Weaverville. In Trinity county, as in Siskiyou, there are no restrictions requiring the impounding of the mining débris, as these counties are outside the drainage basins of Sacramento and San Joaquin rivers, where the government restriction applies to this character of gravel mining on navigable streams. These details are given in a report recently issued by the U. S. Geological Survey, and were compiled by Charles G. Yale.

The Trinity Consolidated Mining Co. has started work on fitting up its placer mines for the season, and has employed all the available miners. Its properties consist of what are known as the Hupp and Union Hill mines.

TUOLUMNE COUNTY

(Special Correspondence.)—A 4-stamp mill, purchased from the owners of the Nervi mine, is being installed at the Sonnet mine, above Columbia, operated by R. C. Davis and associates. The long 8 by 8-ft. adit to drain the workings of the Springfield Tunnel & Development Co., near Columbia, has been driven 50 ft. during the progress of the work of installing the compressor and other machinery at the site. The working force will be greatly increased soon, when better progress will be made. A certificate showing that the Company has increased its capital stock from $200,000 to $500,000 was recorded in this county this week. It is reported that a body of high-grade ore has just been opened in the 500-level drift at the Dreisam mine, at Arastraville. The property is operated by James E. Conde, the owner. The Street mine, at Tuttletown, is being dewatered for inspection by T. J. Russell, who, with others, will resume operations at the property if satisfied with prospects. B. W. Rhay, G. A. Waddle, Robert Jameson, and John Brill, of Marysville, are developing a mining property on the App ranch, near Jamestown, and this week inspected operations to determine the advisability of conducting work on a more extensive scale. Some high-grade ore was recently uncovered in the Carlin mine, near Jamestown, operated by the Jamestown Exploration Co. A sufficient quantity of the ore is in sight, it is said, to insure the continuance of development operations. The property of the Cherokee Gravel Mining Co., situated at Cherokee, north of Tuolumne, is to be reopened for further development. The long adit started years ago will, it is understood, be driven to cut an old shaft, the bottom of which had reached a rich gravel deposit. Unable to handle the water which entered the shaft, the early-day miners were forced to abandon the undertaking before much gold was taken out. The owners of the property are confident of ultimate success, but considerable money will have to be expended in dead work before reward is theirs.

Sonora, December 6.

The Gold Ridge group of claims, locally known as the Jones' properties, situated a little northeast of the Shawmut mine, is being examined by W. H. Adams. The property was recently bonded by Henry T. Gage, ex-governor, of California, at a purchase price of $60,000, with time privilege of payment.

COLORADO

CLEAR CREEK COUNTY

(Special Correspondence.)—Hendrie & Bolthoff, operating a property near Dumont, are grading for a 100-ton mill that is to be erected soon. A new boarding-house has just been completed. W. H. Barrick is manager. Shipments have been started from the Captain Jack property, situated on Ohio mountain. The smelting ore is worth $40 per ton in gold, silver, and lead. J. R. Richards is

manager. Hayden & Co., leasing on the Young America, on Red Elephant mountain, are shipping ore that mills $75 per ton in silver and lead. Work is being conducted through the White adit. Shaffer & Co., leasing on No. 14 level of the Gem mine on Seaton mountain, is shipping an average of 1000 tons of mill ore per month. The product is being consigned to the Newton mill. G. W. Ford has secured a lease upon 500 ft. of ground on the East Bellman vein. Operations will be prosecuted through the Central adit. Work was resumed this week on the Lake property, one of the former heavy producers of the district, and work was started last week on the Argus property, situated on Chicago mountain. The adit that has been driven 1100 ft. will be continued on into the hill. J. T. Mallalieu is manager. Rendahl & Co., leasing on the Anamosa mine on Columbia mountain, is making large shipments of 140-oz. silver ore. Stoping is in progress on a shoot that is 14 in. wide. R. D. Blair, owner of the Castle Rock property at Freeland, is doing development work. A new cross-cut has been started that is figured to undercut the shaft workings by 150 feet.

Idaho Springs, December 7.

GARFIELD COUNTY

On December 16, 38 miners were killed by an explosion of gas in the Vulcan coal mine at Newcastle. Relief work was rushed as soon as possible, but too late to save anybody. Two men, out of 40 on shift, escaped from an upper level of the mine.

PARK COUNTY

It is reported that the Mineral Park, Camp Bird, and Weber claims are to be opened in the spring. The Columbian is being worked under lease.

TELLER COUNTY (CRIPPLE CREEK)

The anuual report of Stratton's Independence, Ltd., contains the following:

Ore treated, tons	130,110
Gold output	$302,000
Profit	115,000
Ore sales on Company account, profit	67,000
Ore sales on lessees' account, profit	53,000
Dividends	120,000

Mine development opened no new ore-shoots, and lessees' production declined, and is likely to decrease. A working profit of $7000 per month is all that is figured on for the future.

At the beginning of December the Roosevelt drainage tunnel was yielding 6700 gal. of water per minute. A new measuring weir is to be constructed at the portal. The Dexter shaft on Bull hill is down 1217 ft., and a station is being cut at 1200 ft. Lessees are shipping ore regularly to the Golden Cycle mill.

IDAHO

The total mineral production of Idaho in 1912 was $21,816,390, according to E. W. Parker, of the U. S. Geological Survey. The increase over 1911 was $3,374,845. Lead constitutes about 60% of the total mineral output of the state, the production for 1912 being valued at $12,788,355, an increase of $523,311 over that of 1911. About 94% of the refined lead came from the Coeur d'Alene district, in Shoshone county, the centre of the mining industry of the state. As a lead producer, Idaho ranks second among the states, Missouri being first. Second in importance in the mineral products of the state is silver, the value of which in 1912 was $5,101,268, an increase of $757,316 over the value in 1911. Shoshone county yields 91% of the silver output. The value of the gold produced in 1912 was $1,381,214, against $1,372,387 in 1911; that of copper was $1,236,205, against $644,117 in 1911; and that of zinc was $959,479, against $475,394 in 1911. Idaho also produced in 1912 nonmetallic products valued at $339,716, consisting of clay products, coal (lignite), gem materials, lime, mica, phosphate rock, salt, sand, gravel, sand-lime brick, and stone. The non-metallic resource of greatest promise is phosphate, large deposits of which occur in the southeastern part of the state and extend over into northeastern Utah and southwestern Wyoming. As the agricultural industries of the Western states are developed this necessary fertilizer should become one of the important items in the mineral production of Idaho.

SHOSHONE COUNTY

The Stewart Mining Co. will pay a dividend of 10% on December 29. The land in the Pine Creek district is more valuable for mineral than for any other purpose, according to the decision of the federal land office at Coeur d'Alene in the case brought by the Constitution Mining Co. against H. Lester Gilliland, who filed a homestead claim on the property, the mining company protesting. The decision in part reads: "Without setting forth in detail the testimony as to the mineral character of the land, we find that the evidence is sufficient to show that the land embraced within the American Girl, Percy, Fred, Defender, Crescent, and Comet lode claims is more valuable for mineral than for any other purpose, and we recommend that segregation survey be ordered."

MICHIGAN

HOUGHTON COUNTY

Having to tram its ore over a long distance, the Champion Mining Co. has decided to install electric locomotives underground. Ten have been ordered and six have been delivered by the General Electric Co. Hardinge mills are being installed in the mill.

NEVADA

EUREKA COUNTY

The Buckhorn mill is complete, and will probably be started before the end of the year.

HUMBOLDT COUNTY

Ten carloads of ore, totaling about 350 tons, having a gross value of $10,500, is shipped daily from Rochester to custom works. Rich ore has been opened in the Cole, and lessees are doing well.

The Kramer mine at Golconda has been sold for $350,000 to J. T. Sullivan and J. Berger and others of San Francisco and Seattle. The property consists of six claims. S. H. Crittenden is surveying the mine.

LYON COUNTY

The Casting Copper orebody of the Nevada-Douglas mine continues to yield 130 tons per day of ore containing 8.5% copper. The development work for the past week has extended the orebody about 50 ft. in a southeast direction. It is extending on a flat dip into the limestone mountain with the ore remaining the same grade. Raises are being driven from the 200-ft. level to cut this ore on its dip.

LINCOLN COUNTY

The right of way for the new tramway of the Day-Bristol company is cleared, and grading for towers has been completed. This line will connect the mines on the Bristol side with the terminus of the Pioche-Pacific railway, on the other side of the ridge. The line is 9125 ft. long, has a rise of 300 ft. to the summit, then a fall of 900 ft. to the railway. A 15-hp. Alamo oil-engine will drive the ropeway, which has a capacity of 15 tons per hour. It is constructed on the Broderick & Bascom system.

NYE COUNTY

At Pioneer, the Pioneer Consolidated mill is in operation treating from 50 to 60 tons per day. During November, the following outputs were made:

	Tons.	Yield.	Profit.
Belmont	14,825	$266,618	$161,388
Jim Butler	1,500	.....	7,153
Tonopah	12,011	220,775	137,470
West End	4,539	.....	36,605

STOREY COUNTY

The annual report of the Ophir Silver Mining Co. contains the following information: The mine produced 4455 tons of ore yielding $24.62 per ton, and there was 2227 tons of tailing treated at the cyanide plant. The total yield was valued at $163,552. On No. 16 level the southwest drift was retimbered, and parts of the 1800, 2000, and 2300-ft. levels were repaired. Development was done on the East and Hardy veins at 1600 ft., but stopped through lack of funds.

An understope on a shoot of the Hardy vein at 2400 ft. yielded good ore. A fair amount of work was done on the 2500-ft. level. The cyanide plant treated 31,509 tons of tailing from nine different sources, yielding $99,494. The cost of treatment was $1.75 per ton. Average recoveries were 92.91% of the gold, and 75.01% of the silver, based on actual bullion produced.

White Pine County

The safety department of the Nevada Consolidated reports 72 accidents during November, 34 at the mines, 17 in the mill, and 21 at the smelter and shops. There was only one death, a man being crushed by cars at Copper Flat.

OREGON

Josephine County

(Special Correspondence).—At the Oriole mine, in the Galice district, a large number of men is busy with deep development and erecting a new 10-stamp mill. J. C. Mattison is manager. In addition to the reduction plant, concentration and cyanidation is also to be used. Power will be supplied by water and steam, and the mill will be crushing ore within 60 days. As the ore of the Oriole is soft and friable, the 10 stamps will easily reduce from 40 to 50 tons per day. The Oriole has now a mile of underground workings, and is one of the best developed quartz mines in the Galice district. In opening the property a considerable quantity of shipping ore was extracted, and this has been shipped to Tacoma for treatment. There is enough profitable ore in reserve to keep the new plant running for a considerable time.

The Silver Creek district, in the western part of the county, is showing unusual activity this season, both in quartz and placer mining. F. L. Mangum, manager of the Old Glory, is employing men on development through the winter. The Old Glory is a large low-grade proposition, containing gold, copper, and silver, gold being the predominating metal. F. V. Metts, owner and manager of the Metts hydraulic mine, of Silver creek, reports that his property has been in steady operation for some time, and that the present season promises to be an excellent one, not only for the Metts, but for many of the placers of western and southern Josephine county. It is figured that the falling off of the surface gold yield, as shown by last year's figures, will more than be made up this season, because of the extended run and richness of ground on which many mines are operating.

Deep snows are putting a check on the development of claims on the Siskiyou range, particularly in the upper Sucker Creek districts above Holland, where a number of rich discoveries were made late in the fall. Work on these will be resumed in the spring. The snow is proving of great benefit in maintaining a steady water supply for the placers, and assure an extended run in the spring.

Grant's Pass, December 20.

SOUTH DAKOTA

Fall River County

(Special Correspondence.)—The Ardmore Oil Co., at Ardmore, started well No. 1 on November 1. In the neighborhood is some oil seepage and the characteristic shales of the neighboring Wyoming fields of Salt Creek and Lander.

Ardmore, December 15.

Lawrence County

While the gold production of the Black Hills district of South Dakota is smaller for 1913 than for the previous year, economic results, measured in dividends, are the greatest in the history of the area. Among the dividend payers the Homestake heads the list, with a total distribution in 1913 of $2,167,620, as against $1,310,400 in 1912. Wasp No. 2 paid $55,000, and a large number of close corporations and small operators and lessees accumulated profits which have not been made public.

Considerable new work is planned for next year by the Homestake company, among the most important of which will be an auxiliary steam-driven electric-generating station and a new hoisting engine for the Old Abe shaft. Both of these will be driven from a centrally placed boiler plant. The new hoisting equipment will be the finest in the Black Hills, and will be capable of handling material from a depth of 5000 feet. It will be installed at the Old Abe 5-compartment shaft, which has recently been equipped with an electric pumping system, a most complete installation with all units in duplicate. With the new hoist in operation skips will replace the cages so long used for hoisting ore at this property. It is estimated that improvements contemplated for 1914 will cost nearly a quarter of a million dollars. The Wasp No. 2 operated 8 months and 20 days in 1913. The property was closed during March, owing to cold and stormy weather, and on October 20 a shortage of water forced a suspension of work for the balance of the year. The Golden Reward mill at Deadwood was operated continuously at full capacity through the year. The Company owns a large territory in the Bald Mountain district. A good area of this property is operated by lessees, the Company milling the ore for them. The Company will soon erect a new mill, but whether it will be at the Astoria mine, where a large orebody has been developed, or at Deadwood, has not been decided. The Astoria ores differ materially from anything previously found in the district, and to treat them a Wedge oil-fired roasting furnace has been erected. Some tests have been made, but the plant is not now in operation.

Pennington County

(Special Correspondence.)—At Keystone, mica and the lithia minerals are being mined. Regular shipments of scrap mica are being made from a number of properties in the district, and the present good market promises a continuation of activity. The Etta mine in 1913 produced the lithia minerals, spodumene, lepidolite, and amblygonite. They are shipped to Jersey City for treatment. The Continental Copper Co. resumed work on its property late in the fall. The 800-ft. shaft is to be continued. The Otho Co., at Spokane, is erecting a mill which it is hoped to have in operation early in 1914. The Gold King company in the Rohford district, did considerable development work, with encouraging results.

Keystone, December 15.

UTAH

Summit County

On December 23, the Silver King Coalition Mines Co. of Park City paid 15c. per share, making a total of $2,347,385 by the present Company, and $13,022,385 by this and the old company.

WASHINGTON

Ferry County

Ore mined in the Republic district is the largest since it was opened. Increased tonnages are coming from the Quilp, Surprise, Lone Pine, Ben Hur, and San Poil. On the 600-ft. level of the Ben Hur, $9.20 ore has been opened.

Okanogan County

Rich gold-bearing ore has been discovered at Chesaw, 125 miles northwest of Spokane, chiefly at the Eagle and Reco properties.

Stevens County

A small furnace was blown-in on December 14 at the Copper King mine, near Chewelah, to determine whether the ore was self-fluxing or not.

WYOMING

Fremont County

(Special Correspondence.)—The American Fireproofing & Mining Co. has been organized to operate some of the partly developed gold claims in the Lewiston district. Charles M. Hampson, of Denver, has been retained as consulting engineer, and has just completed a series of tests to determine the best treatment of this peculiar ore. While the gold is to all appearances free, it has been ascertained that amalgamation will save only 10% of the content, yet there is so much coarse gold that it is impracticable to cyanide the entire product of the mine; therefore it is probable that a combination treatment will be resorted to. The ore will be crushed to 12 mesh and amalgamated, the pulp reduced to 150 mesh, and the continuous agitating

cyanide process will be adopted. Over $1,000,000 in high-grade ores is estimated to be available for milling. Much of the ore in the Bobtail claim will average about $100 per ton, and tests show that 97% can be saved by the process mentioned. A small mill will be at once erected with a capacity of 50 tons per 24 hours, and plans at once commenced for a larger plant. A hoisting and compressor plant is already on the property.

Denver, Colorado, December 12.

CANADA

British Columbia

Zinc ore and concentrate from the Slocan district in November was 2773 tons, and a total of 6545 tons for the 11 months. The Queen Victoria mine, near Nelson, shipped 25,946 tons of ore to the Greenwood smelter during the same period. A dividend of $2 per share has been declared by the Consolidated Mining & Smelting Co., which operates several mines in the province and a smelter at Trail. Distributions during 1913 totaled $464,352. High-grade silver-lead ore has been opened in the Treasure Mountain mine, in the Leadville district.

Ontario

(Special Correspondence.)—The Associated Gold Mines of Western Australia has taken an option on the North Thompson, and, when the Crown Reserve allowed its option on the Vipond to lapse, the Associated took an option on the Vipond. On the North Thompson, two diamond-drills are at work, and a shaft is being sunk on the extension of one of the rich Vipond veins, that in the shaft is showing considerable free gold. The Nipissing Mines Co., which has an option on the St. Paul, Hewitt & Hull claims in Bartlett and McArthur townships, has completed new camps, and is going ahead with the preliminary development of the above claims. The Lally gold mines, in Turnbull township, has finished the construction of a winter road from Sandy Falls, and as soon as the weather is suitable, will

CROWN RESERVE MINE, COBALT; KERR LAKE, WHICH HAS BEEN DRAINED, IS IN THE FOREGROUND.

take in machinery and supplies for continuous development work during the winter months. The Wittsky-Cling Syndicate, which owns claims in Whitesides township, has commenced the construction of a winter road to its claims, which are about fifteen miles west of Bristol Landing, on the Mattagami river. A 50-ft. shaft has been sunk on a vein traced about 700 ft., and which shows gold content varying from $4.90 to $63 per ton.

The extraordinarily mild and very unseasonable weather is retarding development work in the outlying districts, owing to the impassibility of the trails. The Mattagami river is clear of ice again, and almost all the snow has disappeared.

Mattagami Heights, December 4.

The Dome mill treated 13,820 tons of ore in November, yielding gold worth $121,100. This makes a total of 90,860 tons and $829,202 since April. Diamond-drilling on the 200-ft. level of the Hollinger has proved an extension of the main orebody. During December the Company paid two dividends totaling $180,000.

The Kirkland Lake Proprietary, Ltd., has been formed in London with a capital of £200,000. C. A. Foster, of Haileybury, is largely interested. The Teck-Hughes Co. has been acquired by the Company, and other transactions are pending. The Hurricanaw gold-mining district is near Keniwisik, 55 miles south of the Transcontinental Railway. People who have recently returned from there, speak well of its possibilities.

COLOMBIA

Withdrawal of the concessions of the Pearson syndicate has opened a wide oil territory to other interests, and several American syndicates are already in the field. One of them is headed by William Potts, of California. Another, the Colombian Land & Industrial Co. of New York, has secured large holdings in the Magdalena valley. The American Colombian syndicate, headed by C. E. Holaby of New York, is buying land, as are also the Colombia Syndicate, Ltd., the Standard Oil Co., and the Caribbean Oil Co. Both public and private lands are available for development.

The General Development Co. of New York has taken an option on a large area of alluvial ground on the Neché river south of Pato.

COSTA RICA

The Abangarez Gold Fields company reports as follows for October:

	October.	Year to date.
Ore crushed, tons	5,958	54,435
Tailing leached, tons	540	5,332
Slime treated, tons	4,970	44,759
By amalgamation	$ 9,356	$108,133
By cyanidation	40,516	366,017
Total bullion	$49,872	$474,151
Cost of operation, marketing, and administration	46,986	500,889
Profit	$ 2,886	*$ 26,738
Betterment expenditure	$5,587	$66,767

*Deficit.

During the same period of 1912 the deficit was $92,370, and $194,769 was spent on betterments.

KOREA

The Oriental Consolidated Co. reports the following results in October, 1913:

Stamps working	240
Time, days	27.4
Ore crushed, tons	27,178
Gross receipts	$137,626
Operating costs	88,287
Operating profit	$ 49,339
Cost of improvements	7,545
Net profit	$ 41,794

MEXICO

Sonora

The Tigre Mining Co., operating at El Tigre, reports the following output during November:

Stamp-mill crushed, tons	5525
Cyanide plant treated, tons	6942
Revenue from shipping ore, concentrate, and bullion	$127,675
Total expenditure	77,685
Estimated profit	49,990

On December 4 bonds worth $23,000 were purchased, leaving $49,600 outstanding. On December 20 a dividend of 6c. per share was paid.

At La Cobriza mine, at Noria, about 100 miles south of Nogales, a furnace of 150-ton capacity will be blown-in early in January. A 100-ton concentrating plant will also be erected to treat the low-grade copper-silver ore. Fifty men are employed under Robert Mitchell.

The following ore shipments were made through the 'port' of Agua Prieta during November: Nacozari, 13,491 tons; El Tigre, 214; Swamp Queen, 8; La Sonora, 101; La Alemana, 48; San Carlos, 10; San Pablo, 18; Monte Cristo, 10; La Union, 25; Good Enough, 19; Crestoncito, 4; Santa Rosa, 41; Ventana, 42; and El Vaguero, 27; a total of 14,058

tons. El Tigre shipped 62 bars of gold and silver bullion weighing 9748 lb. Estimated values, in Mexican money, of ores and bullion were: copper, ₱2,119,400; silver, ₱806,700; and gold, ₱259,600; a total of ₱3,185,700. The Greene Cananea has paid a dividend of $1 per share. Four furnaces are running and a total of 2500 men are employed in the district.

NICARAGUA

At the annual meeting of Camp Bird, Ltd., in London on November 17, some details were given regarding this Company's interests in the republic. A 40% interest has been accepted in a syndicate of the Canadian Agency, Ltd., of New York. The properties have been examined on two occasions by the Camp Bird company's engineers and have been favorably reported on by them, and their reports have been entirely endorsed by R. J. Frecheville. The properties consist of five groups of mines in Nicaragua, known as the Bonanza, Mars, the Lone Star, Siempre Viva, and Colona. The Bonanza and the Mars have mills and plant of 75-ton daily capacity and have, during the past 10 years, produced

MAP OF NICARAGUA.

over 200,000 tons of ore at a yield of about $1,920,000. Operations, being handicapped by lack of funds and by expensive transportation, have only been on a small scale, the light equipment not being sufficient to treat the hard material after exhaustion of the soft surface ores. Orvil R. Whitaker was commissioned by the directors to make an exhaustive examination of these properties, and after visiting the properties with a staff of engineers, he strongly recommends their purchase and further development. Mr. Whitaker reports that the aggregate length of known ore-shoots in these groups is 20,500 ft., the average width of the veins being about 15 ft., and that there are now in sight above drainage level approximately 2,400,000 tons of positive and probable ore, all of which can be mined by means of open-cuts and adit levels, of an average grade of $6.66 per ton, from which a profit of $5,000,000 should be obtained. There is no payment for working the bond and lease of the claims for a year, only a rental of $6000 per month. Provided all titles are clear, the syndicate must pay $369,000 at the end of the first year, and if all is satisfactory the balance of $753,600 is to be paid a year later.

PHILIPPINE ISLANDS

Australian dredging companies in the Philippines promise well, according to *The Bulletin*, Sydney. The Gaumus company is getting $38,000 worth of gold per month from gravel worth from 48 to 60c. per yard. The Philippines Dredging Co. has 1000 acres, and is working one small dredge on 48c. ground. Three other dredges are building to work gravel worth 24c. per yard. Excellent prospecting work has been done by the Umeari company, which has 1600 acres on the Umeari river lower than and adjoining a Manila company which is getting 96c. per yard.

Personal

R. G. Hall is at Boston.

William Hague is in New York.

Spencer C. Browne, Jr., is in San Francisco for the holidays.

J. B. Tyrrell is in England, but is expected home before Christmas.

A. D. Wilcox, of Goldfield, is ill at the Lane hospital in San Francisco.

H. P. Henderson has removed his offices to 66 Broadway, New York City.

G. A. Duncan has gone to Santa Monica, California, from Nelson, Nevada.

C. W. Van Law, of Pachuca, Hidalgo, Mexico, is now in Boston, Massachusetts.

A. D. Sproat, formerly of Chillicothe, Ohio, has moved to San Antonio, Texas.

C. B. Whitwell is examining the Red Cross mines, at Dobbins, Yuba county, California.

Frank R. Porter, owner of the Porter Placer Co., at Grass Valley, has gone to Pasadena, California.

Jesse J. MacDonald passed through San Francisco this week on his way to Los Angeles from Garfield, Utah.

Louis Emanuel is now superintendent of the smelter of the Arizona Consolidated Copper Co., at Humboldt, Arizona.

F. G. Fabian and H. E. Hall have formed a partnership to engage in general mining and consulting engineering work, with offices at 220 West 42nd street, New York City.

W. G. Page, president of the Kelsey Mining Co., of San Francisco, has been visiting Portland and making arrangements for the operation of a placer property in Curry county, Oregon.

John R. Rutherford has resigned his position on the engineering staff of the Hollinger Gold Mines, Porcupine, to accept a position as superintendent at the Motherlode Gold mine, Sheep Creek, British Columbia.

George S. Bailey, superintendent for the Anaconda Gold Mining & Smelting Co., has been appointed by Judge E. K. Pendergast, of the Superior Court, receiver for the Republic Mines Corporation, controlled by J. L. Harper.

J. M. Callow, of the General Engineering Co., of Salt Lake City, Utah, is at Superior, Arizona, starting work on the construction of the concentrator for the Magma Copper Co. at that point. He expects to return to Salt Lake City shortly before Christmas.

Petroleum producers and others interested in the oil industry are invited to attend a meeting of the California section of the American Chemical Society in the Committee Room of the San Francisco Chamber of Commerce, Merchants Exchange building, Monday, December 29, at 8 p.m. The meeting will be addressed by Irving C. Allen, of the United States Bureau of Mines. Plans for a petroleum exhibit at the Panama-Pacific Exposition will also be discussed.

Obituary

John O. Harron, president of Harron, Rickard & McCone, of San Francisco, died on December 19, following an operation for appendicitis. Mr. Harron's death removes one of the notable figures in the Western machinery world. He commenced his business career as an apprentice at the Union Iron Works, and later became identified with the firm of Parke & Lacey, at that time one of the prominent machinery concerns of San Francisco. His advancement was rapid, and at the time of the death of B. P. Lacey, in 1901, Mr. Harron had become vice-president and general manager. He then associated himself with the late Thomas Rickard and A. J. McCone, and formed the firm of Harron, Rickard & McCone to take over the business of Parke & Lacey, under which name the business is still conducted. Mr. Harron was 54 years of age and left a widow and one son.

The Metal Markets

LOCAL METAL PRICES

San Francisco, December 24.

Antimony	10—10½c	Quicksilver (flask)	$40
Electrolytic copper	15¼—15½c	Tin	41—42¼c
Pig lead	4.35—5.30c	Spelter	6¼—6½c

Zinc dust, 100 kg. zinc-lined cases, 7¼ to 8c. per pound.

EASTERN METAL MARKET

(By wire from New York.)

NEW YORK, December 24.—The copper market is stronger and an increased demand is being experienced. Standard is quiet, with December to March offered at 14.37½. A change for the better has taken place in the lead market, while spelter is quiet with quotations ranging from 5.25 to 5.50. The Chino dividend of 75c. per share will be paid on December 31, and a dividend of 37½c. will be made by the Ray Consolidated company at the same time. The share market is greatly improved and an upward tendency is to be seen in the majority of the stocks. Shares sold in New York on December 23 were valued at $2,476,000 as against $1,454,000 for the same day one year ago.

SILVER

Below are given the average New York quotations, in cents per ounce, of fine silver.

Date.		Average week ending	
Dec. 18	57.75	Nov. 12	59.62
" 19	58.00	" 19	59.26
" 20	58.00	" 25	58.20
" 21 Sunday		Dec. 3	57.22
" 22	57.87	" 10	58.23
" 23	57.50	" 17	57.79
" 24	57.50	" 24	57.77

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	56.25	63.01	July	60.67	58.70
Feb.	59.06	61.25	Aug.	61.32	59.32
Mch.	58.37	57.87	Sept.	62.95	60.53
Apr.	59.20	59.26	Oct.	63.16	60.88
May	60.88	60.21	Nov.	62.73	58.76
June	61.29	59.03	Dec.	63.38	....

The outstanding feature of the week ended December 4 was the necessity for the Indian Specie Bank to close its doors. The huge speculations of this bank have been a source of much general uneasiness for some three years past, and the burden of carrying the large stock involved has been exceedingly heavy to those concerned. Negotiations have just been completed by which the entire unrealized stock, both in actual silver and also in the form of contracts for forward delivery, formerly held here by the Indian Specie Bank, has been acquired by a strong London syndicate. This step will prove of immense benefit in relieving apprehensions as to further disturbance of the silver market, as a consequence of recent events.

A sharp fall in prices during the week, according to Pixley & Abell's report, brought in large covering orders from China and India on December 2, and quotations advanced to 26⅛ and 26⅝d., respectively. Since then, although business has been restricted, prices have recovered a little further. At the close the market was quite steady, supplies being small, while bears show a disposition to cover their commitments.

COPPER

Quotations on copper as published in this column represent average wholesale transactions on the New York market and refer to electrolytic copper. Lake copper commands normally from 1-5 to 1-4c. per lb. more. Prices are in cents per pound.

Date.		Average week ending	
Dec. 18	14.13	Nov. 12	15.54
" 19	14.13	" 19	15.08
" 20	14.13	" 25	14.62
" 21 Sunday		Dec. 3	14.41
" 22	14.15	" 10	14.13
" 23	14.15	" 17	14.17
" 24	14.25	" 24	14.28

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	14.09	16.54	July	17.19	14.21
Feb.	14.08	14.93	Aug.	17.49	15.42
Mch.	14.68	14.72	Sept.	17.56	16.23
Apr.	15.74	15.22	Oct.	17.32	16.31
May	16.03	15.42	Nov.	17.31	15.08
June	17.23	14.71	Dec.	17.37	....

The copper market was almost featureless during the week ended December 20. Most of the recent buying had been on European account, but by December 15 even the European purchasers disappeared from the market. Large sellers were asking 14½c. delivered to the consumer, 30 days, but without any large sales. On December 16 and 17 buyers had completely deserted the market. On December 18 small European orders were placed, but none of any importance.

The following figures of German consumption of foreign copper for the first ten months of 1913 have been supplied by L. Vogelstein & Company:

	Tons.
Imports	193,457
Exports	8,076
Consumption	185,381

The consumption for the same period of 1912 was 169,551 tons. Of the 1913 total, 167,015 tons was imported from the United States.

LEAD

Lead is quoted in cents per pound or dollars per hundred pounds, New York delivery.

Date.		Average week ending	
Dec. 18	4.00	Nov. 12	4.19
" 19	4.00	" 19	4.18
" 20	4.00	" 25	4.13
" 21 Sunday		Dec. 3	4.15
" 22	4.00	" 10	4.00
" 23	4.00	" 17	3.90
" 24	4.10	" 24	4.02

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	4.43	4.28	July	4.71	4.35
Feb.	4.03	4.33	Aug.	4.54	4.60
Mch.	4.07	4.32	Sept.	5.00	4.70
Apr.	4.20	4.36	Oct.	5.08	4.37
May	4.20	4.34	Nov.	4.91	4.16
June	4.40	4.33	Dec.	4.20	....

ZINC

Zinc is quoted as spelter, standard Western brands St. Louis delivery, in cents per pound.

Date.		Average week ending	
Dec. 18	5.15	Nov. 12	5.09
" 19	5.15	" 19	5.05
" 20	5.15	" 25	5.08
" 21 Sunday		Dec. 3	5.00
" 22	5.15	" 10	5.00
" 23	5.15	" 17	5.00
" 24	5.15	" 24	5.15

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	6.42	6.88	July	7.12	5.11
Feb.	6.50	6.13	Aug.	6.96	5.51
Mch.	6.57	5.94	Sept.	7.45	5.55
Apr.	6.63	5.52	Oct.	7.36	5.77
May	6.68	5.23	Nov.	7.32	5.09
June	6.88	5.00	Dec.	7.09	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California, being the largest producer The price is fixed in the open market, and, as quoted weekly in this column, is that at which moderate quantities are sold. Buyers by the carload can usually obtain a slight reduction, and those wanting but a flask or two must expect to pay a slightly higher price. Average weekly and monthly quotations, in dollars per flask of 75 lb., are given below:

Week ending			
Nov. 25	40.00	Dec. 11	40.00
Dec. 4	40.00	" 18	40.00
		" 24	40.00

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	43.75	39.37	July	43.00	41.00
Feb.	46.00	41.00	Aug.	42.50	40.50
Mch.	46.00	40.20	Sept.	42.12	39.70
Apr.	42.25	41.00	Oct.	41.50	39.37
May	41.75	40.25	Nov.	41.50	39.40
June	41.30	41.00	Dec.	39.75	....

TIN

New York prices control in the American market for tin, since the metal is almost entirely imported. San Francisco quotations average about 5c. per lb. higher. Below are given average monthly New York quotations, in cents per pound:

Monthly averages.

	1912.	1913.		1912.	1913.
Jan.	42.53	50.45	July	44.25	40.70
Feb.	42.96	49.07	Aug.	45.80	41.75
Mch.	42.58	46.95	Sept.	48.64	42.45
Apr.	43.92	49.00	Oct.	50.01	40.61
May	46.05	49.10	Nov.	49.92	39.77
June	45.76	45.10	Dec.	49.80	....

The Stock Markets

SAN FRANCISCO STOCKS AND BONDS

(San Francisco Stock and Bond Exchange.)

BONDS

December 24.

Listed.	Bid	Ask	Unlisted.	Bid	Ask
Associated Oil 5s	$ —	99	General Petroleum 6s	50	51
E. I. du Pont pfd	84	—	Natomas Dev. 6s	—	100
Unlisted.			Pac. Port. Cement 6s	99½	—
Ass. Oil 5s	$ 75½	—	Santa Cruz Cement 6s	81	—

STOCKS

Listed.	Bid	Ask	Unlisted.	Bid	Ask
Amalgamated Oil	73	75	Noble Electric Steel	—	3
Associated Oil	39½	40	Natomas Consol.	1¼	4
Giant	81	87½	Riverside Cement	50	—
Pac. Cst Borax, pfd	65	—	Santa Cruz Cement	40	—
Pacific Crude Oil	—	35c	Stand. Port. Cement	17½	—
Sterling O. & D.	—	1½			
Union Oil	—	56½			

NEVADA STOCKS

(By courtesy of San Francisco Stock Exchange.)

San Francisco, December 24.

Atlanta	$ .12	Mizpah Extension	$ .26
Belcher	.50	Montana-Tonopah	1.00
Belmont	7.25	Nevada Hills	.46
Big Four	.10	North Star	.38
Cash Boy	[illegible]	Ophir	.19
Florence	.24	Pittsburg Silver Peak	.35
Goldfield Con.	1.37	Round Mountain	.36
Goldfield Ore.	.08	Sierra Nevada	.12
Halifax	1.25	Tonopah Extension	1.65
Jim Butler	.70	Tonopah Merger	.51
Jumbo Extension	.12	Tonopah of Nevada	6.40
MacNamara	.08	Victor	30
Mexican	1.15	West End	1.22
Midway	.36	Yellow Jacket	.35

COPPER SHARES—BOSTON

(By courtesy of J. C. Wilson, Mills Building.)

December 24.

	Bid	Ask		Bid	Ask
Allouez	$ 37½	37¾	Mohawk	$ 44	—
Ariz. Commercial	4¼	4⅜	Nevada Con.	15⅛	15⅜
Butte & Superior	31½	31¾	North Butte	28½	28⅝
Calumet & Arizona	63¾	63½	Old Dominion	50½	50⅝
Calumet & Hecla	420	425	Osceola	74¾	75
Copper Range	36	37	Quincy	59½	60
Daly West	2¼	3	Shannon	5¾	6
East Butte	11½	12	Superior & Boston	2¾	2⅞
Franklin	2¾	3	Tamarack	33	33½
Granby	73¾	74	U. S. Smelting, com.	41½	41¾
Greene Cananea	29⅜	30	Utah Con.	8⅜	9
Isle-Royale	19½	20	Winona	1¼	1⅜
Mass Copper	2⅜	2¾	Wolverine	45	45½

NEW YORK CURB QUOTATIONS

(By courtesy of E. F. Hutton & Co., Kohl Building.)

December 24.

	Bid.	Ask.		Bid.	Ask.
Braden Coper	6⅛	7⅛	McKinley-Dar.	1	1⅛
Braden 6s	142	152	Mines Co. Am.	2	2¼
B. C. Copper	2⅛	2⅜	Nipissing	7¾	8
Davis-Daly	1⅝	1⅞	Ohio Copper	⅜	½
Dolores	2	4	San Toy	15	25
El Rayo	1	2	Sioux Con.	1	2
Ely Con.	1	2½	So. Utah	⅛	¼
First Nat.	2½	[illegible]	Stand. Oil of Cal.	263	265
Giroux	¾	1	Tri Bullion	⅛	¼
Iron Blossom	1⅛	1¼	Tuolumne	½	1
Kerr Lake	4⅜	4½	United Copper	¼	⅜
La Rose	1⅞	2	Wettlaufer	7	8
Mason Valley	3½	4	Yukon Gold	2	2⅛

NEW YORK STOCK EXCHANGE

(By courtesy of J. C. Wilson, Mills Building.)

December 24.

	Bid	Ask		Bid	Ask
Amalgamated	73⅞	74	Nat. Lead	$ 44	46¼
Anaconda	35⅛	35¼	Quicksilver, com.	1½	[illegible]
A. S. & R.	63⅛	63⅞	Ray Con.	18⅜	18½
Calif. Pet.	16½	16⅜	Tenn. Copper	30⅜	31
Chino	39⅛	39¼	U. S. Steel, pfd.	106	106½
Mexican Pet	45½	46	U. S. Steel, com.	58⅜	58⅜
Miami	22⅜	22½	Utah Copper	49⅜	49½

LONDON QUOTATIONS

(By cable, through the courtesy of Catlin & Powell Co., New York.)

December 18.

	£	s.	d.		£	s.	d.
Alaska Mexican	1	7	6	Kern River Oilfields	0	6	3
Alaska Treadwell	7	16	9	Mexico Mines	5	7	6
Alaska United	3	5	0	Mexina	1	10	0
Arizona	1	16	9	Oroville	0	12	6
California Amalg.	0	1	3	Pacific Oilfields	0	3	9
California Oilfields	6	0	[illegible]	Rio Tinto	68	17	6
Camp Bird	0	13	9	Santa Gertrudis	0	16	9
El Oro	0	15	0	Stratton's	0	2	6
Esperanza	0	18	9	Tanganyika	2	0	0
Granville	0	11	3	Tomboy	1	7	6

AUSTRALASIAN

December 18.

	£	s.	d.		£	s.	d.
British Broken Hill	1	15	0	Mount Boppy	0	[illegible]	9
Broken Hill Prop.	1	15	0	Mount Elliott	[illegible]	3	9
Golden Horse-Shoe	2	16	9	Mount Lyell	1	5	0
Great Boulder Prop.	0	15	0	Mount Morgan	3	5	0
Ivanhoe	2	15	0	Waihi	2	[illegible]	6
Kalgurli	1	13	9	Waihi Grand Junc.	1	5	0

MINERAL PRODUCTION OF WYOMING

The mineral product of most importance in Wyoming is coal, the value of which represents nearly 90% of the total output of the state. The value of the products of all the mines in 1912 was $13,374,088, of which coal, 7,368,124 short tons, represented $11,648,088. The value of the other mineral products in 1912 was about $1,700,000. The development of the extensive phosphate deposits in the southwestern part of the state gives promise of establishing an important industry there in the future.

MINERAL PRODUCTION OF TEXAS

The total value of the mineral production of this state increased from $18,798,837 in 1911 to $22,797,015 in 1912, an advance of $4,000,000, two-thirds of which was due to the larger production of petroleum and natural gas, according to the U. S. Geological Survey. Details are as follows:

Oil, barrels	11,735,057
Coal, short tons	2,188,612
Cement, barrels	1,762,780
Value of clay products	$2,886,068

MINERAL PRODUCTION OF MICHIGAN

The total value of all minerals in 1912 was $80,062,486, against $65,275,324 in 1911, according to the U. S. Geological Survey, which publishes the following:

Iron ore, long tons	12,717,468
Copper, pounds	218,138,408
Copper since 1810, pounds	5,200,000,000
Salt, barrels	10,271,715
Cement, barrels	4,000,000
Sand and gravel, short tons	2,185,165
Gypsum, short tons	384,297

MINERAL PRODUCTION OF GERMANY

The output in 1912 was as follows, according to a recent report:

Employees	755,888
Fatal accidents	1,777
Total mineral output, metric tons	246,623,289
Total value	$524,763,000
Hard coal, tons	165,303,784
Brown coal, tons	65,803,959
Brown coal used in manufacturing briquettes, tons	55,000,000
Asphalt, tons	21,241
Petroleum, tons	87,443
Iron ore mined, tons	5,238,766
Zinc ore, tons	647,081
Lead ore, tons	135,366
Copper ore, (Mansfield Copper Co., 879,695 tons) tons	967,785
Manganese ore, tons	92,474
Sulphur ore, tons	233,397
Mineral salts, (potash, etc.) tons	8,071,114

Company Reports

MOUNT LYELL MINING & RAILWAY COMPANY, LTD.

This well known Company operates copper mines, railways, smelters, and pyrite deposits in Tasmania, and superphosphate works in Victoria, South and Western Australia, under the general management of Robert C. Sticht. The report covers the half-year ended September 30, 1913.

After the disastrous fire and flooding of the North Lyell mine, a return to the usual scale of mining operations was reached toward the end of the period. There are at present 1040 men employed in the mines, and all workings and equipment are in good condition. Development covered 2065 ft. At the Mt. Lyell property both surface and underground work was continued without interruption on five overburden and three ore benches. No new development was carried out during the term, such not being necessary.

The South Lyell pyrite deposit, which is distinct from the parent mine, is being worked as one with the latter. Operations were confined to development, and, incidentally, some pyrite was recovered. This is lower grade than the Mt. Lyell ore. Prior to resuming stoping in the North Lyell, a great deal of work was rendered necessary by the flooding of the mine. New passes were made and diamond-drilling done. Pump-houses at 700 and 1000 ft. were rebuilt in concrete and steel. The Lyell Tharsis mine supplied silicious metal-bearing flux for the smelters. Ore extraction was carried on four levels in the Lyell Comstock mine, and a large amount of development was done. At the Crown Lyell nothing special was done. The Chester mine, in the North Pieman district, supplied 4400 tons of pyrite for the superphosphate works. Ore reserves are as follows:

	Tons.	Copper, %.
Mt. Lyell, available for open-cut work	408,101	0.58
Mt. Lyell, available for underground work	1,794,234	0.52
North Lyell	1,086,112	6.00

The Mt. Lyell ore contains 0.0275 oz. gold and 1.96 oz. silver, and the North Lyell 0.005 oz. gold and 1.33 oz. silver per ton.

At the smelter, an average of 2.3 blast-furnaces were in operation, resulting in the following production:

Mt. Lyell ore, tons	93,470
North Lyell, tons	36,255
Lyell Comstock, tons	8,544
Metal-bearing fluxes, tons	4,346
Flue-dust, tons	3,191
First matte, tons	3,244
Converter slags, tons	4,395
Converter linings, tons	425
Total	153,869
Blister copper, pounds	5,470,080
Gold, ounces	4,050
Silver, ounces	187,097
Revenue from blister copper and superphosphates	$1,180,000
Revenue from railway	81,600
Profit after paying all expenses	201,000
Surplus	2,300,000

MT. LYELL SMELTER AT QUEENSTOWN, TASMANIA.

In the left corner is the converter plant; in the centre is No. 1 blast-furnace, now out of commission; No. 2 blast-furnace plant is on the right, and in the foreground is the granulated slag dump, which now covers the whole area where the houses are shown on the right.

Good progress is being made with the Lake Margaret hydro-electric power scheme, and $180,000 has been spent so far, and contracts for machinery have been let amounting to $307,000. Large tests, with the Minerals Separation process, on ore from the Comstock mine have given good results, and further work is under way in this connection. Rainfall in the various districts where the Company operates varied from 118 to 131 wet days with 43 to 65 inches. Including all claims for compensation, the North Lyell disaster cost $202,000.

MOUNT ELLIOTT, LIMITED

This Company operates in Queensland, Australia, and the report deals with the period ended June 30, 1913. The smelter was shut down for 135 days during the year, but results for the remainder of the time were as follows:

Ore reserves	
Ten per cent ore, tons	44,500
Three per cent ore, tons	350,000
Ore smelted, tons	41,633
Copper produced, pounds	10,373,440
Gold, ounces	8,757
Silver, ounces	7,285
Net profit	$ 682,000
Brought forward from 1911-12	422,000
Dividends paid	965,000
Carried forward to 1913-14	129,000
Depreciation, written off	67,000

HAMPDEN CLONCURRY COPPER MINES, LTD.

This Company operates at Cloncurry, Queensland, Australia, and the report covers the half-year ended August 31, 1913. Development in the Hampden mine, on the 350-ft. level, has opened 161 ft. of pyritic ore containing from 6.5 to 21% copper, with a further extension. Its width is from 8 ft. upward. Operations resulted in the following:

Ore reserves, tons	255,000
Copper content, per cent	10
Ore smelted, tons	24,744
Copper produced, pounds	5,815,040
Gold, ounces	818
Silver, ounces	24,457
Operating profit	$346,000
Net profit, including amount from previous term.	461,000
Depreciation	39,000
Carried forward to next term	422,000

OROVILLE DREDGING, LIMITED

In this journal of October 25 was published the report of the above Company, dealing with operations to January 31, 1913. The present report covers the period up to July 31, 1913. The profit and loss account shows that the California properties returned $162,806 during the full twelve months of the fiscal year just closed, after deducting all expenses, including the expenses of administration of Oroville Dredging, Limited. Of this amount, $59,762 was set aside as a reserve for dismantlement of dredges, and $103,044 was transferred to surplus, which was $402,645 at July 31.

The report of W. P. Hammon, general manager, for the six months ended July 31, contains the following: The California units comprise the Boston & Oroville Mining Co., Boston & California Dredging Co., Oroville Gold Dredging & Exploration Co., Bear River Mining Co., and Boston Machine Shop Co., which are all situated in Butte, Yuba, and Placer counties. At February 1 there were five dredges working, but at the end of the period there were only three, on areas west of the Feather river at Oroville. A total of 1,612,519 cu. yd. of gravel, equal to 30.38 acres, was handled, the depth of banks being 31.1, 36.2, and 38.1 ft., respectively. The yields were 10.88, 11.11, and 7.41c. per yard from these depths, giving a total gold output of $173,458. Costs were 6.78c. per yard dredged. Averages per acre were: 53,078 cu. yd., $5709 yield, $3604 expenditure, and $2105 net profit.

The report gives details of the Pato dredge, in Colombia, recent returns from which were given in the news columns of this journal of December 13. During July the boat crossed and recrossed Pato creek, and handled as high as 5446 cu. yd. per day. From February 28 to July 31 the boat averaged 15.08 hr. per day, treated 2483 cu. yd., attacked a bank 24.4 ft. deep, and yielded 14.79c. at a cost of 12.49c. per yard. The net revenue was $10,374.

Net imports into Germany for the 10 months of 1913 were £16,325,000. Gold reserves in India total $30,000,000 out of a total arrival of over $146,000,000.

Recent Publications

GEOPHYSICAL RESEARCH. By Arthur L. Day. From Smithsonian Report for 1912. Washington.

HANDBOOK OF THE BLACK HILLS. By C. C. O'Harra. P. 159. Ill. Rapid City, South Dakota, 1913. A useful little manual covering geology and mining in this noted district.

THE RELATION OF THE MANUFACTURER TO OUR PATENT SYSTEM. By W. M. Grosvenor. P. 18. Reprinted from the *Journal of Industrial and Engineering Chemistry*, August 1913.

THE GEOGRAPHY AND INDUSTRIES OF WISCONSIN. By Ray Hughes Whitbeck. Wisconsin Geological and Natural History Survey Bulletin No. 26. P. 94. Ill., index. Madison, Wisconsin, 1913.

THE MOUNT LYELL COPPER DISTRICT OF TASMANIA. By Chester G. Gilbert and Joseph E. Pogue. United States National Museum, Washington, 1913. Illustrated with photomicrographs of polished ore sections.

COMPARATIVE STATISTICS OF LEAD, COPPER, SPELTER, TIN, ALUMINUM, NICKEL, QUICKSILVER, AND SILVER. Metallbank und Metallurgische Gesellschaft, Frankfort on Main, July 1913. P. 109. An annual compilation of figures of the highest value.

LONG SAULT RAPIDS, ST. LAWRENCE RIVER. By Arthur V. White. Commission of Conservation, Canada. P. 384. Ill., index, maps. Ottawa, 1913. An enquiry into the constitutional and other aspects of the project to develop power from the rapids.

CYANIDATION IN THE MERCUR DISTRICT OF UTAH. By L. O. Howard. Reprinted from the *Salt Lake Mining Review*. October 1913. P. 64. Ill. This series of articles gives an interesting account of the history of the properties owned by the Consolidated Mercur Co. and the development of the methods of ore treatment at Mercur. It was at the Sunshine mill that the difficulty of treating the slime first inspired George Moore with the idea of a vacuum filtration system, which was afterward used most successfully. With the dismantling of the Consolidated Mercur plant, now under way, this great property appears to have ended its long and profitable existence.

DETAILED REPORT ON CABELL, WAYNE, AND LINCOLN COUNTIES. WEST VIRGINIA. By C. E. Krebs and D. D. Teets, Jr. P. 483. Ill., index. West Virginia Geological Survey, 1913. Also a case of 9 maps, covering the soils, topography, and geology of each county separately. In addition to the description of all geologic features of the counties in question, the geologic maps give the structural contours on the Pittsburgh coal horizon, as also the location of the anticlines and synclines, showing their relations to the several oil and gas pools of the district. The soil maps and reports of the experts of the U. S. Department of Agriculture covering this great agricultural and tobacco region of the state should prove of especial value to the agricultural and horticultural interests. Price, with case of maps, delivery charges paid by the Survey, $2. Extra topographic or geologic maps, 25c. for each county.

DETAILED REPORT ON MARION, MONONGALIA, AND TAYLOR COUNTIES, WEST VIRGINIA. By Ray V. Hennen and David B. Reger. P. 844. Ill., index. West Virginia Geological Survey, 1913. See notice above.

INGERSOLL-RAND PRODUCTS. Vest-pocket size, 2¾ by 4 in., cloth bound. P. 140. Ill., index. The Ingersoll-Rand Co., New York, 1913. This is an extremely useful little publication, issued by a firm well known throughout the world. The book contains the following data: steam, electric, and gasoline-driven air-compressors, with details of cylinders, valves, capacity, and space occupied; auxiliary apparatus for compressors; Cameron steam pumps for all purposes; machine-drills for mines; drill-sharpening machines; air hammers; uses of compressed air, density of gases, and considerable useful information.

Book Reviews

STRUCTURAL GEOLOGY. By C. K. Leith. P. 169. Ill., index. Henry Holt & Co., New York, 1913. For sale by the *Mining and Scientific Press*. Price $1.50.

In this small book are brought together in convenient form data previously available only in separate reports and documents. The attempt is made to relate structural features from the genetic viewpoint and to get away from the old way of thinking of fractures, faults, flow structure, schistosity, and similar features as individual and unrelated. The geologists who have grasped the relations of these phenomena find it possible many times to use one to uncover others and in the practical work of determining structure in areas where the latter is complicated, as is usually true where ore deposits occur, the method proves extremely fruitful. The book serves a useful purpose and should be widely used.

HYDRAULIC TURBINES. By R. L. Daugherty. P. 151. Index. McGraw-Hill Book Co. For sale by the *Mining and Scientific Press*. Price $2.

This work is intended rather for hydraulic turbine operators than for the designer or hydraulic engineer. It is recognized by the author that as the use of the turbine increases, it is desirable that men in charge of hydraulic turbine power-houses should have at least a fair working knowledge of the characteristics of the machinery that they operate. The data given are therefore chiefly fundamental, and while they may not throw any additional light upon the subject as understood by engineers and turbine designers, at the same time for students and power-plant operators, this work will be especially useful, as the author has endeavored to prepare the text in such a way as to make it easily understandable by men who have not necessarily had the benefits of a technical training.

THE MINERAL INDUSTRY DURING 1912. Edited by Charles Of. P. 1090. Ill., index. McGraw-Hill Book Co., New York, 1913. For sale by the *Mining and Scientific Press*. Price $10.

The twenty-first volume of 'Mineral Industry' is the second one edited by Charles Of, and is similar to its predecessor. The articles descriptive of the numerous mineral industries with statistics of production, were contributed by 73 writers, among whom are noticed many well known college professors, mining engineers, and geologists. The articles on coal appear to have been written principally by state Coal Mine Inspectors. There is a reasonably complete bibliography of articles upon general mining and engineering topics which have appeared in the engineering journals during the year, in addition to the bibliographies attached to the regular articles in this volume. The number of special chapters is smaller than usual, but the article on 'Geology Applied to Mining,' by C. F. Tolman, Jr., is of timely interest. R. H. Richards contributes an exhaustive chapter on the 'Progress in Ore Dressing and Coal Washing.' The volume is an excellent and useful book of reference on account of the large amount of carefully compiled statistics which it contains.

THE AMERICAN FERTILIZER HANDBOOK. P. 352. Ware Bros. Co., Philadelphia, 1913. For sale by the *Mining and Scientific Press*. Price $1.

At first thought fertilizers may seem somewhat out of the field of mining engineering, but the reverse is actually the case. The production of the raw materials for phosphate fertilizer manufacture involves interesting mining problems. The utilization of the sulphurous fumes of copper smelters for the production of sulphuric acid, to be utilized in fertilizer manufacture has been practised successfully in Tennessee and California, while the production of potash salts in this country is a subject of keen interest at the present time. As a result many metallurgists and mining engineers have a lively interest in fertilizers, and all such will find in this convenient handbook a mine of useful statistical data, as well as valuable technical articles on the fixation of atmospheric nitrogen, production and use of cyanamide, potash salts, and fertilizers, the occurrence and mining of potash deposits, the manufacture and utilization of sulphuric acid, and a great variety of related matters. The tabular matter contained in this volume is of exceptional value to anyone whose interests touch on these fields. A classified directory of fertilizer manufacturers and of firms engaged in allied lines of business completes the work.

A TREATISE ON PETROLEUM. In three volumes. By Sir Boverton Redwood. J. B. Lippincott Co., Philadelphia. P. 1198. Bibliography. Index. For sale by the *Mining and Scientific Press*. Price $15.

This is the third edition of this standard work, the first having appeared in 1895. With the petroleum-producing world as a field, some idea may be obtained of the monumental labor involved in the preparation of a work of this character. This is no mere reprint of a previous edition, as the entire text has been revised, rewritten, and added to, bringing the subject-matter up to present-day conditions in the oil industry. The first volume is divided into sections as follows: Historical Account of the Petroleum Industry; Geological and Geographical Distribution of Petroleum and Natural Gas; Physical and Chemical Properties of Petroleum and Natural Gas; Origin of Petroleum and Natural Gas; Production of Petroleum, Natural Gas, and Ozokerite. The second volume covers: Refining of Petroleum; Shale Oil and Allied Industries; Transport, Storage, and Distribution of Petroleum; Testing of Crude Petroleum, Petroleum, Shale-Oil Products, Ozokerite, and Asphalt; and the Uses of Petroleum and Its Products. The third volume covers: Statutory, Municipal, and Other Regulations Relating to the Testing, Storage, Transport, and Uses of Petroleum and Its Products; Statistical Appendix; Marine Transport of Petroleum; Import Duties Levied in the United States; Petroleum and the Thames Conservancy. It is impossible to do justice in a limited space to a work of this character, as the book itself must be seen and read to be appreciated.

GOLD DREDGING. By T. C. Earl. P. 208. Ill., maps, index. E. and F. N. Spon, Ltd., London, 1913. For sale by the *Mining and Scientific Press*. Price $8.

This is a little book on a big subject made attractive by its numerous instructions. The author has evidently attempted to write a simple work for the use of mining investors and company directors who wish to inform themselves somewhat concerning gold dredging without being bothered with too many details and technical terms. In this respect the book may be useful, although to the experienced engineer it will appear too sketchy, if not altogether superficial. Such subjects as 'Reporting on Dredging Areas,' 'Cost of Dredges,' and 'Working Costs' are dismissed with a single page, but the chapter on 'Fields for Dredging' is 65 pages in length. In many respects this last chapter is the most interesting in the book, as it gives short accounts of all of the principal gold-dredging areas in the various countries of the world, together with descriptions of the different dredges working and tables giving the gold production, yardage dug, and similar figures. The data are given in order "to attract the investor in gold dredging and induce him to investigate grants on new and partly unknown fields." Mr. Earl is apparently a most patriotic New Zealander, and a large part of his book has to do with New Zealand dredges and dredging practice, but his figures speak eloquently in favor of the California dredge. For example, he states that in New Zealand in 1911 one hundred boats dug 14,000,000 cu. yd., and recovered £312,500 worth of gold; while in California 61 boats dug 65,000,000 cu. yd., and recovered £1,635,416 worth of gold. The average working costs are given as 1.71d. per cubic yard in New Zealand and 1.82d. in California, but there is always a doubt as to the accuracy of New Zealand figures, because bank measurements are not the rule there as they are in California. The author gives little evidence of any great amount of experience or technical knowledge of the subject. Like most attempts at a popular work on a technical subject, it is a disappointment.

Recent Patents

1,072,753.—Process for Treating Ores. James Ainsleigh McLarty, Toronto, Ontario. Treating and reducing ores by heating a mixture containing a carbohydrate and a hydrocarbon to a temperature materially below a red heat, igniting the gases and vapors thereby produced and treating the ore with said ignited gases and vapors.

1,080,113.—Heating Molten Electrolytes. Franz von Kugelgen, Holcombs Rock, Virginia, and George Oulton Seward, East Orange, New Jersey, assignors to Virginia Laboratory Co., New York, New York.

An electrolytic cell having a heating means, comprising a hollow body immersed in the electrolyte and means for heating the same by burning a combustible therein.

1,080,223. Centrifugal Ore Concentrator. Edward C. Latchem and Lewis W. Pollock, Oakland, California. A revoluble vessel for centrifugal ore concentrators comprising a body having a plurality of upwardly extending annular steps formed upon its outer wall, the upper surface of the outermost step being outwardly and downwardly inclined, and an upstanding flange formed upon the extreme outer edge of said latter step.

1,080,059.—Process for Producing Clean or Deoxidized Metal Surfaces. John Adams Hatfield and Charles Robert Yates, Newport, England.

Acting upon a metal surface while in a highly heated state with silica to clean the surface and to form thereon a removable protective coating, then coating with a metal to remove this protective coating, and uniting the cleaned surface with the coating metal.

1,080,102.—Process of Reducing Zinc Compounds. Elisha B. Cutten, Erie, Pennsylvania. A process of reducing zinc compounds free from slag-forming materials which consists in subjecting them, in the absence of fluxing material but in the presence of carbon, to a temperature ordinarily sufficient to vaporize metallic zinc and under a pressure sufficiently high to prevent such vaporization, the zinc being thereby precipitated as molten metallic zinc, substantially as set forth.

1,072,992.—Method of Forming Mountings for Metal Leaf. Fred W. Rauskolb, Medford, Mass. Applying gold leaf by supporting the gold leaf upon a sheet having a non-adhesive coating to receive said gold leaf; protecting the outer face of said gold leaf with a coating of adhesive sizing sprayed thereon, and subjecting said gold leaf and said supporting sheet to a heated tool applied with pressure to the rear face of said supporting sheet against the work to receive the gold leaf.

1,073,271.—Mining Machine. Edwin Reuel Merrill, Columbus, Ohio, assignor by mesne assignments, to the Jeffrey Manufacturing Co., a corporation of Ohio. Side cut or long wall; the combination of a carriage, a cutter wheel projecting laterally from the carriage, a carrier for the wheel adjustable relatively to the carriage on a transverse horizontal axis, and a train of devices for adjusting said carrier, the said train having a flexible spring controlled connection between two elements thereof through which power for operating the carrier is applied, substantially as set forth.

1,079,362.—Ore-Separator. Albert M. Plumb, Platteville, Wis. An ore separating apparatus consisting of a separating chamber having a level, reticulated bottom and provided with means for maintaining separate columns of material communicating only at a point near the bottom of the separating chamber and with a discharge opening for each column, the lowest of these discharge openings being substantially higher than the highest point of communication between the columns; these discharge openings being so positioned that the weight of the columns of material, when each extends to the level of the discharge opening, will be equal per unit of cross sectional area; means for supplying material to be separated to one of said columns and means for applying intermittent impulses of air to the entire bottom of the separating chamber.

1,072,977.—Stop for Mining Cars. James A. Nolan, Bowerstown, Ohio. In combination, a vertically moving platform, a stop mounted upon the platform and adapted to arrest the movement of a carrier, a trip mounted upon the approach to the platform and located in the path of the carrier, a cam mounted independently of the platform, connecting means between the cam and trip, and a lever mounted upon the platform and movable therewith and having one end arranged to operate the said stop and having its opposite end adapted to be engaged by the said cam whereby movement of the trip effects a depression of the stop.

1,078,779.—Process for the Treatment and Separation of Complex Sulphide Ores. Tormod Reinert Foriand, Broken Hill, New South Wales, Australia. A process for chloridizing sulphide ores, of zinc, lead, iron, copper, nickel, arsenic, silver, and the like, which comprises treating the ore with chlorine gas, at a temperature at which the metals, with the exception of silver, are converted into chlorides, and certain of the chlorides are volatilized, and chloride of sulphur is formed and volatilized; passing said volatilized chlorides, together with any remaining chlorine and chloride of sulphur, and other gases into contact with a further amount of said ore, at a temperature at which the chloride of sulphur will attack said metal sulphides, and form chlorides of said metals except silver, and free sulphur and at which temperature certain only of said chlorides are volatile.

1,080,053.—Concentrator. John S. Finlay, Wallace, Idaho. A horizontally disposed shaft, means for simultaneously rotating and reciprocating it, a frusto-conical drum having an integral closure at its larger end and open at its smaller end, auxiliary mounted on the shaft for movement therewith, and wholly unsupported and interiorly unobstructed save by said shaft, an annular rib formed integrally with and interiorly of the drum and in slightly spaced relation to the closed end thereof to provide upon one side in connection with the drum an annular treatment chamber triangular in section and upon the other side in connection with the drum and closed end thereof an annular discharge chamber, the bottom of which is inclined at the same angle as the bottom of the treatment chamber, being in fact a continuation thereof, the bottom of said discharge chamber being provided intermediate of its width with a plurality of circumferentially spaced apart, radially directed discharge passages, and means for separately delivering pulp and water to the inside of the drum.

1,080,344—Process of Smelting Metals. John D. Hilliard, Albany, New York, assignor to New England Metal & Machine Co., Boston, Massachusetts, a corporation of Massachusetts.

Producing a purified metal which consists in the following steps: (1) mixing the necessary material directly at normal temperature; (2) feeding the mixture continuously directly into a constantly traveling body of heated gases; (3) maintaining a regular, continuous, and retarded advance of the mixture for a considerable distance through and in opposite direction to the flow of heated gases, so as to progressively absorb heat therefrom; (4) continuously agitating the material throughout its entire path of travel so as to expose every portion thereof to the action of the gases; (5) passing the mixture in its final heated condition, due to the action of the gases, into an enlarged generating and reducing chamber, without interrupting or retarding the generation or flow of gases therefrom into the preheating space of kiln; and (6) raising the temperature of the heated mixture so as to effect complete reduction, by means of electrical energy continuously conducted therethrough, while maintaining constant, free, and unimpaired flow of the gases therefrom over the incoming stream of material throughout its entire path of travel to the point of introduction.

Tube-Mill Discharge

Tube-milling is made more efficient by removing the ground particles as quickly as possible from the machine, immediately they are reduced to the required size. The Chalmers & Williams adjustable quick discharge is claimed to operate on this principle. It consists of a set of four lifter plates which are set between a perforated diaphragm plate covering the entire end of the mill and the discharge head. These lifters pick up the pulp which passes through the submerged portion of the perforated end plates, and the passage of the pulverized material through the mill is thereby accelerated. The total product from the tube-mill is then returned to a classifier, where the

ADJUSTABLE QUICK TUBE-MILL DISCHARGE.

oversize is again returnd to the mill, while the undersize becomes the finished product. Each lifter is pivoted at the ends so that it can be turned like a shutter, by means of adjusting bolts, extending through the head as shown in the accompanying cut, so as to vary and regulate the quantity and size of material ground, thus making an adjustable quick discharge. When the lifters or shutters stand at right angles to the head as shown, they are at closed position and exert a maximum discharging effect; and when turned from this position, by the bolts, gradually to a position nearly parallel with the head, they are in the full open position, and the discharge effect of the lifters is diminished until entirely eliminated. Thus is obtained a wide range of product.

A Portable Sub-Station

The Berwind-White Coal Mining Co., of Windber, Pennsylvania, has recently added a 400-kw. Westinghouse portable sub-station to its equipment and is making an interesting use of it. A sub-station consists of apparatus for changing alternating current into direct current, and is necessary in mining work because direct current must be used for haulage in mines but cannot be transmitted economically over long distances. Hence, when the mine is situated at a distance from the power-station that serves it, electric power can be transmitted more efficiently as alternating current at a high voltage and then transformed to direct current in the sub-station.

The Berwind-White company is developing its outlying properties rapidly and needs direct current at points where permanent sub-stations are not yet erected. In order to prevent delays in the development, the use of a portable sub-station was decided on. This sub-station has the same equipment as a permanent installation, namely, transformers to step down to a moderate voltage the high-voltage current received from the transmission line, a switchboard, and a rotary converter, which receives alternating current and delivers direct current. This apparatus is mounted in a car resembling an ordinary freight car.

When the work at a new property reaches the point where direct current is necessary, the portable sub-station is hauled out to the workings, connected to the alternating current transmission system, and is started to work generating direct current. When the permanent sub-station is built, the portable one becomes unnecessary and is taken to the next development. A further use of the sub-station is to provide insurance against shut-downs. If accidents occur at any of the permanent sub-stations, the portable outfit is sent to carry the load until repairs are completed. One portable sub-station, therefore, is practically the equivalent of a duplicate set of apparatus at each permanent sub-station.

Preventing the Spread of Flames

In spite of the advent of so-called fireproof buildings, the days of fires have not yet passed. No matter what precautions are taken, the lives of the workers have frequently been jeopardized by the rapid spread of flames through inflammable material, even though the blaze has been confined to a single floor. This condition indicates that the real solution to the problem of safeguarding life and property is to provide adequate means for extinguishing the flames before they have a chance to gain headway. One type of extinguisher, which is known as the 'J-M Fryo,' discharges, by means of compressed air, a liquid gas claimed to be 40 times as effective as water. No mechanical force is required to operate it, there is no pumping, no tearing off of caps, no unscrewing of nuts, and no turning upside down. All that is necessary is to hold it in an upright position and turn a small valve-wheel. This little fire-fighter, which measures 3 by 15 in., can be aimed and operated almost as accurately as the pointing of a finger. In many extinguishers the stream has such a force that it is often shot through the flames, a large part of it going to waste. The 'J-M Fyro' device throws a spray as well as a stream; the spray can be thrown a distance of 10 ft., the stream 25 ft. The spray will cover the entire blaze of the average incipient fire so that all of the liquid gas volatilizes. In so doing, the gas forms a dense combustion-arresting 'blanket' which is five times as heavy as air, and quickly envelopes the flames, displacing oxygen and extinguishing the fire. As the extinguishing fluid contains no moisture, it is a non-conductor of electricity and can be used in electric fires without danger of short-circuits. It can also be used on gasoline electric fires. The fluid is non-corrosive and will not cause rust. The 'J-M Fyro' extinguisher is manufactured by the H. W. Johns-Manville Co., New York, which Company has recently issued an interesting little book on the subject of fires, and will be glad to mail a copy to anyone interested.

Catalogues Received

The Hess Flume Co., Denver, Colorado. Leaflet. 2 pages. Illustrated. 3½ by 6 inches.

John A. Roebling Sons' Co., Trenton, New Jersey. 'The Wire Rope at Panama.' 12 pages. 9 by 12 inches.

Hyatt Roller Bearing Co., Newark, New Jersey. Card, 'Hyatt Bushings.' Illustrated. 6 by 8 inches.

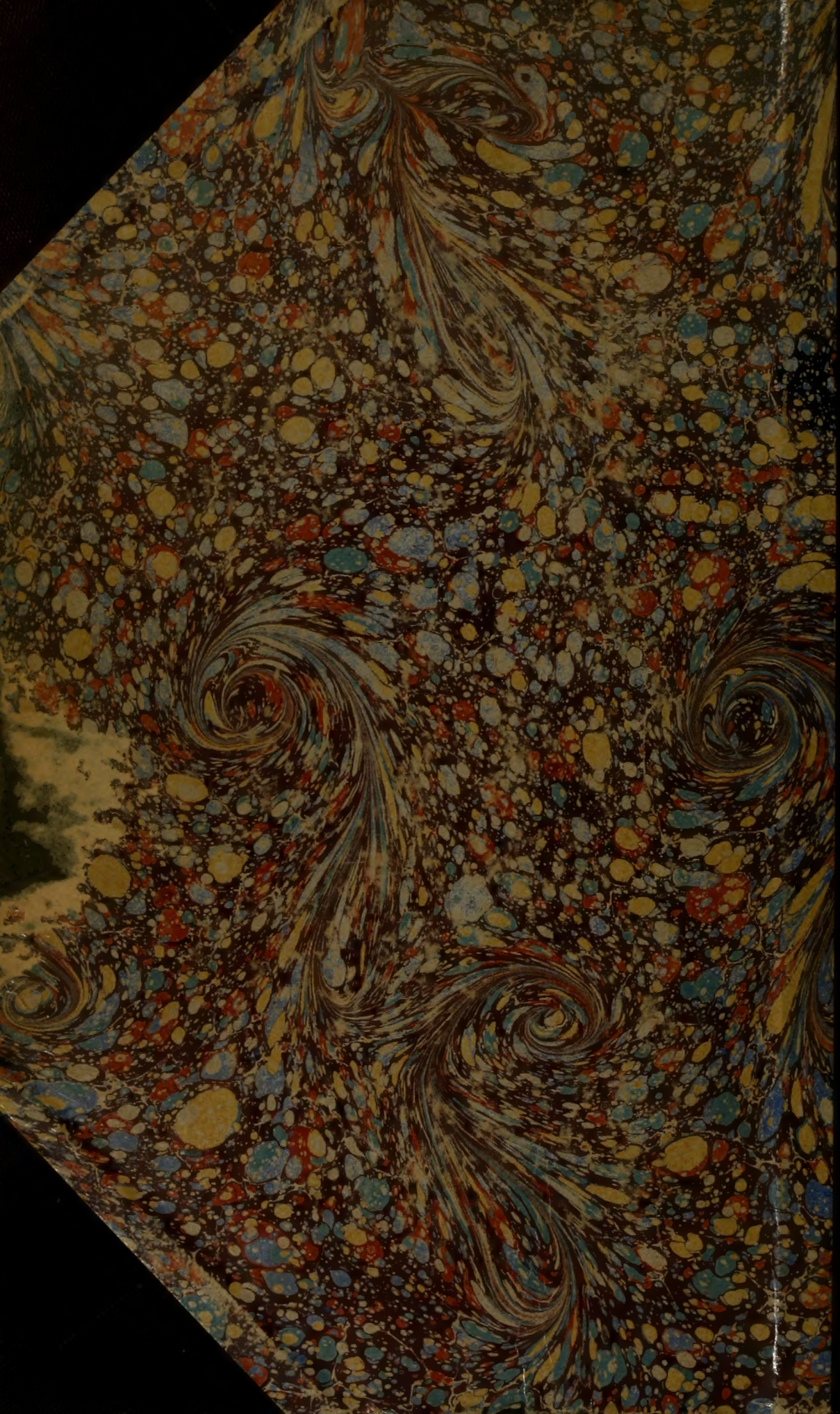
Ingersoll-Rand Co., 11 Broadway, New York. 'Air Compressors: Steam, Belt, Electric.' 20 pages. 6 by 9 inches.

National Tube Co., Pittsburgh, Pennsylvania. Leaflet, 'The Kawanee Union.' 4 pages. Illustrated. 5 by 7½ inches.

The English Iron Works Co., Kansas City, Missouri. Bulletin No. 200, 'Samson Junior Hoist.' Leaflet. Illustrated. 8½ by 11 inches.

The Brown Hoisting Machinery Co., Cleveland, Ohio. Catalogue E, 'Brownhoist Buckets and Tubs.' 63 pages. Illustrated. 6 by 9 inches.

Sprague Electric Works, of General Electric Co., 527-531 West 34th street, New York. Bulletin No. 247, 'Round Type Direct Current Motors.' 23 pages. Illustrated. 8 by 10½ inches.

American Zinc Ore Separating Co., Denver, Colorado. Booklet. 'The Profitable Handling of Ores Containing Zinc.' Describes the Huff electrostatic process. 10 pages. Illustrated. 6 by 6¾ inches.

The Denver Engineering Works Co., Denver, Colorado. Bulletin No. 1061, 'Open Front Stamp Mortar. Improved Ore Feeder.' 3 pages. Illustrated. 8 by 10½ inches. Bulletin No. 1062, 'Ovoca Classifier.' 7 pages. Illustrated. 8 by 10½ inches.